PROJECT MANUAL

WESTERN IDAHO YOUTH SUPPORT CENTER Project #: 23026-00

Prepared For: Southwest District Health 13307 Miami Lane Caldwell, Idaho 83607 Prepared By: Hummel Architects 205 N. 10th Street, Suite 300 Boise, ID 83702 Project Team: Electrical: Eidam Associates Mechanical & Plumbing: Cator Ruma & Associates

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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. Work performed by Owner.
 - 4. Contractor's use of site and premises.
 - 5. Work restrictions.
 - 6. Specification and Drawing conventions.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Western Idaho Youth Support Center .
 - 1. Project Location: 308 East Hawaii Avenue, Nampa, ID 83686
- B. Owner: Southwest District Health
 - 1. Owner's Representative: Cas Adams, Project Manager Crisis Centers. 986.888.0601. cas.adams@swdh.id.gov.
- C. Architect: Hummel Archtiects.
 - 1. Architect's Representative:Mandy Boam, Principal. 208.340.5942. mboam@hummelarch.com.
- D. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

- 1. Electrical Engineer: Eidam Associates has prepared the following portions of the Contract Documents:
 - a. Electrical Engineer Representative: Mike Miller, Project Manager. 208-345-7127. mike@eidam-assoc.com.
 - b. Scope of Service: Electrical, Fire Alarm, Low Voltage Systems Infrastructure.
- 2. Mechanical Engineer: Cator Ruma & Associates has prepared the following portions of the Contract Documents:
 - a. Mechanical Representative: Lilly Johnson, Associate. 208-343-3663. ljohnson@catorruma.com.
 - b. Scope of Service: HVAC and Plumbing.
- 3.
- E. Contractor: TBD has been engaged as Contractor for this Project.
 - 1. Contractor Representative: TBD
- 1.5 WORK COVERED BY CONTRACT DOCUMENTS
 - A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. The project is a 7206 square foot Tenant Improvement, in a portion of a 16,566 square foot medical building. The youth support center includes a lobby, counseling areas, resting areas for clients placed around a central gathering, eating area. The space also has a large break area and conference room. The building is a B Occupancy, VN building type and is sprinkled.
 - B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.6 WORK PERFORMED BY OWNER

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory Work under this Contract.
 - 1. Installation of secure card or fob entry system at doors noted on door schedule. Installation of IT / date related items and security cameras. .

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. <u><></u>
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Coordinate with building owner if necessary. .
 - 2. Early Morning Hours: Coordinate with building owner if necessary. .
 - 3. Work in Existing Building: <Insert restrictions on times permitted and other Owner's restrictions>.
- C.
- D. Smoking and Controlled Substance Restrictions: Use of tobacco products and other controlled substances within the existing building is not permitted.
- E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- F. Employee Screening: Comply with Owner's requirements for [drug] [and] [background] screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 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 scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 01 : LED Lighting Upgrade .
 - 1. Base Bid: Existing luminaire and associated controls for types GLE2, GLE4, RRE1, and BLE1 are to remain. as indicated on Drawing E2.01L .
 - 2. Alternate: Replace existing luminaires and associated controls for types GLE2, GLE4, RRE1 and BLE1. Control upgrades to include 0-10V dimming to 1% and vacancy/occupancy controls where applicable per IECC. Refer to Alternate No. 1 Luminaire Schedule on Sheet E3.00. as indicated on Drawing E2.01L and E3.00 and as specified in Section "Lighting Control Devices " And "LED Interior Lighting".
- B. Alternate No. 02 : Finishes at VESTIBULE 100, ALCOVE 101, WOMEN'S RR 103, MEN'S RR 102 .
 - 1. Base Bid: Existing finishes to remain in these rooms, except new walls in ALCOVE 101 to receive paint and wall base.
 - 2. Alternate: New finishes as shown on the Finish Floor Plan and Interior Finish Schedule.

END OF SECTION 012300

SECTION 012500 - 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 012300 "Alternates" for products selected under an alternate.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. Certificates and qualification data, where applicable or requested.
- g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
- h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
- i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
- j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
- k. Cost information, including a proposal of change, if any, in the Contract Sum.
- I. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
- m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 3. 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.

1.7 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012900 - PAYMENT 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 necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
 - 2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 4. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 5. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 6. <a>

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1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.[Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.]
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - Submit the schedule of values to Architect[through Construction Manager] at earliest possible date, but no later than [seven] <Insert number> days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

- 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of [AIA Document G703] [EJCDC Document C-620] < Insert name and designation of standard form>.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest onehundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 - 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of [five] <Insert number> percent of the Contract Sum.
 - 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 - 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.

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

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect[**and Construction Manager**] and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the <**Insert day**> of the month. The period covered by each Application for Payment is one month, ending on the [**last day of the month**] <**Insert specific day of the month**>.
 - 1. Submit draft copy of Application for Payment [seven] <Insert number> days prior to due date for review by Architect.
- D. Application for Payment Forms: Use [AIA Document G702 and AIA Document G703]
 [AIA Document G703 and AIA Document G732] [EJCDC Document C-620] < Insert name and designation of standard form> as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to [Architect] [Construction Manager] and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. [Architect] [Construction Manager] will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit [three] <Insert number> signed and notarized original copies of each Application for Payment to [Architect] [Construction Manager] by a method ensuring receipt[within 24 hours]. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from [entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment] [subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application].
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 5. Products list (preliminary if not final).
 - 6. Sustainable design action plans, including preliminary project materials cost data.
 - 7. Schedule of unit prices.
 - 8. Submittal schedule (preliminary if not final).
 - 9. List of Contractor's staff assignments.
 - 10. List of Contractor's principal consultants.
 - 11. Copies of building permits.

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- 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
- 13. Initial progress report.
- 14. Report of preconstruction conference.
- 15. Certificates of insurance and insurance policies.
- 16. Performance and payment bonds.
- 17. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Certification of completion of final punch list items.
 - 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 4. Updated final statement, accounting for final changes to the Contract Sum.
 - 5. AIA Document G706.
 - 6. AIA Document G706A.
 - 7. AIA Document G707.
 - 8. Evidence that claims have been settled.
 - 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 10. Final liquidated damages settlement statement.
 - 11. Proof that taxes, fees, and similar obligations are paid.
 - 12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

B. Related Requirements:

- 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
- 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
- 3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of costloaded schedule for Applications for Payment.

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 completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time [belongs to Owner] [is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date].
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
 - 3. **[Two] <Insert number>** paper copies, of sufficient size to display entire period or schedule, as required.
 - B. Startup construction schedule.
 - 1. Submittal 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 digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
 - 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 activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from [commencement of the Work] [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] [monthly] intervals.
- H. Material Location Reports: Submit at [weekly] [monthly] intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.5 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 013100 "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] [area separations] [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[, including commissioning activities].
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. 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.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

- 1. Use [Microsoft Project] [Primavera] [Meridian Prolog] [scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination,"] <Insert name of specific software> for current [Windows] [Macintosh] operating system.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit gualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- C. Time Frame: Extend schedule from date established for [commencement of the Work] [the Notice of Award] [the Notice to Proceed] to date of [Substantial Completion] [Final 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.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than [20] < Insert number> days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. <Insert list of major items or pieces of equipment>.
 - 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 5. Startup and Testing Time: Include no fewer than [15] < Insert number> days for startup and testing.
 - 6. Commissioning Time: Include no fewer than [15] < Insert number > days for commissioning.
 - Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's[and Construction Manager's] administrative procedures necessary for certification of Substantial Completion.
 - 8. Punch List and Final Completion: Include not more than [**30**] <**Insert number**> days for completion of punch list items and Final Completion.

- E. 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 011000 "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 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 - 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.
 - I. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
 - 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. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
 - 9. Other Constraints: <Insert constraints not indicated elsewhere>.

- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion[.][, and the following interim milestones:]
 - 1. Temporary enclosure and space conditioning.
 - 2. <Insert milestones not indicated elsewhere>.
- G. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 - 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- I. Contractor's Construction Schedule Updating: At [monthly] <Insert time> intervals, update schedule to reflect actual construction progress and activities. Issue schedule [one week] <Insert time> 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.
- J. Recovery Schedule: When periodic update indicates the Work is [14] <Insert number> or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- K. Distribution: Distribute copies of approved schedule to Architect[, **Construction Manager**,] Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within [seven] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].

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 [90] <Insert number> days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in **[10]** <**Insert number**> percent increments within time bar.

1.10 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within [14] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award]. Outline significant construction activities for the first [90] <Insert number> 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[**cost- and resource-loaded**,] time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than [60] <Insert number> days after date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

- 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - I. 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, [sustainable design documentation,]and demonstration and training (if applicable), in the amount of [5] <Insert number> 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**] <**Insert time**> before each regularly scheduled progress meeting.

1.11 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Testing and inspection.
 - 8. Accidents.
 - 9. Meetings and significant decisions.
 - 10. Unusual events.
 - 11. Stoppages, delays, shortages, and losses.
 - 12. Meter readings and similar recordings.
 - 13. Emergency procedures.
 - 14. Orders and requests of authorities having jurisdiction.
 - 15. Change Orders received and implemented.
 - 16. [Construction] [Work] Change Directives received and implemented.
 - 17. Services connected and disconnected.
 - 18. Equipment or system tests and startups.
 - 19. Partial completions and occupancies.
 - 20. Substantial Completions authorized.
- B. Material Location Reports: At [weekly] [monthly] intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials

previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

- 1. Material stored prior to previous report and remaining in storage.
- 2. Material stored prior to previous report and since removed from storage and installed.
- 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: 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, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner within [**one**] <**Insert number**> day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 4. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

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

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for

making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

- 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
- 2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
- 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of Construction Manager.
 - 5. Name of Contractor.
 - 6. Name of firm or entity that prepared submittal.
 - 7. Names of subcontractor, manufacturer, and supplier.
 - 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 - 9. Category and type of submittal.
 - 10. Submittal purpose and description.
 - 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 12. Drawing number and detail references, as appropriate.
 - 13. Indication of full or partial submittal.
 - 14. Location(s) where product is to be installed, as appropriate.
 - 15. Other necessary identification.
 - 16. Remarks.
 - 17. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Paper Submittals:
 - 1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 - 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
 - 4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect and Construction Manager will not return copies.
- E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Paper: Prepare submittals in paper form and deliver to Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 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. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
 - a. Two opaque (bond) copies of each submittal. Architect will return one copy(ies).
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 - 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of

repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager 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.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 - 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 - 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
- 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
- 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file 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.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

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

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 - 2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Coordination of Owner-installed products.
 - 7. Progress cleaning.
 - 8. Starting and adjusting.
 - 9. Protection of installed construction.
 - 10. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of [Owner-furnished products] [, Ownerperformed work] [, Owner's separate contracts], and 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, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

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

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at [Project site] <Insert location>.
 - Prior to [submitting cutting and patching plan] [commencing work requiring cutting and patching], review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect [and Construction Manager] of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
- b. Trade supervisor responsible for cutting operations.
- c. Trade supervisor(s) responsible for patching of each type of substrate.
- d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
- 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Layout Conference: Conduct conference at [Project site] <Insert location>.
 - Prior to establishing layout of [new] [new and existing] perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect[and Construction Manager] of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
 - a. Contractor's superintendent.
 - b. [Professional surveyor] [Professional engineer] [Contractor's personnel] responsible for performing Project surveying and layout.
 - c. [**Professional surveyor**] [**Professional engineer**] responsible for performing site survey serving as basis for Project design.
 - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 - 3. Review requirements for including layouts on Shop Drawings and other submittals.
 - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For [land surveyor] [professional engineer].
 - B. Certified Surveys: Submit [two] <Insert number> copies signed by [land surveyor] [professional engineer].
 - C. Certificates: Submit certificate signed by [land surveyor] [professional engineer], certifying that location and elevation of improvements comply with requirements.
 - D. Cutting and Patching Plan: Submit plan describing procedures at least [10] < Insert number> 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.
- E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit [10] < Insert number > copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.[**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. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - I. Operating systems of special construction.
 - m. <Insert operating system>.
 - 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.
- h. <Insert miscellaneous element>.
- 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.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 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 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, gas service piping, and water-service piping; underground electrical services; and other utilities.
- 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to [local utility] [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, submit a request for information to Architect[through Construction Manager] in accordance with 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 and existing conditions. If discrepancies are discovered, notify Architect[and Construction Manager] promptly.
- B. Engage a **[land surveyor]** [**professional engineer**] experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect[**and Construction Manager**] when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect[and Construction Manager].

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect[or Construction Manager]. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect[and Construction Manager] before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of [two] <Insert number> permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

- 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
- 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a **[land surveyor]** [professional engineer] to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by **[land surveyor]** [professional engineer], that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - Maintain minimum headroom clearance of [96 inches (2440 mm)] <Insert dimension> in occupied spaces and [90 inches (2300 mm)] <Insert dimension> in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other

portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

- 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
- 2. Allow for building movement, including thermal expansion and contraction.
- 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements 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 [minimize] [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, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel[and Owner's separate contractors].
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed[and Ownerfurnished, Owner-installed] products.
 - 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractorinstalled[and Owner-furnished, Owner-installed] products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel[and Owner's separate contractors].
 - 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[and Owner's separate contractors] 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.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in [Section 015000 "Temporary Facilities and Controls."] [Section 017419 "Construction Waste Management and Disposal."]
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. 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."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

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

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 the following:
 - 1. Salvaging nonhazardous [demolition] [and] [construction] waste.
 - 2. Recycling nonhazardous [demolition] [and] [construction] waste.
 - 3. Disposing of nonhazardous [demolition] [and] [construction] waste.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 044313.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 4. Section 044313.16 "Adhered Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 5. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction 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 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within [7] [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].

1.6 INFORMATIONAL SUBMITTALS

- Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use
 [Form CWM-7 for construction waste] [and] [Form CWM-8 for demolition waste] < Insert Owner's form designation>. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons (tonnes).
 - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. <a>

 Ouble click to insert sustainable design text for construction waste management submittal.>

- H. Qualification Data: For [waste management coordinator] [and] [refrigerant recovery technician].
- I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- J. Refrigerant Recovery: Comply with requirements in [Section 024116 "Structure Demolition"] [Section 024119 "Selective Demolition"] for refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent [may] [may not] serve as Waste Management Coordinator.
 - 1. <<u>Double click to insert sustainable design text for LEED coordinator.</u>>
- B. Refrigerant Recovery Technician Qualifications: [**Type I**] [**Type II**] [**Type III**] [**Universal**] certified by EPA-approved certification program.
- C. Refrigerant Recovery Technician Qualifications: Comply with requirements in [Section 024116 "Structure Demolition."] [Section 024119 "Selective Demolition."]
- D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis.[**Distinguish between demolition and construction waste.**] Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of [demolition] [site-clearing] [and] [construction] waste generated by the Work. Use [Form CWM-1 for construction waste] [and] [Form CWM-2 for demolition waste] <Insert Owner's form designation>. Include estimated quantities and assumptions for estimates.

- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use [Form CWM-3 for construction waste] [and] [Form CWM-4 for demolition waste] <Insert Owner's form designation>. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with [Section 024116 "Structure Demolition."] [Section 024119 "Selective Demolition."]
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use [Form CWM-5 for construction waste] [and] [Form CWM-6 for demolition waste] <Insert Owner's form designation>. Include the following:
 - 1. Total quantity of waste.
 - 2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
 - 3. Total cost of disposal (with no waste management).
 - 4. Revenue from salvaged materials.
 - 5. Revenue from recycled materials.
 - 6. Savings in transportation and tipping fees by donating materials.
 - 7. Savings in transportation and tipping fees that are avoided.
 - 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 - 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS

2.1 RECYCLING RECEIVERS AND PROCESSORS

A. Subject to compliance with requirements, available recycling receivers and processors include, but are not limited to, the following:

1. <Insert names and telephone numbers of local recycling receivers and processors of recyclable materials>.

2.2 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of [**50**] [**75**] <**Insert number**> percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management

in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials[.][, **including the following:**]

- 1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - I. Rough hardware.
 - m. Roofing.
 - n. Insulation.
 - o. Doors and frames.
 - p. Door hardware.
 - q. Windows.
 - r. Glazing.
 - s. Metal studs.
 - t. Gypsum board.
 - u. Acoustical tile and panels.
 - v. Carpet.
 - w. Carpet pad.
 - x. Demountable partitions.
 - y. Equipment.
 - z. Cabinets.
 - aa. Plumbing fixtures.
 - bb. Piping.
 - cc. Supports and hangers.
 - dd. Valves.
 - ee. Sprinklers.
 - ff. Mechanical equipment.
 - gg. Refrigerants.
 - hh. Electrical conduit.
 - ii. Copper wiring.
 - jj. Lighting fixtures.
 - kk. Lamps.
 - II. Ballasts.
 - mm. Electrical devices.
 - nn. Switchgear and panelboards.
 - oo. Transformers.
 - pp. <Insert materials required>.
- 2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.

- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- I. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.
- n. <Insert materials required>.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.[Coordinator shall be present at Project site full time for duration of Project.]
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within [three] < Insert number> days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by [12 inches (300 mm)] < Insert dimension > or more.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in [Section 024116 "Structure Demolition"] [Section 024119 "Selective Demolition"] [Section 024296 "Historic Removal and Dismantling] for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for [Sale] [and] [Donation]: [Permitted] [Not permitted] on Project site.
- D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area [on-site] [off-site] [designated by Owner].
 - 5. Protect items from damage during transport and storage.
- E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- G. Plumbing Fixtures: Separate by type and size.
- H. Lighting Fixtures: Separate lamps by type and protect from breakage.
- I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING [DEMOLITION] [AND] [CONSTRUCTION] WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall [accrue to Owner] [accrue to Contractor] [be shared equally by Owner and Contractor].
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Grind asphalt to maximum [1-1/2-inch (38-mm)] [4-inch (100-mm)] size.
 - 1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum [1-1/2-inch (38-mm)] [4-inch (100-mm)] size.
 - 2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum [3/4-inch (19-mm)] [1-inch (25-mm)] [1-1/2-inch (38-mm)] [4-inch (100-mm)] size.
 - a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as [general fill] [satisfactory soil for fill or subbase].

- b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.
- 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- K. Carpet[and Pad]: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet[**and pad**] in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- L. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- N. Conduit: Reduce conduit to straight lengths and store by material and size.
- O. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

- 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

3.7 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.

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- F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste reduction progress report.
- H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION 017419

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.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of [10] <Insert number> days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by [Architect] [Construction Manager]. Label with manufacturer's name and model number.
 - 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] [Construction Manager's]
 [Owner's] signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. 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] <Insert number> 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. Advise Owner of changeover in utility services.
- 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
- 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
- 9. Complete final cleaning requirements.
- 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of [10] <Insert number> days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect[and Construction Manager] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 - 1. Submit a final Application for Payment in accordance with Section 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.
 - 4. Submit pest-control final inspection report.
 - 5. Submit Final Completion photographic documentation.
- 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[and Construction Manager] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

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

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within [15] < Insert number> 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.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit [on digital media acceptable to Architect] [by uploading to web-based project software site] [by email to Architect].
- E. Warranties in Paper Form:
 - 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 (215-by-280-mm) 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.
- F. 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 of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- I. Remove labels that are not permanent.
- m. Wipe surfaces of mechanical and electrical equipment[, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- p. Clean ducts, blowers, and coils[if units were operated without filters during construction or that display contamination with particulate matter on inspection].
 - Clean HVAC system in compliance with [NADCA ACR.] [Section 230130.52 "Existing HVAC Air-Distribution System Cleaning."] Provide written report on completion of cleaning.
- q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- r. Clean strainers.
- s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in [Section 015000 "Temporary Facilities and Controls."] [Section 017419 "Construction Waste Management and Disposal."]
- 3.2 REPAIR OF THE WORK
 - A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

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 preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect[and Commissioning Authority] will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:

- 1. Submit [on digital media acceptable to Architect] [by uploading to web-based project software site] [by email to Architect]. Enable reviewer comments on draft submittals.
- 2. Submit [three] <Insert number> paper copies. Architect[, through Construction Manager,] will return [two] <Insert number> copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least [30] <Insert number> days before commencing demonstration and training. Architect[and Commissioning Authority] will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least [15] <Insert number> days before commencing demonstration and training. Architect[and Commissioning Authority] will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's[and Commissioning Authority's] comments. Submit copies of each corrected manual within [15] <Insert number> days of receipt of Architect's[and Commissioning Authority's] comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, [loose-leaf] [post-type] binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name,[and] subject matter of contents[, and indicate Specification Section number on bottom of spine]. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment

included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

- 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
- 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
- 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

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

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.
1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

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

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

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

- 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
- 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

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

- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

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 Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
 - 2. Section 017300 "Execution" for final property survey.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit [one] < Insert number> set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit [**one**] **<Insert number>** paper-copy set(s) of marked-up record prints.
 - Submit PDF electronic files of scanned record prints and [one] <Insert number> set(s) of file prints.
 - 3) Submit Record Digital Data Files and [one] <Insert number> set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit [three] < Insert number > paper-copy set(s) of marked-up record prints.
 - Submit PDF electronic files of scanned Record Prints and [three] < Insert number> set(s) of file prints.

- 3) Print each drawing, whether or not changes and additional information were recorded.
- c. Final Submittal:
 - 1) Submit [**one**] **<Insert number>** paper-copy set(s) of marked-up record prints.
 - Submit Record Digital Data Files and [three] <Insert number> set(s) of Record Digital Data File plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit [annotated PDF electronic files] [and] <Insert number> [paper copies] of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit [annotated PDF electronic files and directories] [and] <Insert number> [paper copies] of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit [annotated PDF electronic files and directories] [and] <Insert number> [paper copies] of each submittal.
- E. Reports: Submit written report [**weekly**] indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

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

- h. Duct size and routing.
- i. Locations of concealed internal utilities.
- j. Changes made by Change Order or [Construction] [Work] Change Directive.
- k. Changes made following Architect's written orders.
- I. Details not on the original Contract Drawings.
- m. Field records for variable and concealed conditions.
- n. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
- 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect[**and Construction Manager**]. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 - 1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
 - 2. Format: [DWG] [DXF] [DGN], Version <Insert designation>, [Microsoft Windows] [Apple Macintosh] operating system.
 - 3. Format: Annotated PDF electronic file[with comment function enabled].
 - 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - 5. Refer instances of uncertainty to Architect[through Construction Manager] for resolution.
 - 6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file[with comment function enabled].
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect[and Construction Manager].
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 - 5. Note related Change Orders[, **Record Product Data**,] and Record Drawings where applicable.

B. Format: Submit record specifications as [annotated PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up paper copy of Specifications].

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders[, **Record Specifications**,] and Record Drawings where applicable.

C. Format: Submit Record Product Data as [annotated PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up paper copy of Product Data].

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

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

1.8 MAINTENANCE OF RECORD DOCUMENTS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

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 instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.
- B. Allowances: Furnish demonstration and training instruction time under the demonstration and training allowance as specified in Section 012100 "Allowances."
- C. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up. See requirements in Section 012200 "Unit Prices."

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit [two] <Insert number> copies within [seven] <Insert number> days of end of each training module.

- 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
- 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
- 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
- 4. At completion of training, submit complete training manual(s) for Owner's use prepared in same [paper] [and] [PDF file] format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

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

- i. Operating procedures for emergencies.
- j. Operating procedures for system, subsystem, or equipment failure.
- k. Seasonal and weekend operating instructions.
- I. Required sequences for electric or electronic systems.
- m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

- 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
- 2. Owner will furnish an instructor to describe Owner's operational philosophy.
- 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner[, through Architect,][, through Construction Manager,] with at least [seven] < Insert number> days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of **[an oral] [a written] [a demonstration]** performance-based test.
- F. Cleanup: Collect used and leftover educational materials and [remove from Project site] [give to Owner]. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of [12] < Insert number> megapixels and capable of recording in full HD mode[with vibration reduction technology].
 - 1. Submit video recordings [on CD-ROM or thumb drive] [by uploading to web-based Project software site].
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

- 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by [audio narration by microphone while] [dubbing audio narration off-site after] video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 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 use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 017300 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items 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, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and , for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and building manager's on-site operations are uninterrupted.
 - 2. Coordination for shutoff, capping, and continuation of utility services.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. 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.
- 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.

1.9 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's 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/ASSP 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 of Existing Conditions: Record existing conditions.
 - 1. Inventory and record the condition of items to be removed and salvaged.

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

3.3 PROTECTION

- A. Temporary Protection:
 - 1. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 3. Cover and protect furniture, furnishings, and equipment that have not been removed.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. 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 portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least four hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 8. Dispose of demolished items and materials promptly.
- B. 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.
- 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.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 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.
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 090561.13 "Moisture Vapor Mitigation System" for fluid applied moisture mitigation.

1.3 DEFINITIONS

- A. 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.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.

- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- I. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Aggregates.
 - 4. 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.
 - 5. Color pigments.
 - 6. Fiber reinforcement.
 - 7. Vapor retarders.
 - 8. Floor and slab treatments.
 - 9. Liquid floor treatments.
 - 10. Curing materials.
 - 11. Joint fillers.
 - 12. Repair materials.
- B. Samples: For vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
 - 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.

- 8. Vapor retarders.
- 9. Semirigid joint filler.
- 10. Joint-filler strips.
- 11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Aggregates.
 - 4. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

1.7 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.

1.8 PRECONSTRUCTION TESTING

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

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 - 3. Do not use frozen materials or materials containing ice or snow.

- 4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
- 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

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

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type IL, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
- C. Normal-Weight Aggregates: ASTM C33/C33M, [Class 3S] [Class 3M] [Class 1N] < Insert class > coarse aggregate or better, graded. Provide aggregates from a single source.
 - 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 an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) 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 (ACI 301M).

- 2. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
- 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride [in steel-reinforced concrete].
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. 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 the requirements of paragraph 5.4]

2.3 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Synthetic macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Euclid Chemical Company (The); an RPM company.
 - b. FiberForce; ABC Polymer Industries, LLC.
 - c. <u>GCP Applied Technologies Inc</u>.
 - d. Sika Corporation.
 - 2.

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Dayton Superior</u>.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Laticrete International, Inc.
 - d. <u>Master Builders Solutions</u>.
 - e. <u>Sika Corporation</u>.
 - f. W.R. Meadows, Inc.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Curing Paper: Eight-feet- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by the following:
 - a. Fortifiber Building Systems Group.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Laticrete International, Inc.
 - d. <u>W.R. Meadows, Inc</u>.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types I and II, nonload bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Floor Slab Protective Covering: Eight-feet- (2438-mm-) wide cellulose fabric.
 - 1. < Double click here to find, evaluate, and insert list of manufacturers and products.>

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than [**4100 psi (29 MPa)**] <**Insert strength**> at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than [**5000 psi (34.5 MPa)**] <**Insert strength**> at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. 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.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.
 - 4. Use permeability-reducing admixture in concrete mixtures where indicated.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.5 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1 inch (25 mm).
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces [not exposed to public view] <Insert locations>.
 - 2. ACI 301 (ACI 301M)Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/4 inch (6 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
 - e. Locations: Apply to concrete surfaces [exposed to public view,] [to receive a rubbed finish,] [or to be covered with a coating or covering material applied directly to concrete] <Insert locations>.

- 3. ACI 301 (ACI 301M) Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/8 inch (3 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
 - e. Locations: Apply to concrete surfaces [exposed to public view,] [to receive a rubbed finish,] [or to be covered with a coating or covering material applied directly to concrete] lnsert locations>.

3.6 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:
 - 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 - 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
 - 3. Apply float finish to surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish:
 - 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 - 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 - 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 4. Do not add water to concrete surface.
 - 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 - 6. Apply a trowel finish to surfaces exposed to view.
 - 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
 - b. Suspended Slabs:
 - Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1,) before and during finishing operations.
- B. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

- Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

3.9 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.10 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least [one] [six] month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.

- b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- 3. After concrete has cured at least 14 days, correct high areas by grinding.
- 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
- 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
- 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- D. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- E. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 PROTECTION

- A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000
SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

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. Framing with dimension lumber.
 - 2. Wood blocking and nailers.
- B. Related Requirements:
 - 1. Section 064116 "Plastic-Laminate-Clad Architectural Cabinets" for wood furring, blocking, and shims not concealed within other construction, for installing plastic-laminate-clad cabinets.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Fire-retardant-treated wood.
 - 2. Power-driven fasteners.
 - 3. Post-installed anchors.
 - 4. Metal framing anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Concealed blocking.
 - 3. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 4. Plywood backing panels.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Spruce-pine-fir; NLGA.
 - 3. Hem-fir; WCLIB or WWPA.
 - 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - 5. Northern species; NLGA.
 - 6. Western woods; WCLIB or WWPA.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
 - A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
 - B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- D. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

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

END OF SECTION 061053

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Solid-surface material countertops
 - 3. Cabinet hardware and accessories.
 - 4. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
 - 2. Division 09 Section "Resilient Base and Accessories" for base materials installed against base cabinets.
 - 3. Division 10 Sections "Wall and Door Protection" and "Toilet, Bath and Laundry Equipment" for equipment installed within, upon or adjacent to casework.
 - 4. Division 22 "Plumbing", Division 26 "Electrical", and Division 27 "Communications" sections for sinks, service fixtures, plumbing fixtures, electrical service, light fixtures and appurtenances, and data lines installed in cabinets.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include 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. Show large-scale details.

- 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- C. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 - 2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
 - a. Provide edge banding on one edge.
 - 3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.
 - 4. Edge material for each p-lam for each condition; drawers, doors, countertops and panels.
 - 5. Solid Surface: 3 inch by 3 inch sample of product in specified color and finish.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data.

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.
- B. Installer Qualifications: Manufacturer of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. All materials and workmanship covered by this section will carry a 5-year warranty from date of Substantial Completion.
- C. SS: Coordinate installation with location of plumbing fittings. Drilling into product must follow manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Architectural Woodwork Standards Grade: Custom.
- B. Type of Construction: Frameless.
- C. Door and Drawer-Front Style: Flush overlay.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- E. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGL.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
 - 4. Edges: Alternates may be submitted to the Architect for review and approval prior to bidding. All edgebanding to be submitted for review and approval prior to bidding.
 - a. 1mm PVC Edge Banding (for semi-exposed edges such as door and drawer edges): Match color, finish, and pattern to adjacent plastic laminate.
 - b. 3mm PVC Edge Banding (for countertop edges): Color, finish and pattern to match plastic laminate on surface.
 - c. 2mm PVC Edge Banding (at all open white melamine shelving noted on drawings): To be determined from Manufacturer's full range of color options.
 - 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- F. Materials for Semiexposed Surfaces:

- 1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 1.0 mm thick, matching laminate in color, pattern, and finish.
 - b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
- 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
- 3. Drawer Bottoms: Thermally fused laminate panels.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Match Architect's basis of design.
 - a. **PL-1**: Wilsonart, "Tailored Linen" 4992 in Fine Velvet Finish 38.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 SOLID SURFACE MATERIAL COUNTERTOPS

- A. Solid Surface Material: Solid sheets consisting of aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
- B. Basis of Design: Alternates require review and approval of Architect before bidding.
 - 1. **SS-1**: Solid surface at countertops: Dupont Corian, Style: Venaro White, Finish: Matte-Satin, Thickness: ½", Edge Profile: Square with eased top and bottom.

- C. Core Material at Sinks: Exterior-grade plywood.
- D. Edge Adhesive for Countertops: Provide one of the following products:
 - 1. Akemi: Colour Bond or Akepox 5010
 - 2. Integra Adhesives: Integra Xi
 - 3. Tenax ceramica: Epoxigres (A+B)
 - 4. As recommended by countertop manufacturer.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 - 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 - 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-testresponse characteristics, using a woodworking shop certified by testing and inspecting agency.
 - 4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing. 270 Degrees of opening where noted on drawings.
- C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, Stainless steel, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter
 - 1. Color: Brushed stainless steel at all casework..
- E. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- G. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- H. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Standard Duty (Grade 1 and Grade 2): Side mount.
 - 2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full extension.
 - b. Material: Zinc-plated ball bearing slides.
 - c. Motion Feature: Self-closing mechanism.

- 3. Pencil drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide 100 lb. load capacity.
- 4. General-purpose drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide 100 lb. load capacity.
- 5. File drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide 200 lb. load capacity.
- I. Cabinet Door Locks: ANSI/BHMA A156.11, E07121.
- J. Drawer Locks: ANSI/BHMA A156.11, E07041. Provide lockable file drawer at each workstation.
- K. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- L. Grommets for Cable Passage Through Countertops: 3-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Match Doug Mockett & Company Inc., Color: Black.
 - 2. Location of grommets to be determined in field with equipment location accounted for, and confirmation from Owner/Architect.
- M. 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.
- N. Work Surface Brackets:
 - 1. Steel Work Surface Bracket: Hafele America "SpeedBrace" Model 287.74.704, steel, black epoxy-coated, with 1,000 lb. weight capacity per pair when spaced at 16-inch centers, or equal.
- O. File Bar and Holder Rail (File Drawers): FUTABA, INC #6120 file bar holder with 44" flat bars, cut to length. Provide at all workstations and where noted on Drawings.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with waferhead cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

- 2. Secure backsplashes to tops with concealed metal brackets at 16" on center and to walls with adhesive.
- 3. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealats."

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- D. SS: At completion of the installation, clean surfaces in accordance with the manufacturer's maintenance and clean-up instructions.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

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. Glass-fiber blanket insulation.
- B. Related Requirements:
 - 1. Section 078443 "Joint Firestopping" for fire-resistive joint assemblies incorporating firesafing insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

- 2.1 GLASS-FIBER BLANKET INSULATION SOUND ATTENUATION
 - A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

- 3. Thickness / R-Value: 3-1/2 inches / R-13
- 2.2
 - Α.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.4 PROTECTION

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

END OF SECTION 072100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.
 - b. Penetrations in horizontal assemblies.
 - c. Penetrations in smoke barriers.
- B. Related Requirements:
 - 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
 - 2. Section 092900 "Gypsum board" for joints in or between fire and smoke rated construction at interior partitions.
- 1.3 PREINSTALLATION MEETINGS
 - A. Preinstallation Conference: Conduct conference at Project site.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

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. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Approval in its "Approval Guide."

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide penetration firestopping assemblies manufactured by one of the following:
 - 1. Hilti, Inc.
 - 2. Specified Technologies, Inc.

2.3 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.
- 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. Penetrations in Horizontal Assemblies: 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: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

- 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
- 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
- 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. 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.

3.5 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.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
 - 2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

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

1.7 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."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

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. Hilti, Inc.
 - c. Nelson Firestop; a brand of Emerson Industrial Automation.
 - d. NUCO, Inc.
 - e. RectorSeal.
 - f. ROXUL.
 - g. Specified Technologies, Inc.
 - h. Thermafiber, Inc.; an Owens Corning company.
 - i. 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. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Nelson Firestop; a brand of Emerson Industrial Automation.
 - d. RectorSeal.
 - e. Specified Technologies, Inc.
 - f. Thermafiber, Inc.; an Owens Corning company.
 - g. Tremco, Inc.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- E. 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 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

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

3.4 IDENTIFICATION

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

- 4. Date of installation.
- 5. Manufacturer's name.
- 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM 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.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Firestop Systems.
- C. Floor-to-Floor, Joint Firestopping Systems :
 - 1. UL-Classified Systems: FF-D 0000-0999.
 - 2. Assembly Rating: match rating of assembly penetrated.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I or Class II
 - 5. L-Rating at Ambient: Less than 5.0 cfm/ft..
 - 6. L-Rating at 400 Deg F: Less than 5.0 cfm/ft...
 - 7. W-Rating: No leakage of water at completion of water leakage testing.
- D. Wall-to-Wall, Joint Firestopping Systems :
 - 1. UL-Classified Systems: WW-D 0000-0999.
 - 2. Assembly Rating: match rating of assembly penetrated.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I Class II.

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- 5. L-Rating at Ambient: Less than 5.0 cfm/ft..
- 6. L-Rating at 400 Deg F : Less than 5.0 cfm/ft..
- E. Floor-to-Wall, Joint Firestopping Systems :
 - 1. UL-Classified Systems: FW-D 0000-0999.
 - 2. Assembly Rating: match rating of assembly penetrated.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I or Class II.
 - 5. L-Rating at Ambient: Less than 5.0 cfm/ft..
 - 6. L-Rating at 400 Deg F: Less than 5.0 cfm/ft..
- F. Head-of-Wall, Fire-Resistive Joint Firestopping Systems :
 - 1. UL-Classified Systems: HW-D 4000-4999.
 - 2. Assembly Rating: match rating of assembly penetrated.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I or Class II.
 - 5. L-Rating at Ambient: Less than 5.0 cfm/ft...
 - 6. L-Rating at 400 Deg F: Less than 5.0 cfm/ft. .
- G. Bottom-of-Wall, Joint Firestopping Systems :
 - 1. UL-Classified Systems: BW- S- 4000-4999.
 - 2. Assembly Rating: match rating of assembly.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I or Class II
 - 5. L-Rating at Ambient: Less than 5.0 cfm/ft..
 - 6. L-Rating at 400 Deg F: Less than 5.0 cfm/ft.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Latex joint sealants.

B. Related Requirements:

- 1. Division 08 "Door" and "Window" Sections for weather-resistant joint sealants at assembly perimeters.
- 2. Section 092900 "Gypsum Board" for acoustical joint sealants in sound rated construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Joint-sealants.
 - 2. Joint sealant backing materials.
- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for testes performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- B. Sample warranties.

1.5 QUALITY ASSURANCE

A. Qualifications:

- 1. Installers: Authorized representative who is trained and approved by manufacturer.
- 2. Testing Agency: Qualified in accordance with 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 masonry substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 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.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

- 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
- 2. Disintegration of joint substrates from causes exceeding design specifications.
- 3. Mechanical damage caused by individuals, tools, or other outside agents.
- 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC SEALANTS

A. Elastomeric Joint Sealant Standard: comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and use.

2.4 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Nonstaining, Ssingle-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; Dow Corning® 795 Silicone Building Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf NB.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 295 FPS NB.
 - d. Pecora Corporation; Pecora 895NST.
- B. Tremco Incorporated; Spectrem 2 or Spectrem 3.
 - 1.

2.5 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; "786 Silicone Sealant."
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; "SCS1799 Sanitary."
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation; "Sikasil -GP."
 - d. Tremco Incorporated; Tremsil 200."

2.6 LATEX JOINT SEALANTS

- A. 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. May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex 600 or Bondaflex Sil-A 700.
 - b. Pecora Corporation; AC-20, AVW-920, or Tilt-Seal.
 - c. Sherwin-Williams Company (The); 850A Siliconized Acrylic Latex Caulk 950A or PowerHouse Siliconized Acrylic Latex Sealant.
 - d. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular 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.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

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3.6 JOINT-SEALANT SCHEDULE

- A. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement[**JS-#**1:
 - 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 windows and elevator entrances.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces[JS-#2]:
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - 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.

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 and Exterior standard steel doors and frames.
- B. Related Requirements:
 - 1. Section 081416 "Flush Wood Doors" for wood doors installed in hollow metal frames.
 - 2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
 - 3. Section 088000 "Glazing" for borrowed lights in hollow metal doors and sidelights in hollow metal frames.
 - 4. Section 099123 "Interior Painting" for verifying compatibility of shop primer with intermediate and topcoats on hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 3. Locations of reinforcement and preparations for hardware.
 - 4. Details of each different wall opening condition.
 - 5. Details of anchorages, joints, field splices, and connections.
 - 6. Details of moldings, removable stops, and glazing.
- C. 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.
- 1.7 INFORMATIONAL SUBMITTALS
 - A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- 1.8 QUALITY ASSURANCE
 - A. Verify compatibility of shop primer with intermediate and topcoats specified in Division 09 Sections "Exterior Painting" and Interior Painting."
- 1.9 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
- PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. Security Metal Products; a brand of ASSA ABLOY.
- B. Source Limitations: Obtain hollow-metal doors and frames from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.37 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

2.3 INTERIOR FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Frames: SDI A250.8, Level 1; Provide at all door openings less than 42-inches wide.
 - 1. Frames:
 - a. Physical Performance: Level C according to SDI A250.4.
 - b. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - c. Construction: Knocked-down or Full-profile welded as determined by Architect / Building Owner..
 - d. Exposed Finish: Prime.

2.4 EXTERIOR 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: SDI A250.8, Level 2; SDI A250.4, Level B.
 - 1. Doors:
 - a. Physical Performance: Level B according to SDI A259.4.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weephole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Polyurethane.
 - i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

- 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating; Construction: Full profile welded.
- 3. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type for welded frames: Designed to engage stud, welded to back of frames; not less than 0.042-inch thick.
 - 2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042-inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory-assembled before shipment.
- B. 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.
- C. 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. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60-inches high.
 - 2) Four anchors per jamb from 60 to 90-inches high.
 - 3) Five anchors per jamb from 90 to 96-inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24-inches or fraction thereof above 96-inches high.
 - b. Compression Type: Not less than two anchors in each frame.
 - 4. 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.
- D. 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 SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. See Drawings for custom hardware requirements including hinge mounting heights.
 - 2. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 - 3. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparing hollowmetal doors and frames for hardware.
- E. 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 square stops unless otherwise indicated.

- 2. 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.
- 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
- 4. 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 SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Galvanized Steel Straps for fastening hollow metal frames to wall framing: 0.0635-inch-thick (16gauge) galvanized sheet steel.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

- B. Hollow-Metal Frames: Comply with 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. At fire-rated openings: Install frames according to NFPA 80.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. In-Place Metal-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 5. 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.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9-inches o.c. and not more than 2-inches from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Sections 083113 "Hollow Metal Doors and Frames" for door frames for flush wood doors.
 - 2. Section 087100 "Door Hardware."
 - 3. Section 088000 "Glazing" for glass vision panels in light frames of flush wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Doors to be factory finished and finish requirements.
 - 5. Fire-protection ratings for fire-rated doors.
- C. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
 - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

- a. Provide Samples for each species of veneer and solid lumber required.
- b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
- 3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated".
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers Flush Wood Doors: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eggers Industries.
 - 2. Graham Wood Doors; ASSA ABLOY Group company.
 - 3. Lynden Door.

- 4. VT Architectural Doors.
- B. WDMA I.S.1-A Performance Grade: Heavy Duty
- C. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1 Grade LD-2, made with binder containing no urea-formaldehyde resin.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate throughbolting hardware and as follows:
 - a. 5-inch top-rail blocking.
 - b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c. 5-inch mid-rail blocking, in doors indicated to have exit devices.
- D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fireprotection rating indicated.
 - 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
- E. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware as follows:
 - a. 5-inch top-rail blocking.
 - b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch mid-rail blocking, in doors indicated to have armor plates.
 - d. 5-inch mid-rail blocking in doors indicated to have exit devices.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screwholding capability and split resistance. Comply with specified requirements for exposed edges.

2.2 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior, Factory-Finished Solid-Core Doors :
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: White Maple.
 - 3. Cut: Plain sliced.
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - 6. Exposed Vertical Edges: Same species as faces.
 - 7. Core: Particleboard
 - 8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
 - 9. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.3 LIGHT FRAMES

A. Provide manufacturer's standard metal light frame formed of 0.048 -inch thick cold-rolled steel sheet with baked-enamel or powder-coated finish matching frame color paint. Light sizes should match elevations shown and what is allowable by current fire ratings.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
 - 1. Transparent Finish:
 - a. Grade: Custom.
 - b. Finish: WDMA TR-6 catalyzed polyurethane.
 - c. Sheen: Satin.
 - d. Staining: As selected by Architect from manufacturer's full range. To match existing doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

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

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- 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 that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass products.
 - 2. Glazing sealants.
 - 3. Glazing tapes.
 - 4. Miscellaneous glazing materials.

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- 1.5 INFORMATIONAL SUBMITTALS
 - A. Product Certificates: For glass.
 - B. Sample Warranties: For special warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 WARRANTY

1. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtainglass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA Publications:"Glazing Manual."
- B. Thickness: Where glass thickness is indicated, it is a minimum.[**Provide glass that complies with** performance requirements and is not less than thickness indicated.]
- C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass[**as needed to comply with "Performance Requirements" Article**]. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass[**as needed to comply with "Performance Requirements" Article**]. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass[**as needed to comply with "Performance Requirements" Article**]. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
 - 1. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face and edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

- 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
- 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 TAPE GLAZING

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

3.5 GASKET GLAZING (DRY)

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

seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- 3.7 MONOLITHIC GLASS SCHEDULE
 - A. Low-Iron Glass Type: Heat-strengthened and Fully tempered float glass.
 - 1. Minimum Thickness: **6 mm**.

END OF SECTION 088000

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SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

<u>TIPS:</u>

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination check-lists**, click on MasterWorks/Supporting Information.

Access Product MasterSpec Sections:

<Double click here to view the list of manufacturer Sections available at ProductMasterSpec.com.>

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. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vaporemission rate of high-moisture, interior concrete to prepare it for floor covering installation.
 - 2. Loose-laid, sheet membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.3 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.
- 1.4 ACTION SUBMITTALS
 - A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F (18 deg C) and not more than 85 deg F (29.4 deg C) at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29.4 deg C) and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F (3 deg C) higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.9 WARRANTY

- A. Manufacturer's Special Material Warranty: Manufacturer agrees to repair or replace MVE-control system that fails in materials within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
 - 1. Relative Humidity: Maximum 100 percent when tested in accordance with ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm (5.75 ng/s x sq. m x Pa) when tested in accordance with ASTM E96/E96M.

2.2 MVE-CONTROL SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide UZIN; a brand of Uzin Utz North America, Inc.; PE 460 or comparable product by one of the following:
 - 1. ARDEX Americas.
 - 2. KOSTER American Corporation.
 - 3. MAPEI Corporation.
- B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, 100 percent solids epoxyresin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
- C. Physical Properties:
 - 1. Water-Vapor Transmission: 0.1 perm (5.72 ng/s x sq. m x Pa) in accordance with ASTM E96/E96M.
 - 2. VOC Emissions: 10 g/L; complying with SCAQMD Rule 1168 and CA Section 01350.
 - 3. VOC Content: Provide coating with VOC content of 100 g/L or less.

2.3 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000 psi (20.68 MPa) compressive strength after 28 days when tested in accordance with ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Concrete Substrates: Prepare and clean substrates in accordance with MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
 - 1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
 - 2. Provide concrete surface profile complying with ICRI 310.2R [**CSP 3**] <**Insert requirements**> by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - 3. After shot blasting, repair damaged and deteriorated concrete in accordance with MVE-control system manufacturer's written instructions.
 - 4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
- B. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

- A. Install MVE-control system in accordance with ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
 - 1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer.
- D. Cure MVE-control system components in accordance with manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies in accordance with manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired in accordance with manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 090561.13

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.
 - 2. Section 061053 "Miscellaneous Rough Carpentry" for backing and blocking used in nonstructural stud walls.
 - 3. Section 072100 "Thermal Insulation" for glass fiber blanket insulation used as sound attenuation insulation in interior stud walls.
 - 4. Section 092900 "Gypsum Board" for interior gypsum board panels applied to non-structural metal framing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-loadbearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, highstrength steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - 2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide the following:
 - 1. Single Long-Leg Track System: ASTM C645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp; Fire Track System.
 - b. GCP Applied Technologies Inc. (formerly Grace Construction Products); FlameSafe FlowTrak System.
 - c. Metal-Lite; The System
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Steel Thickness: 0.0269 inch (0.683 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.

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- 1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
- 2. Depth: 7/8 inch (22.2 mm).
- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from carrion-resistant materials with holes or loops for attaching wire hanger and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Uses: Securing hangers to structure.
 - b. Type: Post-installed, expansion anchor.
 - 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70. Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 2 inches (51 mm).
- E. Furring Channels (Furring Members):
 - 1. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.0269 inch (0.683 mm).
 - b. Depth: 3-5/8 inches (92 mm).
 - 2. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.025 inches. .
 - b. Depth: 3-5/8 inches (92 mm).
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armstrong World Industries, Inc.: Drywall Grid Systems
 - b. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicatied

- 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install studs so flanges within framing system point in same direction.
- B. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 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.
 - Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- C. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types and other components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Joint Treatment materials
 - 3. Auxiliary materials
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
 - 3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
 - 4. Section 135100 "RF Shielding" for coordination with MRI Room shielding.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Gypsum wallboard.
 - 2. Gypsum board, Type X.
 - 3. Gypsum ceiling board.
 - 4. Glass-mat gypsum sheathing board.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 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. CertainTeed Corporation
 - b. Continental Building Products, LLC
 - c. Georgia-Pacific Building Products
 - d. National Gypsum Company
 - 2. 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. CertainTeed Corporation
 - b. Continental Building Products, LLC
 - c. Georgia-Pacific Building Products
 - d. National Gypsum Company
 - 2. Thickness: 1/2 inch.
 - 3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

- 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
 - a. Available manufacturers offering products that may be incorporated into the Work, include, but are not limited to the following:
 - 1) Joint Compound for CertainTeed Corp.; ProRoc Level V Wall and Ceiling Primer/Surfacer.
 - 2) USG Corporation; Sheetrock Brand Tuff-Hide Primer-Surfacer.

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.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

- 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.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. Flame and smoke-developed indexes of 25 and 50 respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly. Provide ASTM C 665, Type I, unfaced mineral-fiber blanket insulation meeting requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AIS-919
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
- F. Acoustical Seals at Junction Boxes in Sound-Rated Walls: Acoustical putty pads designed to wrap electrical boxes and other devices in acoustically rated walls.
 - 1. Available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Harry Lowry & Associates; 1 (800) 225-8231; Lowry's Outlet Box Pads.
 - b. Specified Technologies, Inc.; 1 (800) 993-1180; STI Sped-Seal Firestop Putty Pads.
- G. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces unless otherwise indicated.
 - 2. Flexible Type: As indicated on Drawings.
 - 3. Ceiling Type: Ceiling surfaces.
 - 4. Impact-Resistant Type: As indicated on Drawings.
 - 5. Mold-Resistant Type: At toilet and shower rooms and full wall heigh a minimum of 24-inches each side of any plumbing fixture, where ceramic wall tile is not indicated on Drawings..
- B. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
- 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
 - 4. U-Bead: Use where indicated.
 - 5. Curved-Edge Cornerbead: Use at curved openings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: [At panel surfaces that will be exposed to view unless otherwise indicated] <Insert locations>.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 INSTALLATION OF ACOUSTICAL SEALANTS AND PUTTY

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Wrap all electrical and miscellaneous wall boxes and similar penetrations in acoustically-rated partitions with acoustical putty according to manufacturer's recommendations.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other nondrywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Glazed wall tile.
 - 3. Tile backing panels.
 - 4. Waterproof membranes.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 090561.13 "Moisture Vapor Mitigation System" for waterproof membrane coordination.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Metal edge strips in 6-inch (150-mm) lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. 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 wall tile installation.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

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- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain waterproof membrane from manufacturer of moisture vapor mitigation system.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- 2.3 TILE PRODUCTS
 - A. Porcelain Tile Type **PFT-1**: Unglazed.
 - 1. Basis of Design: American Olean's "Color Story Floor."
 - a. Certification: Tile certified by the Porcelain Tile Certification Agency.
 - b. Face Size: 11 7/8 by 23 5/8 inches (30.23 by 60.12 cm)..
 - c. Thickness: 5/16 inch..
 - d. Dynamic Coefficient of Friction: Not less than 0.42.
 - e. Tile Color: Matte Balance 0034.
 - f. Grout Color: As selected by Architect from manufacturer's full range.
 - g. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - 1) **PFT-2** Cove Base: 6 by 12 inches, P36C9.
 - 2) Internal Corners: Field-butted square corners.
 - B. Glazed Wall Tile Type **CWT**:
 - 1. Basis of Design: American Olean's "Color Story Wall."
 - a. Face Size: 2 by 8 inches.
 - b. Thickness: 5/16 inch (8 mm).

- c. Face: Pattern of design indicated, with manufacturer's standard edges.
- d. Tile Color:
 - 1) **CWT-1**: Calm 0035
 - 2) **CWT-2**: Lemon Zest 0075
 - 3) **CWT-3**: Restore 0058
 - 4) **CWT-4**: Tranquility 0059
 - 5) **CWT-5**: Fresh 0031.
- e. Grout Color: As selected by Architect from manufacturer's full range.

2.4 THRESHOLDS

- A. Description: Metal Transition Floor Tile to Luxury Vinyl Tile
 - 1. Basis of Design Product: "Schiene," as manufactured by Schluter Systems, or comparable product.
 - 2. Material: Satin Anodized Aluminum (AE).
 - 3. Tile subcontractor to supply connectors, end caps, and outside corner squares.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 - 1. Thickness: 5/8 inch (15.9 mm).

2.6 WATERPROOF MEMBRANES

- A. Waterproof Membrane: Provide UZIN WP Hydrostop flexible sheet bonded waterproofing and vapor retadring membrane.
- 2.7 SETTING MATERIALS
 - A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber (as recommended by manufacturer) liquid-latex additive at Project site .
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.

- C. Metal Edge Strips: Manufacturer's standard "Jolly" metal trim S1/212J at all exterior corners of tiled walls.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.9 MIXING MORTARS AND GROUT

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
- 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. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

- 1. Glazed Wall Tile: 1/16 inch (1.6 mm).
- 2. Porcelain Floor Tile: 3/16 inch.
- G. 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.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 INSTALLATION OF WATERPROOF MEMBRANES

- A. 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.
- B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

- 1. TCNA F113 : Thinset mortar.
 - a. Porcelain Tile Type: **PFT-1**, **PFT-2**.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. TCNA W244C or TCNA W244F: Thinset mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.
 - a. Ceramic Tile Type: **CWT-1-5**.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Related Requirements:
 - 1. Division 21 "Fire Suppression," Division 23 "HVAC," Division 26 "Electrical," Division 27 "Communications," and Division 28 "Electronic Safety and Security" Section for fixtures and appurtances penetrating acoustical panel ceilings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 3. Items penetrating finished ceiling and ceiling-mounted items including the following:

- a. Lighting fixtures.
- b. Diffusers.
- c. Grilles.
- d. Speakers.
- e. Sprinklers.
- f. Access panels.
- g. Perimeter moldings.
- 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Extra materials shall not be used to replace panels prior to Final Completion of the project.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class B according to ASTM E1264.
 - 2. Smoke-Developed Index: 450 or less.
- 2.3 ACOUSTICAL PANELS APC-1 (Match Existing)
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong, **"Cortega #769"** Acoustical Panels, or comparable product by one of the following:
 - 1. USG Corporation
 - 2. CertainTeed Ceilings.
 - B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
 - C. Classification: Provide panels as follows:
 - 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
 - 2. Pattern: CD (perforated, small holes and fissured).
 - D. Color: White.
 - E. Light Reflectance (LR): Not less than 0.80.
 - F. Ceiling Attenuation Class (CAC): Not less than 35.
 - G. Noise Reduction Coefficient (NRC): Not less than 0.55.
 - H. Edge/Joint Detail: Square.
 - I. Thickness: 5/8 inch (15 mm).
 - J. Modular Size: 24 by 48 inches (610 by 1220 mm).
 - K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold,

mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 ACOUSTICAL PANELS APC-2 (Match Existing)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong, "Ultima **Tegular 1914**" Acoustical Panels, or comparable product by one of the following:
 - 1. USG Corporation
 - 2. CertainTeed Ceilings.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
 - 1. Type and Form: Type IV,; Form 2, cloth. Binder shall not contain urea formaldehyde.
 - 2. Pattern: E.
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.80.
- F. Ceiling Attenuation Class (CAC): Not less than 35.
- G. Noise Reduction Coefficient (NRC): Not less than 0.75.
- H. Edge/Joint Detail: Beveled Tegular 15/16".
- I. Thickness: 3/4 inch .
- J. Modular Size: 24 by 48 inches (610 by 1220 mm).
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.5 METAL SUSPENSION SYSTEM

- A. Basis of Design Product: Subject to compliance with requirements, provide Armstrong, "Prelude" 15/16" suspension system.Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Capped, Double-Web, Stainless-Steel Suspension System: Main and cross runners roll formed from Type 304 or 316 stainless-steel sheet, with prefinished 15/16-inch- (24-mm-) wide, stainless-steel caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. Face Design: Flat, flush.

2.6 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Hold-Down Clips: Manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- F. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- 2.7 METAL EDGE MOLDINGS AND TRIM
 - A. Provide metal edge moldings and trim by the same manufacturer as the metal suspension system.
 - 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.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

- 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- 8. Do not attach hangers to steel deck tabs.
- 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches (610 mm) o.c. on all cross runners.
 - 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistancerated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 CLEANING

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

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Thermoplastic-rubber base.
- 2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:

- 1. 48 hours before installation.
- 2. During installation.
- 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

- 2.1 THERMOPLASTIC-RUBBER BASE RWB-1
 - A. Basis of Design:
 - 1. Johnsonite, "Duracove" Base
 - B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with resilient floor coverings.
 - C. Thickness: 0.25 inches.
 - D. Height: 4 inches (102 mm)
 - E. Lengths: Cut lengths 48 inches (1219 mm) long or Coils in manufacturer's standard length.
 - F. Outside Corners: Job formed.
 - G. Inside Corners: Job formed.
 - H. Colors: 48, "Grey."

2.2 RUBBER MOLDING ACCESSORY

- A. Description: Rubber transition strips as required by new construction and existing conditions.
 - 1. Carpet to Concrete Edge Guard: Tarkett, "EG-48-H."
 - 2. Sheet Vinyl to Concrete Reducer Strip: Tarkett, "RRS-48-B."
 - 3. Carpet to Sheet Vinyl Adapter Strip: Tarkett, "SLT-48-H."
- B. Colors and Patterns: 48, "Grey."

2.3 INSTALLATION MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) 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 (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

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. Unbacked vinyl sheet flooring.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for wall base.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient sheet flooring.
 - 1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: For each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
- D. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive resilient sheet flooring during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F.
- C. Close spaces to traffic during resilient sheet flooring installation.
- D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.
- E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED VINYL SHEET FLOORING SV-1

- A. Basis of Design: Provide Mohawk Group, Healthy Environments Homogenous Resilient Sheet Collection, "Medella Hues" C2062.
- B. Product Standard: ASTM F1913.
- C. Thickness: 0.080 inch (2.0 mm).
- D. Wearing Surface: Smooth.
- E. Sheet Width: 6.6 feet (2.0 m).
- F. Seamless-Installation Method: Heat welded.
- G. Colors and Patterns: Steel Light H5328.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Colors: Match flooring.
- D. Integral-Flash-Cove-Base Accessories:
 - 1. Cove Strip: 1-inch (25-mm) radius provided or approved by resilient sheet flooring manufacturer.
 - 2. Cap Strip: Seal top of ICB with sealant provided or approved by resilient sheet flooring manufacturer.
 - 3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

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

3.2 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 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 resilient sheet flooring manufacturer. Do not use solvents.
- 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 resilient sheet flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Adhere resilient sheet flooring 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.
- H. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Warranty of each type of floor tile included.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

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

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE LVT-1

- A. Basis of Design: Interface, "Natural Woodgrains" from Level Set Collection A002.
- B. Tile Standard: ASTM F1700.
 - 1. Class: Class III, Printed Film Vinyl Tile.
 - 2. Type: A, Smooth Surface.
- C. Thickness: 4.5 mm.

- D. Wear Layer Thickness: 22 mil.
- E. Size: 25cm by 1m (9.845 by 39.38 inches).
- F. Colors and Patterns: Washed Maple A00211.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 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.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in Ashlar pattern.
- 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 with grain running cardinal North to South.
- 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.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for removing existing floor coverings.
 - 2. Section 096513 "Resilient Base and Accessories" Section 096519 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Type, color, and location of insets and borders.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
- 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
- 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.

PART 2 - PRODUCTS

2.1 CARPET TILE **CPT-1**

- A. Basis of Design Product: Provide Tarkett "Input 11083" Powerbond Hybrid Carpet.
 - 1. Color: "Basaltic Mineral" 11612.
 - 2. Fiber Type: Dynex SD Nylon.
 - 3. Pile Characteristic: Patterned Tipshear pile.
 - 4. Backing System: Powerbond Cushion.
 - 5. Size: 6 foot rolls.
 - 6. Performance Characteristics:
 - a. Appearance Retention Rating: minimum according to ASTM D7330.
 - b. Colorfastness to Light: Not less than 4 after 100 AFU (AATCC fading units) according to AATCC 16, Option E.
 - c. Electrostatic Propensity: Less than 2 kV according to AATCC 134.

2.2 CARPET TILE **CPT-2**

- A. Basis of Design Product: Provide Tarkett's Meta Firma in "Earthbound 11573" Powerbond Hybrid Carpet.
 - 1. Color: "Ice Sky" 52607.
 - 2. Fiber Type: Dynex SD Nylon.
 - 3. Pile Characteristic: Stratatec Patterned Loop.
 - 4. Backing System: Powerbond Cushion.
 - 5. Size: 6 foot rolls.
 - 6. Performance Characteristics:
 - a. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
 - b. Colorfastness to Light: Not less than 4 after 100 AFU (AATCC fading units) according to AATCC 16, Option E.
 - c. Electrostatic Propensity: Less than 2 kV according to AATCC 134.

2.3 WALK OFF MATT **WM-1**

A. Basis of Design Product: Provide Tarkett "Abrasive Action II 02578" Powerbond Hybrid Carpet.

- 1. Color: "Winter Gray" 19103.
- 2. Fiber Type: TDX Nylon.
- 3. Pile Characteristic: Accuweave Patterned Loop.
- 4. Primary Backing: Non-woven Synthetic.
- 5. Protective Treatments: Eco-Ensure.
- 6. Size: 6 foot rolls.
- 7. Performance Characteristics:
 - a. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
 - b. Colorfastness to Light: Not less than 4 after 100 AFU (AATCC fading units) according to AATCC 16, Option E.
 - c. Electrostatic Propensity: Less than 2 kV according to AATCC 134.

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

SECTION 097200 - WALL COVERINGS

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. Vinyl wall covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Samples for Initial Selection: For each type of wall covering.
- C. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.
- D. Product Schedule: For wall coverings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.

- 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 0.
 - b. Smoke-Developed Index: 10 or less.
 - 2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 286.

2.2 VINYL WALL COVERING WC-1

- A. Basis of Design: Provide WolfGordon "Rampart Wall Protection."
- B. Description: Provide vinyl products in rolls from same production run and complying with the following:
 - 1. FS CCC-W-408D for Type III, Heavy Duty.
 - 2. Total Weight: 35 ounces per linear yard, excluding coatings.
 - 3. Width: 52 inches.
 - 4. Backing Fiber Content: Polycotton .
 - 5. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.
 - 6. Features:
 - a. Stain-Resistant Coating: Suurcoat.
 - b. Antimicrobial.
 - c. Abrasion resistant.
 - 7. Patterns: Custom Art. Coordinate with Architect.

8. Texture: CDP 510, "Tabby Emboss" canvas texture.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 2. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches (152 mm) from outside corners and 6 inches (152 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Primers.
 - 2. Water-based finish coatings.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples: For each type of topcoat product.
- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

- 1. Maintain containers in clean condition, free of foreign materials and residue.
- 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin-Williams Company (The)
 - 3. Kelly-Moore Paint Company Inc.
 - 4. Rodda Paint Co.
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated in a color schedule below.
 - 1. P-1: General; Match Sherwin-Williams Color: White Heron SW7627 (Sheen as noted below)
 - 2. P-2: Interior Hollow Metal Doors and Frames; Match Sherwin-Williams Color: Bracing Blue SW6242 (Sheen as noted below)
 - 3. P-3: Gyp Board Ceilings; Match Sherwin-Williams Color: Ceiling Bright White SW7007 (Sheen as noted below).
 - 4. P-4: Accent; Match Sherwin-Williams Color: Windy Blue SW6240 (Sheen as noted below).
 - 5. P-5: Accent: Match Sherwin-Williams Color: Acacia Haze SW9132 (Sheen as noted below).

2.3 PRIMERS

A. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster, concrete, and gypsum wallboard surfaces.

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- 1. Benjamin Moore: Eco Spec WB Interior Latex Primer/Sealer
- 2. Kelly-Moore Paints: Acry-Plex Interior PVA Primer/Sealer
- 3. Sherwin-Williams: ProGreen 200 Interior Latex Primers.
- B. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams (The)
- C. Drywall Primers for Epoxy intermediate and topcoats:
 - 1. Benjamin Moore
 - 2. Columbia Paint: Pro Sheild II Acrylic Primer Sealer
 - 3. Sherwin-Williams: PrepRite 200 Latex Primer

2.4 WATER-BASED FINISH COATS

- A. Interior, Latex, Flat: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss and Sheen Level: Manufacturer's standard flat finish.
- B. Interior, Latex, Eggshell: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss and Sheen Level: Manufacturer's standard eggshell finish.
- C. Interior, Latex, Semigloss: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss Level: Manufacturer's standard semigloss finish.
- D. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss Level: Manufacturer's standard semigloss finish.

- E. Interior, Latex, High-Performance Architectural Coating, Eggshell:
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss and Sheen Level: Manufacturer's standard eggshell finish.
- F. Interior, Latex, High-Performance Architectural Coating, Semigloss:
 - 1. Benjamin Moore
 - 2. Kelly-Moore Paints
 - 3. Sherwin-Williams
 - 4. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.
 - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. 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 applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

- C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Aluminum Substrates: Remove loose surface oxidation.
- H. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- 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, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Steel or Galvanized Metal Substrates:
 - 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Alkyd quick-dry primer for metal.
 - 1) Basis of design product: Sherwin-Williams Protective & Marine Kem Bond HS Universal Alkyd Primer #B50-Series.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Topcoat: Interior, latex, high-performance architectural coating, semigloss.
 - 1) Basis of design product: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss Coating #B66-650-Series.
- B. Gypsum Board Substrates: Dry Walls

- 1. Latex over Latex Sealer System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, satin.
 - 1) Basis of Design Product: Sherwin-Williams Pro Tech Interior Latex Satin Enamel #C102.
- C. Gypsum Board Substrates: Wet Walls
 - 1. Latex over Latex Sealer System
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, Semi-Gloss.
 - 1) Basis of Design Product: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss #B31-2600 Series.
- D. Gypsum Board Substrates: Dry Ceilings
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, flat.
 - 1) Basis of Design Product: Sherwin-Williams Pro Tech Interior Latex Flat Enamel.
- E. Gypsum Board Substrates: Wet Ceilings
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, Semi-Gloss.
 - 1) Basis of Design Product: Sherwin-Williams ProMar 200 Zero VOC Interior Latex #B20-12600 Series Egg-Shel.

SECTION 102600 - WALL AND DOOR PROTECTION

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. Abuse-resistant wall coverings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Abuse-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Lifetime Limited.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 ABUSE-RESISTANT WALL COVERINGS RSV-1

A. Abuse-Resistant Sheet Wall Covering **RSV-1**: Fabricated from semirigid, plastic sheet wall-covering material.

- 1. Basis of Design: Provide InPro Corporation Palladium Rigid Sheet Vinyl.
 - a. Sheet Thickness: 0.040 inch (1.0 mm).
 - b. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
 - c. Color: "Blue Mist" 0324.
 - d. Height: As indicated.
 - e. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
 - f. Mounting: Adhesive.

2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.

- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Adjust top caps as required to ensure tight seams.
- D. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- 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.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.
- D. Delegated Design Submittal: For grab bars.
 - 1. Include structural design calculations indicating compliance with specified structuralperformance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 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. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. 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 (1112 N) concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser "E":
 - 1. Basis of Design: Bobrick B-9882, "Ligature-Resistant Spindle Button Semi-Recessed Toilet Paper Holder."
 - 2. Mounting: Semi-Recessed .
 - 3. Capacity: Designed for 4-3/8- or 4 1/2-inch diameter tissue rolls.
 - 4. Material and Finish: White powder-coated stainless steel.
- C. Anti-Ligature Paper Towel (Folded) Dispenser "D":
 - 1. Basis of Design: Bobrick B-9881, "Ligature-Resistant Vertical Bay C Fold Paper Holder."
 - 2. Mounting: Surface.
 - 3. Minimum Capacity: 200 C-fold paper towels per bay (400 C-fold total).
 - 4. Material and Finish: White powder-coated stainless steel.
- D. Soap Dispenser "C":
 - 1. Basis of Design: Bobrick 818615, "Surface-Mounted Soap Dispenser for Antibacterial Soaps."
 - 2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
 - 3. Mounting: Vertically oriented, surface mounted.
 - 4. Capacity: 40 fluid ounces.

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- 5. Materials: type 316 stainless steel.
- 6. Refill Indicator: Window type.
- E. Stainless Steel Ligature Resistant Grab Bars "B":
 - 1. Basis of Design: InPro Corporation, "Stainless Steel Ligature Resistant Grab Bars."
 - 2. Mounting: Flanges with exposed fasteners.
 - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - 4. Configuration and Length: As indicated on Drawings.
- F. Sanitary-Napkin and Tampon Vendor "H":
 - 1. Basis of Design: Bradley 407-40, "Napkin/Tampon Vendor."
 - 2. Mounting: Fully recessed, designed for 4-inch (100-mm) wall depth.
 - 3. Capacity: 18 napkins and 28 tampons of most popular brands.
 - 4. Operation: No coin (free).
 - 5. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 6. Lockset: Tumbler type.
- G. Sanitary-Napkin Disposal Unit "I":
 - 1. Basis of Design: Bobrick TrimLine Series B-3513 "Recessed Sanitary Napkin Disposal."
 - 2. Mounting: Recessed.
 - 3. Receptacle: Removable.
 - 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- H. Mirror Unit "A":
 - 1. Basis of Design: Bobrick B-290 Series, "Glass Mirror with Stainless Steel Angle Frame."
 - 2. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick.
 - a. Corners: Welded and ground smooth.
 - 3. Size: 18 by 30 inches.
 - 4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.
- I. Anti-Ligature Towel Hook "F":
 - 1. Basis of Design: Bobrick B-9884, "Adjustable Auto-Release Clothes/Towel Hook."
 - 2. Description: Single-prong unit.
 - 3. Mounting: Exposed.
 - 4. Material and Finish: White powder-coated stainless steel.
 - 5. Operation: Auto-release hook with adjustable release between 0-25 pounds.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod "**G**":

- 1. Basis of Design: Brey Krause S-4650-SS and U-1024-36-SS, "Break-Away Shower Rod Flange System."
- 2. Description: 1-inch- (25.4-mm-) outside diameter, straight rod, 36 inch length.
- 3. Mounting Flanges: S-4650-SS Break-away shower rod flange fasteners; in manufacturer's standard material and finish.
- 4. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

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.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces according to manufacturer's written instructions.

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.
- B. Related Requirements:
 - 1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated

1.2 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at **Project site**Retain subparagraph below if additional requirements are necessary; include information about conference.
 - 1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - B. Samples: For each type of exposed finish required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of **fire extinguishers**indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- 2.3 FIRE-PROTECTION CABINET See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics.
 - A. Cabinet Type: Suitable for fire
 - B. Cabinet Construction: **Nonrated**
 - C. Cabinet Material: **Cold-rolled steel sheet**.
 - 1. Shelf: Same metal and finish as cabinet.
 - D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
 - 2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
 - E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
 - F. Cabinet Trim Material: Steel shee
 - G. Door Material: **Steel sheet**
 - H. Door Style: Fully glazed panel with frame.
 - I. Door Glazing: **Tempered**

1.

- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide manufacturer's standard.
 - 2. Provide **continuous hinge**, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:

- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fireprotection 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**
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER
 - 1) Location: Applied to **cabinet door**
 - 2) Application Process: **Pressure-sensitive vinyl letters**.
 - 3) Lettering Color: **Red**.
 - 4) Orientation: Vertical

L. Materials:

- 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: white
- 2. Shelf: Same metal and finish as cabinet.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Miter corners and grind smooth.
 - 3. Provide factory-drilled mounting holes.
 - 4. Prepare doors and frames to receive locks.
 - 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose [valves] [racks] and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where **semirecessed** cabinets will be installed.
- 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 cabinets in locations and at mounting heights indicated
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factoryfinished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, **hand-carried**fire extinguishers
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION

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

1.8 WARRANTY

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

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
 - B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each **fire-protection cabinet** indicated.
- B. Multipurpose Dry-Chemical Type in Steel Container UL-rated **10-lb (4.5-kg)**nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
 - 1. UL-rated.
- C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical

2.3

PART 3 - EXECUTION

3.1 EXAMINATION

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

SECTION 122413 - ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
 - 2. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of shadeband material.
- B. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Basis of Design: Hipac Anti-Ligature Roller Blind System using spring lift-assist mechanisms designed to operate without chains or cords.
 - 1. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated Mount Kestrel using the K558PC Top Fix Bracket to release under abnormal load at exterior windows. Face Fix Bracket at interior doors with windows.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hunter Douglas
 - 2. Mechoshade, Inc.
 - 3. SWF Contract
 - 4. Inpro, Inc.

2.2 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
- C. Basis of Design Product: Thermoveil 1300 Series
 - 1. Type: PVC-coated polyester.
 - 2. Weave: Basketweave.
 - 3. Thickness: .036-Inches.
 - 4. Weight: 21 oz./sq. yd. (g/sq. m).
 - 5. Orientation on Shadeband: Up the bolt.
 - 6. Openness Factor: 5 percent.
 - 7. Color: 0719 Silver Birch.

2.3 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Roller Shade Locations:
 - 1. All exterior windows within project scope.
 - 2. All interior doors with windows as noted on finish schedule.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 210500 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY

A. This Section specifies the basic requirements for fire protection installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.3 FIRE PROTECTION INSTALLATIONS

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not

intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

- F. Before any work is installed, determine that pipe and equipment will properly fit the space; that required piping grades can be maintained and that piping can be run as intended without interferences between systems, structural elements or work of other trades.
- G. Verify all dimensions by field measurements.
- H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- K. Install pipe and equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
- M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
- N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
- O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all equipment, opening/closing of all valves, draining/refilling all systems and operating/verifying the operation of all systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.4 COORDINATION

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, devices, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and shop drawings. Increases to contract sum or schedule shall not be considered for such effort.

- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Contractors.
- C. Existing Conditions:
 - 1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing drawings.
 - 2. Contractor shall be responsible for showing all existing conditions on the shop drawings.
 - 3. Provide proper coordination of mechanical work with existing conditions.
 - 4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - 2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cabletray.
 - 7. Domestic hot and cold water
 - 8. Hydronic piping
 - 9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 10. DDC control wiring and other low voltage systems.
 - 11. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
 - 2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.
 - 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.

- E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.
- G. Modifications required as a result of failure to resolve interferences, provide correct shop drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of shop drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Final coordinated distribution of fire protection and other systems within the ceiling cavity.
 - 2. Any system not fully detailed
 - 3. Equipment supports, hangers, anchors, and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
 - 4. Seismic restraint systems
- D. Design Limitations:
 - 1. The Contractor shall not modify the Engineers design intent in any way.
 - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
 - **3.** The Contractor shall conform to the NFPA and IFC when design and installing fire protection systems.

1.7 PROJECT CONDITIONS

- A. The Contractor shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Field verify all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.
- D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

- E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.
- F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.
- G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.
- H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.
- I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY

- A. Refer to Division 1.
- 1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:
 - A. Refer to Division 1 and conform with the State and Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Refer to Division 1.
- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, , EPA, and OSHA.
- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies as outlined and adopted by State Fire Marshal.
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 PROJECT SEISMIC REQUIREMENTS

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.12 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

1.13 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.
 - 2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
 - 3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
 - 4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.14 SUBMITTALS

A. General

- 1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
- 2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
- 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
- 4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc.

within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.

- 5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
- 6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
- 7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.
- B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.
- C. All equipment shall conform to the State and/or local Energy Conservation Standards.
- D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the State Fire Marshal and Authority having Jurisdiction and stamped by the respective Fire Marshall prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.
- E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the SUBMITTAL CHECKLIST, at the end of this section.
- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods
 - 3. Coordination of the work with other trades
 - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review.

Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.15 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

- A. Product Listing:
 - 1. Prepare listing of major I equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 - 2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
 - 3. When two or more items of same material or equipment are required (pipe, valves, sprinklers, fittings, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), wire, steel bar stock, welding rods, fasteners, and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Schedule of Values
 - 1. Provide preliminary schedule of values with product data submittal, within three (3) weeks from award of contract to successful bidder. Provide according to the following descriptions:
 - a. Site Utilities
 - b. Fire Protection

- 1) Equipment
- 2) Piping rough in
- 3) Piping finish
- 4) Testing and training
- 2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.
- C. Product Data:
 - 1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 - 2. Delete or mark-out portions of pre-printed data which are not applicable.
 - 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 - 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Piping and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.
 - h. Manufacturer's specifications.
- D. Shop Drawings:
 - 1. Shop Drawings are defined as sprinkler system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 - 2. Prepare Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- E. Test Reports:
 - 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 - 3. Submit test reports as required for O & M manuals.
- F. Operation and Maintenance Data: See separate paragraph of this specification section.
- G. Record Drawings: See separate paragraph of this specification section.

1.16 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.
- E. Coordinate deliveries of materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

1.17 DEMOLITION

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping and related items either as shown on the demolition drawings as being removed, or as required for the work. At the completion of the remodeling work or when directed by the Architect, all items demolished shall be removed from the premises.
- C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.
- D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

1.18 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and

equipment. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

- B. Refer to Division 1.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- F. Perform cutting, fitting and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work;
 - 2. Remove and replace defective work;
 - 3. Remove and replace work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed work as specified for testing;
 - 5. Install equipment and materials in existing structures;
 - 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.
- G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of piping, sprinklers, and other items made obsolete by the new work.
- H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.
 - 1. ICRA procedures must be maintained during construction.
- J. Locate identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Protect equipment and systems to remain.

1.19 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
- C. Work through all coordination before rough-in begins.

1.20 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification.
- C. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.
- D. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
- E. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.
- F. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.
- G. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.21 CLEANING

A. Refer to Division 1.

1.22 RECORD DOCUMENTS

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of devices, and similar units requiring periodic maintenance or repair; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and devices located and numbered, and with items requiring maintenance located; Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0inches from where shown on the drawings.
- D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

- E. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.
- F. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
- G. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.23 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1.
- B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- C. The testing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- D. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Description of equipment, function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 3. Manufacturer's printed operating procedures to include start-up, routine and normal operating instructions; shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
 - 4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 5. Servicing instructions, including Contractor reports.
 - 6. Manufacturer's service manuals for all equipment provided under this contract.
 - 7. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
 - 8. Complete recommended spare parts list.
 - 9. System and Equipment Warranties.
 - 10. Copies of all test reports shall be included in the manuals.
 - 11. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.

- 12. Final schedule of values with all mechanical change order costs included and identified.
- 13. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
- E. Healthcare Compliance Documentation to be compiled under a single section by Division 21, contractor.
 - 1. Authority Having Jurisdiction sign off documentation
 - 2. Sprinkler
 - a. Above ground piping system certification
 - a. Tamper and flow certification
 - b. Fire pump flow tests if included in system
 - 3. Backflow Devices
 - a. Certification report
- F. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.24 PROJECT CLOSEOUT LIST

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.25 WARRANTIES

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.26 CONSTRUCTION REQUIREMENTS

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
 - 1. Up to date record drawings.
 - 2. Submittals
 - 3. Site observation reports with current status of all action items.

- 4. Test results; including recorded values, procedures, and other findings.
- 5. Outage information.

1.27 SUBMITTAL CHECKLIST

Spec Section	Item	Requirements							
		Submittals			Supplemental		Factory	Training	Extra
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³	Rep Super- Vision At Site	Req'd At Site	Material
210500	Common Work Results for Fire Suppression	х	х	x	х	х		х	х
211000	Water Based Fire Protection	Х	х	X	Х	Х		Х	Х
Notes:	¹ For Starters and Variable Frequency Drives								
² Requires Review & Approval of calibrated balance valves from T & B Contractor									
³ See Specific Specification Section for Test & Certification Requirements									

END OF SECTION 210500

SECTION 211000 – WATER BASED FIRE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:
 - 1. Pipe, fittings, valves and specialties.
 - 2. Sprinklers and accessories.
- B. Products furnished and installed include sprinkler head cabinet with spare sprinkler heads.
- C. The work of this section includes design responsibility to be performed by a NICET Level III technical for the system being provided
- D. The fire protection system work is an extension of the existing fire protection system. Provide all modifications to the existing system as required to complete the new work. Provide hydraulic calculations and shop drawings where required by the extent of the work or by the authority having jurisdiction.

1.2 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Other definitions for fire protection systems are listed in NFPA Standards 13, 13R, 14, 20 and 24.
- C. Working plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and 14 for obtaining approval of the authority having jurisdiction.

1.3 SYSTEM DESCRIPTION

- A. Provide a complete fire sprinkler system for the entire building (including, but not limited to, electrical rooms, mechanical penthouses and accessible sections of air handling units,) except designated areas as shown on the drawings which will not require fire sprinkler coverage and will be specifically noted with "No A/S"
- B. Fire protection system is a "wet-pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.
- C. Fire protection system is a "dry-pipe" system employing automatic sprinklers attached to a piping system containing nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry-pipe valve. The water then flows into the piping system and out the opened sprinkler.

- D. Single Interlocked Preaction System: Provide UL listed Preaction system control panel. System shall be FM approved and a UL listed assembly. Provide all detectors, valves, supervisory pressure switches, auxiliary contacts, nitrogen maintenance devices, nitrogen generators, etc. for a complete installation. The single interlocked pre-action system utilizes a detector system and pressurized nitrogen in the sprinkler piping. The single interlocked preaction system with water. Water will then be discharged on the fire when the sprinklers fuse. If the sprinkler piping or sprinkler is broken, the valve will not open, but a trouble signal shall be sent to fire alarm.. If the detection system operates due to fire, damage, or malfunction, the valve will open but the water will be contained in the sprinkler piping. If the detection system does not operate, the valve will not open. The system shall be supervised. Provide manual release as required by NFPA-13. Refer to Division 26 for wiring requirements and Division 28 for Fire Alarm requirements and interfaces. Coordinate with Divisions 26 and 28 as required.
 - 1. The Preaction System shall be a UL listed assembly.
- E. Double Interlocked Preaction System: Provide UL listed Preaction system control panel. System shall be FM approved and a UL listed assembly. Provide all detectors, valves, supervisory pressure switches, auxiliary contacts, nitrogen maintenance devices, nitrogen generators, etc. for a complete installation. The double interlocked preaction system utilizes a detector system and pressurized nitrogen in the sprinkler piping. This system utilizes the deluge valve and is so arranged that the valve will open only when both: pressure is reduced in the sprinkler piping and the detection system operates. If the detection system operates due to fire, damage, or malfunction, the valve will not open. If the sprinkler piping is damaged or sprinkler is broken or fused, the valve will not open but a trouble signal shall be sent to fire alarm. The operation of both a sprinkler head and a detector is required before the valve will open allowing water to enter the system piping. The system shall be supervised. Provide manual release as required by NFPA-13. Refer to Division 26 for wiring requirements and Division 28 for Fire Alarm requirements and interfaces. Coordinate with Divisions 26 and 28 as required.
- F. Fire protection system is a "deluge" system employing open sprinklers attached to a piping system connected to a water supply through a valve that is opened by the operation of a fire detection system installed in the same areas as the sprinklers. When this valve opens water flows into the piping system and discharges from all attached sprinklers.
- G. Fire protection system is a "Class I, II or III, Standpipe and Hose" system which is an arrangement of piping, valves, hose connections and allied equipment as shown on drawings.
- H. Elevator Shafts and Machine Rooms: Sprinklers shall be installed in elevator machinery rooms, at the top of elevator shafts, and at the bottom of elevator shafts as required by AHJ and NFPA.
 - 1. Sprinkler coverage shall be designed for Hazard per NFPA. Sprinkler heads shall be temperature classification per NFPA.
 - 2. The sprinkler heads in the elevator machinery room shall be supplied from a separate, independent sprinkler branch line with a readily accessible indicating shut-off valve located outside of the shaft or machinery room as allowed by Authority having Jurisdiction.
 - 3. At least one smoke detector shall be located in the same area of each sprinkler head. Activation of any one of these detectors shall cause emergency recall (if equipped) of the elevator(s) and also put the building into alarm.
 - 4. In addition to smoke detectors, at least one thermal detector, with 190 degrees F. fixed temperature shall be installed in the same area of each sprinkler head. The circuitry for the thermal detector(s) shall be separate from the circuitry for the smoke detector(s). When any thermal detector is activated, a shunt-trip circuit breaker shall automatically

disconnect all electrical power to the elevator machinery room and the elevator machinery.

5. Refer to Division 28 for Fire Detection System (detectors, wiring, panel, etc.) for complete operation of the Fire Sprinkler System for the elevator shaft and machine room.

1.4 PROJECT SEISMIC REQUIREMENTS

- A. All fire protection systems shall be installed to meet NFPA requirements. Refer to structural drawings for seismic design requirements. Provide seismic bracing as required by NFPA.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.

1.5 SUBMITTALS

- A. Product data for each type sprinkler head, valve, piping and piping specialty, fire protection specialty, fire department connection and any equipment installed in accordance with the Contract Documents. Index per specification chapter and item number.
- B. Shop drawings prepared in accordance with NFPA 13 identified as "working plans," including detailed riser schematics indicating pipe sizes and lengths; and hydraulic calculations, which have been approved by the authority having jurisdiction. Do not proceed with the installation of the work until Authority having Jurisdiction has approved the shop drawings and the the Architect/Engineer review of shop drawings is received.
- C. Contractor shall stamp shop drawings indicating compliance with applicable codes and contract drawings. Contractor shall stamp drawing "Approved for Construction."
- D. If more than two submittals (either for shop drawings or for record drawings) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.
- E. Maintenance data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and hose valve specified, for inclusion in operating and maintenance manual specified in Division 1 and Division-21 Section "Common Work Results for Fire Protection".
- F. Welder's qualification certificate.
- G. Test reports and certificates including "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Materials and Test Certificate for Underground Piping" as described in NFPA 13.
- H. Provide hydraulic calculations and shop drawings stamped and prepared b a NICET Level III technician familiar with this type of installation. NICET technician shall be a full time employee of the sprinkler company doing the work.
- I. Fire sprinkler piping design drawings shall show all ductwork, air devices, lighting and electrical panels.
- J. Shop drawings and hydraulic calculations shall be stamped and signed by the local fire prevention authority prior to submitting shop drawings to the Architect/Engineer.

1.6 HYDRAULIC DESIGN

- A. The Fire Sprinkler System shall be hydraulically calculated by the Contractor. Pipe schedule method is acceptable only as allowed in NFPA 13 and local Fire Marshal.
- B. The wet pipe fire sprinkler system for the building shall be hydraulically calculated to comply with NFPA-13 and the following criteria:
 - 1. Light hazard occupancy for areas unless noted otherwise
 - 2. Ordinary hazard occupancy Group 1 for the following and per NFPA
 - a. Loading dock
 - b. Commercial kitchens/Food preparation areas
 - c. Storage rooms (Storage below 8 ft high)
 - d. Mechanical equipment rooms
 - e. Electrical equipment rooms
 - f. Telecomm/Technology equipment rooms
 - g. Parking Garages
 - h. Theaters and auditoriums
 - i. Laundries
 - j. Library stack areas
 - k. Radiology exam and treatment rooms, including control and equipment room
 - I. Custodial closets.
 - 3. Ordinary Hazard Group 2 for the following:
 - a. Boiler rooms
 - b. Generator rooms
 - c. Laboratories
 - d. Repair shop areas
 - e. Flammable storage rooms
 - f. Medical gas storage rooms
 - g. Stages
 - h. Electrical switchgear rooms
 - i. Wood shops
 - j. Machine shops/Metal shops
 - k. Elevator machine rooms
 - I. Storage rooms
 - 4. Hose allowance shall comply with NFPA-13.
- C. The final fire protection system demand shall be a minimum of 10 PSI below the water supply curve.
- D. Velocities in pipes shall be shown on hydraulic calculations. Velocities in overhead piping shall not exceed 32 feet per second. Velocities in underground piping shall not exceed 16 feet per second per NFPA.
- E. Allow 10 feet of loss for electric water flow switches and note on hydraulic calculations.
- F. The Fire Protection Contractor shall provide as many sets of hydraulic calculations as necessary, performed and submitted to prove that the most remote and demanding areas are calculated.

- G. Design information shall be permanently affixed to the main riser as described in NFPA-13.
- H. Water flow data for bidding purposes is to be verified by contractor from local water purveyor::
- I. The Fire Protection Contractor shall be responsible for water flow data from the appropriate water department. A copy of the water flow test data from the water department shall accompany the hydraulic calculations before hydraulically calculating equipment fire sprinkler system.
- J. The pipe and valve sizes indicated on the drawings and details are minimum sizes to be used regardless of sizes allowed by hydraulic calculations.
- K. If flexible sprinkler pipe heads are used increased pressure drop shall be included in hydraulic calculations.
- L. Atriums, as defined by the International Building Code, shall be designed as a separate zone for activation of the smoke control system.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by qualified installer. The contractor shall be licensed for the design and installation for the specific type of system in the jurisdiction where the work is to be performed and the State Fire Marshal. Upon request, submit evidence of such qualifications to the Engineer. Refer to Division-1 Section: "Definitions and Standards" for definitions for "Installers."
- B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3."
- C. Regulatory Requirements: Comply with the requirements of the following codes:
 - 1. NFPA 13 Standard for the installation of Sprinkler System, including applicable seismic requirements.
 - 2. NFPA 14 Standard for the Installation of Standpipe and Hose Systems.
 - 3. NFPA 24 Installation of Private Fire Service Mains and their applications.
 - 4. NFPA 1961 Standard for Fire Hose.
 - 5. NFPA 1963 Screw Threads and Gaskets for Fire Hose Connections.
 - 6. UL and FM Compliance: All fire protection system materials and components shall be Underwriter's Laboratories and Factory Mutual listed as well as labeled for the application anticipated.
 - 7. National Electrical Code (NEC).
 - 8. International Building Codes, including applicable seismic requirements.
 - 9. Requirements of the local Building Department and Fire Department.
- D. Reference and standards listed are minimum requirements. Where more stringent requirements are specified or noted on the drawings, those shall be applicable.

1.8 SEQUENCING AND SCHEDULING

A. Schedule rough-in installations with installations of other building components.

B. Minimum time frame for notice of inspections, tests and meetings is five (5) days and list the persons to be notified.

1.9 EXTRA STOCK

- A. Heads: For each style and temperature range (and length for dry heads) required, furnish additional sprinkler heads per NFPA-13.
 - 1. Obtain receipt from Owner that extra stock has been received.
- B. Wrenches: Furnish 2 wrenches for each type and size of valve connection and fire hose coupling.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems.
- B. All equipment used on this project shall be new and UL listed unless noted or specified otherwise.

2.2 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:
 - 1. Swing Check Valves:
 - a. Central
 - b. Mueller
 - c. Kennedy Valve
 - d. Star Sprinkler Corp.
 - e. Viking
 - f. Victaulic
 - g. Globe
 - h. Potter Roemer
 - 2. Butterfly and Ball Valves:
 - a. Grinnell
 - b. Mueller
 - c. Victaulic
 - d. Milwaukee
 - e. Kennedy

- 3. Grooved Mechanical Couplings:
 - a. Gruvlok
 - b. Victaulic Company of America
 - c. Central Sprink, Inc.
- 4. Sprinkler Heads:
 - a. Automatic Sprinkler Corp. of America.
 - b. Tyco.
 - c. ITT Grinnell
 - d. Reliable Automatic Sprinkler Co., Inc.
 - e. Star Sprinkler Corp.
 - f. Viking Corp.
 - g. Globe
- 5. Fire Protection Specialties:
 - a. Croker-Standard Div.,; Fire-End & Croker Corp.
 - b. Elkhart Brass Mfg. Co., Inc.
 - c. Grinnell Fire Protection Systems Co., Inc.
 - d. Grunau Sprinkler Mfgr. Co., Inc.
 - e. Potter Roemer, Inc.

2.3 BASIC PIPING SPECIALTIES

- A. General: Provide piping specialties complying with Section 210500, in accordance with the following listing:
 - 1. Pipe escutcheons.
 - 2. Drip pans.
 - 3. Pipe sleeves.
 - 4. Sleeve seals.
 - 5. Fire Barrier Penetration Seals.

2.4 BASIC SUPPORTS AND ANCHORS

- A. General: Provide supports and anchors complying with NFPA in accordance with the following listing:
 - 1. Hangers (which are acceptable for project) and hanger spacing shall be in accordance with NFPA-13.

2.5 PIPE AND TUBING MATERIALS (INSIDE BUILDING)

- A. General: Refer to Part 3 Article "Pipe Applications" for identification of systems where the below specified pipe and fitting materials are used.
- B. Steel Pipe: ASTM A 53, A795 or A135, Schedule 40 or Schedule 10, U.S. manufacture, black steel pipe, with antimicrobial coating, plain ends.

- C. Bull Moose "Eddy-Thread" & "Eddy Flow", Wheatland "Mega-Thread" & "Mega-Flow", Allied Tube and Conduit Corporation "Super Flo" are acceptable to Schedule 40 pipe. Installation shall be per manufacturer's recommendations.
- D. Schedule 5 pipe shall not be allowed.
- E. The Corrosion Resistance Ratio of the pipe shall be 1.00 or greater. Documentation shall be presented with product submittal.
- F. Schedule 10 pipe shall only be allowed for pipe sizes 2-1/2inches and larger.
- G. Provide galvanized, schedule 40, piping system for drain risers.

2.6 FITTINGS (INSIDE BUILDING)

- A. Cast-Iron Threaded fittings: ANSI B16.4, Class 125 standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. Install steel pipe with threaded joints and fittings for 2inches and smaller and where shown on drawings.
- C. Steel Fittings: ASTM A234, seamless or welded, for welded joints.
- D. Grooved Mechanical Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S.
- E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll- grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.
- F. Grooved Mechanical Fittings and Couplings for the entire fire protection system shall be of the same manufacturer as submitted in shop drawing equipment review.
- G. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt spot faced.
- H. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.
- I. Plain end, hooker type, or push-on fittings or couplings shall not be allowed.
- J. Bushings and reducing couplings shall not be allowed.
- K. UL listed and Factory Mutual approved segmentally welded fittings are acceptable. Friction loss and flow data shall accompany hydraulic calculations.

2.7 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Gasket Materials: Thickness, materials and type suitable for fluid or gas to be handled, and design temperatures and pressures.

2.8 GENERAL DUTY VALVES

- A. Butterfly Valves: 2-1/2inches to 12inches, grooved, ductile iron body and disc ASTM-536, disc EPDM coated, listed and approved minimum 175 psi service, actuator, self-contained supervisory switch, weatherproof approved for indoor or outdoor use.
- B. Ball Valves: 1-1/2inches and smaller shall be threaded, forged brass construction, with Teflon seats and blow out proof stem. Ball shall be full port with chrome plated ball.
- C. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast-iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

2.9 BASIC METERS AND GAUGES

- A. General: Provide meters and gauges complying with NFPA 13 appropriate for system pressures and applications.
 - 1. Pressure gauges, 0-250 psi range.

2.10 ALARM DEVICE AND FIRE PROTECTION SPECIALTIES

- A. General: Provide fire protection specialties, UL-listed, in accordance with the listing. Provide sizes and types which mate and match piping and equipment connections.
- B. Water Flow Indicators: Vane type water flow detector, rated to 250 psig; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 volts DC; complete with factory-set field-adjustable retard element to prevent false signals, tamper-proof cover which sends a signal when cover is removed, and with activation time retarding capability set at 30 seconds. The setting shall be verified through the inspectors test prior to final inspection.
- C. Supervisory Switches: Provide products recommended by manufacturer for use in service indicated. SPST, normally closed contacts, designed to signal valve in other than full open position.
- D. Pressure Switch: Indicating low pressure trouble in sprinkler system.
- E. Pressure switch: Indicating flow in sprinkler system.
- F. Low Air/Nitrogen Pressure Horn: Provide low air/nitrogen pressure horn as indicated.
- G. Electric Alarm Bell: UL, vibrating metal bell, [8] [10] inch, red enamel factory finish, suitable for outdoor use, listed and labeled per NFPA 70 marked for intended location and application.

2.11 AUTOMATIC SPRINKLERS

- A. Sprinkler Heads: Fusible link or frangible bulb type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½ inch discharge orifice, for "ordinary" temperature range with a minimum temperature of 155 degrees F. Provide "intermediate" temperature heads in Electrical rooms, where required as noted in NFPA 13, and as required by the Authority having jurisdiction.
- B. Sprinkler Head Finishes: Provide heads with the following finishes:
 - 1. Upright, Pendent and Sidewall Styles: Factory brass, rough bronze finish for heads in unfinished spaces. Heads shall be stainless steel or wax coated where installed exposed to acids, chemicals, or other corrosive fumes.
 - 2. Concealed Style: Rough brass, adjustable, with painted white cover plate in finished spaces.
 - 3. Semi-Recessed Style: Bright chrome, with bright chrome escutcheon plate.
 - 4. See drawings for additional sprinkler type requirements.
- C. Sprinkler Head Cabinet and Wrench: Finished steel cabinet, suitable for wall mounting, with hinged cover and space for spare sprinkler heads plus sprinkler head wrench. Provide amounts of each style per NFPA-13. Locate head cabinet on shop drawing submittal.
- D. Sprinkler Escutcheons:
 - 1. Ceiling Mounted: Chrome plated steel one piece flat of 2 piece with 1" adjustment
 - 2. Wall Mounted: Chrome plated steel one piece flat of 2 piece with 1" adjustment
- E. Plastic fire sprinkler escutcheons are not acceptable.
- F. Sprinkler Guards: UL 199, wire cage with fastening device for attaching to sprinkler head.
- 2.12 FLEXIBLE SPRINKLER HEAD CONNECTORS
 - A. General: UL listed, FM approved, braided corrugated annealed stainless-steel hose with support brackets and inlet/outlet nipples
 - B. Length: no longer than 48"
 - C. Flexible Tube: 304 stainless steel
 - D. Braid: 304 stainless steel
 - E. Outlet Extension Nipple (Straight): Steel (ASTM A53 A) with yellow zinc plating.
 - F. Inlet Nipple: Steel (ASTM A53 A) with yellow zinc plating
 - G. Seal: EPDM

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine rough-in for fire hose valves and cabinets to verify actual locations of piping connections prior to installing cabinets.
- B. Examine walls for suitable conditions where cabinets are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS

- A. Wet Pipe Systems
 - 1. Pipe size 2" and smaller:
 - a. Schedule 40 Black Steel with threaded joints and threaded fittings.
 - b. Schedule 10 Black Steel with roll groove end fittings for steel pipe and grooved end couplings for steel pipe
 - 2. Pipe Size 2-1/2" and larger:
 - a. Schedule 40 Black Steel with threaded joints and threaded fittings
 - b. Schedule 40 Black Steel with rolled groove ends, grooved fittings and grooved couplings for steel pipe.
 - c. Schedule 10 Black Steel with rolled groove ends, grooved fittings and grooved couplings for steel pipe.
 - 3. Schedule 40 pipe acceptable manufacturers:
 - a. Bull Moose Eddy-Thread and Eddy-Flow
 - b. Wheatland Mega-Thread and Mega-Flow
 - c. Allied Tube
 - d. Conduit Corp Super-Flo
 - e. Installation shall be in accordance with manufacturers requirements.

3.3 PIPING INSTALLATIONS

- A. Provide a minimum 5 feet-0 inches cover for all underground pipe installations. Install in accordance with AWWA C600.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.
 - 1. Deviations from approved "working plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "working plans."

- C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- D. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Welded outlet branch pipe fittings are acceptable.
- E. Install unions in pipe 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
- G. For welded pipe, all cutouts (coupons) shall be removed prior to installation.
- H. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13.
- I. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.
- J. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
- K. All piping penetrating fire walls to structure shall be sleeved and sealed per specification Section 23 05 09 "Mechanical Fire Stopping".
- L. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve.
- M. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than ¼" and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.
- N. The fire line entry valves shall have monitoring electrical switches, the wiring from which shall be carried to the fire annunciating panel.
- O. The fire protection contractor shall be responsible for the coordination of his installation with all other contractors. See Section 21 05 00 for prioritized components.
- P. Protect adjacent area where pipe cutting and threading takes place (e.g. floors, ceilings, walls, etc.).
- Q. There shall be no fire sprinkler piping in electrical rooms or IT/Technology rooms (with the exception of piping serving sprinklers directly in that room) no piping shall be installed over any electrical panels.
- R. Provide spring-loaded check valve at top of drain risers.
- S. Install pressure gauges on city and system sides of fire entry valve assembly per NFPA.
- T. Install hangers straight and true and piping parallel to building lines.

U. Do not run wet sprinkler piping through areas subject to freezing.

3.4 PIPE JOINT CONSTRUCTION

- A. Welded Joints: AWS D10.9, Level AR-3.
- B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
 - 5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- C. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings.
- D. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.5 VALVE INSTALLATIONS

A. General: Install fire protection specialty valves, fittings and specialties in accordance with the manufacturer's written instructions, NFPA 13 and the authority having jurisdiction.

3.6 SPRINKLER HEAD INSTALLATIONS

- A. Any sprinkler heads with any paint on them shall be replaced. The sprinkler system shall then be hydrostatically tested again at the contractor's expense.
- B. Sprinkler heads shall be positioned so as to comply with NFPA-13 for any obstructions. This includes, but is not limited to, soffits, surface mounted lights, large ducts, and indirect lighting arrangements. The Fire Protection Contractor is responsible for identifying these obstructions and designing the system accordingly.
- C. Run piping concealed above heated furred ceilings and in joists to minimize obstructions. Expose only heads.
- D. Protect exposed sprinkler heads against mechanical injury with standard guards. Provide sprinkler headguards in all gyms, mechanical, electrical, IT/technology, or storage rooms, and gyms, as well as exposed pendant heads which are installed less than 8 feet-0 inches A.F.F.
- E. Provide heads in "pocketed" areas caused by exposed duct, piping or beams per NFPA.
- F. Sprinkler head deflector distance from face of finished ceiling per NFPA.
- G. Sprinkler heads shall be located in the center of all 2-foot x 2 foot ceiling tiles and quarter points, along the center line lengthwise of 2 foot x 4 foot ceiling tiles.

- H. Use proper tools to prevent damage during installations.
- I. Install sprinkler piping in a manner such that mechanical equipment, ceiling tiles or lights can be accessed and easily removed. The sprinkler piping shall be installed to provide a minimum of 6 inches above the top of a finished ceiling where space allows.
- J. Minimum fire sprinkler head temperature rating for sprinklers in electrical rooms shall be 212 degrees F. Keep sprinklers as far from transformers and/or panels as spacing allows.

3.7 INSTALLATION OF BASIC IDENTIFICATION

- A. Install fire protection signs and identification on piping in accordance with NFPA 13 and NFPA 14 requirements.
- B. Install piping system labels to clearly identify all dry and preaction system piping. Follow requirements of Division 23 for label location and spacing.

3.8 INSTALLATION OF METERS AND GAUGES

A. Install meters and gauges in accordance with NFPA.

3.9 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping systems in accordance with NFPA 13, Standard for installation of sprinkler systems.
- B. The fire sprinkler system shall not be connected to underground piping until the fire service main is tested and approved.
- C. The Fire Protection Contractor shall conduct and bear the costs of all necessary tests of the fire protection work, furnish all labor, power and equipment. All piping shall be tested with water as required, the tests witnessed by the authority having jurisdiction.
- D. The fire protection piping shall be tested under a hydrostatic pressure of not less than pressure per NFPA, for a duration of not less than 2 hours.
- E. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system at Fire Protection Contractor's expense.
- F. All piping tests (pneumatic and hydrostatic) shall be conducted prior to the application of any painting materials. This will prevent hidden leaks and/or repainting of repaired/altered piping.

3.10 FINAL INSPECTION AND TESTING

- A. The Contractor shall make arrangements with the Owner and Fire Marshal for final inspection and witnessing of the final acceptance tests. The Fire Protection Contractor, the Alarm System Contractor and the Owner will conduct the final inspection and witness the final acceptance test.
- B. All tests and inspections required by the referenced Codes and Standards, and the Owner shall be performed by the Contractor.

- C. The inspecting committee as referenced above will visit the job site to inspect the work and witness the final acceptance tests when they have been advised by the Contractor that the work is completed and ready for test. If the work is not complete or the test is unsatisfactory, the Contractor shall be responsible for the Consultant's extra time and expenses for re-inspection and witnessing the re-testing of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- D. After the system has been inspected and tested, a certificate, "Contractor's Material and Test Certificate Sprinkler System - Water Spray System," shall be provided by the contractor and shall be signed by him or his representative, the Owner's representative and by a representative of the fire department. Sufficient copies shall be prepared to ensure the Engineer, Owner, all inspecting authorities and the contractor have a copy for their files. The Contractor shall prepare one (1) test report for each inspection performed whether successful or not.
- E. The signing of the certificate by the Owner's representative shall in no way prejudice any claim against the contractor for faulty material, poor workmanship, or failure to comply with inspecting authority's requirements or local ordinances.
- F. Contractor shall provide at least five (5) working days' notice for all tests.
- G. All sprinkler supervisory initiating devices shall be functionally tested to verify proper operation.
- H. All supervisory functions of each initiating device shall be functionally tested.
- I. Receipt of all alarm and trouble signals, initiated during the course of the testing, shall be verified at the fire alarm control panel.

3.11 WORK BY OTHERS

A. Wiring of all water flow switches and tamper switches on valves to central alarm panel are by Division 26. Coordinate requirements.

3.12 OPERATION AND MAINTENANCE MANUAL

- A. The Contractor shall provide the Owner with a loose-leaf manual containing:
 - 1. A detailed description of the systems.
 - 2. A detailed description of routine maintenance required or recommended or which would be provided under a maintenance contract including a maintenance schedule and detailed maintenance instructions for each type of device installed.
 - 3. One copy of NFPA-25.
 - 4. Manufacturers' data sheets and installation manuals/instructions for all equipment installed.
 - 5. A list of recommended spare parts.
 - 6. Service directory, listing the specific equipment items and where parts can be obtained, with name, address and telephone number.
 - 7. Set of the record drawings (PDF format).
 - 8. Hydraulic calculations
 - 9. Test certificates.
- B. Refer to Division 1 and Section 21 05 00 for additional requirements.

C. Within 15 days of the completion of the work, six (6) copies of the manual shall be submitted for approval.

3.13 RECORD DRAWINGS

- A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the sprinkler system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved by the Owner without written instruction from the Owner in each case. This set of drawings shall be used only as a record set.
- B. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings reflecting any and all changes and deviations made to the sprinkler system.
- C. The Owner, at his option and at the Contractor's expense, may require revised hydraulic calculations depending on the extent and nature of field changes.
- D. The Record Drawings and Hydraulic Calculations shall have the signed stamp of the individual who prepared the design certifying the Record Drawings and the Hydraulic Calculations accurately represent the completed fire protection system.
- E. Upon completion of the work, PDFs of the record drawings shall be submitted to the Architect/Engineer and Owner for review. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.

3.14 GUARANTEE PERIOD

- A. Guarantee: The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by him (or his subcontractors) or by defects in his (or his subcontractors') work, materials, or equipment.
- B. Emergency Service: During the installation and warranty period, the Contractor shall provide emergency repair service for the sprinkler system within four hours of a request by the Owner for such service. This service shall be provided on a 24 hour per day, seven days per week basis.

END OF SECTION 211000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:

- 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
- 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Comply with Division 1 and requirements specified herein.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 PLUMBING INSTALLATIONS:

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the plumbing work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.
- F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.
- G. Verify all dimensions by field measurements.
- H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- K. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
- M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset and install system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
- N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
- O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all plumbing equipment, opening/closing of all valves, draining/refilling all plumbing systems and operating/verifying the operation of all plumbing systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.8 COORDINATION

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.
- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21 and 23 Contractors.
 - 2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.
 - 3. Furnish building equipment (elevator, food service, medical, technology, etc) information to Div 21, 22, and 23 contractors.
- C. Existing Conditions
 - 1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing coordination.
 - 2. Contractor shall be responsible for showing all existing conditions on coordination drawings.
 - 3. Provide proper coordination of mechanical work with existing conditions.
 - 4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.9 COORDINATION WITH OTHER DIVISIONS

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cabletray.
 - 7. Domestic hot and cold water
 - 8. Hydronic piping
 - 9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 10. DDC control wiring and other low voltage systems.
 - 11. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
 - 2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.

- 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.
- G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.10 DESIGN WORK REQUIRED BY CONTRACTOR

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
 - 2. Any system not fully detailed
 - 3. Fire protection systems
 - 4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
 - 5. Temperature controls systems
 - 6. Seismic restraint systems
- D. Design Limitations:
 - 1. The Contractor shall not modify the Engineers design intent in any way.
 - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
 - 3. Back-to-back 90° fittings on piping system shall not be installed under any circumstance.
 - 4. Bull nosed tees on piping systems shall not be installed under any circumstance.

1.11 PROJECT CONDITIONS

- A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Field verify all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.
- D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.
- E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.
- F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.
- G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.
- H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.
- I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.12 REQUIREMENTS OF REGULATORY AGENCIES

- A. Refer to Division 1.
- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.
- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies.
 - 1. Refer to the project code declaration sheet.
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. The handling, removal and disposal of regulated refrigerants and other materials shall be in accordance with U.S. EPA, state and local regulations.

- F. The handling, removal and disposal of lead-based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State or Local regulations.
- G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.13 PERMITS AND FEES

- A. Refer to Division 1.
- B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner IN WRITING.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.14 PROJECT SEISMIC REQUIREMENTS

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.
- C. Refer to structural drawings for Seismic Design conditions

1.15 TEMPORARY FACILITIES

- A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
- B. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. Steam and hydronic systems shall be flushed and chemically treated. Ductwork and air moving equipment shall be cleaned to an "AS New" condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1.16 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and Division 1.

- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
 - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
 - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.
- D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.
 - 2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
 - 3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
 - 4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.17 SUBMITTALS

- A. General
 - 1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
 - 2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
 - 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
 - 4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
 - 5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.

- 6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
- 7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.
- B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.
- C. All equipment shall conform to the State and/or local Energy Conservation Standards.
- D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.
- E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.
- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods
 - 3. Coordination of the work with other trades
 - 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.18 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

- A. Product Listing:
 - 1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 - 2. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Product Data:
 - 1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 - 2. Delete or mark-out portions of pre-printed data which are not applicable.
 - 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 - 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.

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- c. Speeds.
- d. Capacities.
- e. Piping and electrical connection sizes and locations.
- f. Statements of compliance with the required standards and regulations.
- g. Performance data.
- h. Manufacturer's specifications.
- C. Shop Drawings:
 - 1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 - 2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- D. Test Reports:
 - 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 - 3. Submit test reports as required for O & M manuals.
- E. Operation and Maintenance Data: See separate paragraph of this specification section.
- F. Record Drawings: See separate paragraph of this specification section.

1.19 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture. Refer to Division 1 for insurance requirements for offsite storage.
- E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic endcaps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain endcaps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

- G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.20 DEMOLITION

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.
 - 1. Return all demolished control valves and devices to the Owner.
 - 2. Return existing plumbing fixtures to the Owner.
 - 3. Return existing medical gas outlets to the Owner.
- C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.
- D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of the work, Contractor shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.
- E. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim and other mechanical items made obsolete by the new work.
- F. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- G. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.
 - 1. ICRA procedures must be maintained during construction.
- H. Locate, identify and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Cover openings in piping to remain. Protect equipment and systems to remain.

1.21 CUTTING AND PATCHING

- A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials.
- B. Refer to Division 1.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of plumbing installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- F. Perform cutting, fitting and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work;
 - 2. Remove and replace defective work;
 - 3. Remove and replace work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed work as specified for testing;
 - 5. Install equipment and materials in existing structures;
 - 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.

1.22 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
- C. Work through all coordination before rough-in begins.

1.23 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 8 for access door specification and Division 23 for duct access door requirements.
- C. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

- D. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
- E. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.
- F. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.
- G. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, sensors, motors, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.24 EXCAVATING AND BACKFILLING

- A. General:
 - 1. Provide all necessary excavation and backfill for installation of mechanical work in accordance with Division 2.
 - 2. In general, follow all regulations of OSHA as specified in "Excavations, Trenching and Shoring." Follow specifications of Division 23 as they refer specifically to the mechanical work.
- B. Contact Owners of all underground utilities to have them located and marked, at least 2 business days before excavation is to begin. Also, prior to starting excavation brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.
- C. Pipe Trenching:
 - 1. Provide all necessary pumping, cribbing and shoring.
 - 2. Walls of all trenches shall be a minimum of 6 inches clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6 inches clearance between them when located in same trench.
 - 3. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6inches below the level of the bottom of the pipe to be installed. Install 6 inches bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.
- D. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the soils engineer. In no case shall lumber, metal or other debris be buried in with backfill.
 - 1. Provide detectable warning tape for marking and locating underground utilities. Tape shall be specifically manufactured for this purpose and shall be polyethylene film, 6 inches wide, 0.004 inches thick and have a minimum strength of 1750 psi. Tape shall carry continuous inscription naming the specific utility.
 - a. Tape shall have magnetic strip and be used for exterior underground system only.

- E. Trench Backfill:
 - 1. Backfill to 12 inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
 - 2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6-inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is not permissible.
- F. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this contractor's expense.
- G. This contractor shall repair and pay for any damage to finished surfaces.
- H. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6 inch lifts and mechanically tamping to achieve 95 percent compaction.
- I. Use suitable excavated material to complete the backfill, installed in 6 inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper, 30 inches below paving and slabs and 90 percent elsewhere.

1.25 NAMEPLATE DATA

A. Provide permanent operational data nameplate, refer to the section on Plumbing Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.26 CLEANING

A. Refer to Division 1.

1.27 RECORD DOCUMENTS

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, cleanouts, valves, and other control devices, strainers, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., strainers, expansion compensators, tanks, etc.); Change Orders; concealed system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1foot-0 inches from where shown on the drawings.

NOTE: REFERENCES TO RFIS, PRs, CHANGE ORDERS, ETC., WILL NOT BE ACCEPTED AS ASBUILT CONDITIONS.

- D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
- E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.
- F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.
- G. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed
- H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.28 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1.
- B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- D. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Description of equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
 - 4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
 - 6. Manufacturer's service manuals for all equipment provided under this contract.

- 7. Include the valve tag list.
- 8. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
- 9. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
- 10. Complete recommended spare parts list.
- 11. Mechanical System and Equipment Warranties.
- 12. Copies of all test reports shall be included in the manuals.
- 13. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
- 14. Final schedule of values with all mechanical change order costs included and identified.
- 15. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
- 16. Backflow preventor test certification.

1.29 PROJECT CLOSEOUT LIST

- A. In addition to the requirements specified in Division 1, complete the requirements listed below.
- B. The Contractor shall be responsible for the following Plumbing Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.30 WARRANTIES

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire plumbing system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 21, 22, and 23, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference or include the Operating and Maintenance Manuals.
- C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.31 CONSTRUCTION REQUIREMENTS

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
 - 1. Up to date record drawings.
 - 2. Submittals
 - 3. Site observation reports with current status of all action items.
 - 4. Test results; including recorded values, procedures, and other findings.
 - 5. Outage information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

- 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
- 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
- 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
- 4. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

- A. Description: 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: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070kPa) minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ringtype neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.

- d. Pipeline Seal and Insulator, Inc.
- 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic Carbon steel or Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: 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. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, steel chrome plated spring clip fasteners, box-shaped brass with polished chrome-plated finish.
- D. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated, Rough brass or Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel or stainless steel type and set screw.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel or stainless steel type with concealed hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping in Equipment Rooms: One-piece, stamped-steel or stainless steel type with set screw or spring clips.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

- 2. Existing Piping: Use 2-piece hinged chrome plated steel escutcheons.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Rated Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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.
- F. 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 ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Non-Pressure PVC Joints: Clean and dry joints and surfaces. Make joints complying with ASTM F402 Safe Practices for Cleaners, Primers, and Cements. Join PVC in accordance with ASTM D2855 and D2665. Remove burrs and cuttings prior to joint pipe and fittings
- I. Hubless Cast Iron: Join in accordance with CISPI Handbook for Cast Iron Soil Pipe and Fittings and CISPI 310.
- J. Hub and Spigot Cast Iron: Join gasketed joints in accordance with CISPI Cast Iron Soil Pipe and Fittings Handbook
- K. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

MECHANICAL SUBMITTAL CHECKLIST

Spec Section	ltem	Requirements							
		Submittals			Supplemental		Factory	Training	Extra
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³	Rep Super- Vision At Site	Req'd At Site	Material
220500	Common Work Results For Plumbing			Х					
220500	O&M Manuals		Х	х		х			Х
220500	Record Drawings	х	х	х					

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	Item	Requirements							
Spec Section		Submittals			Supplemental		Factory	Training	Extra
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³	Rep Super- Vision At Site	Req'd At Site	Material
220523	General duty Valves for Plumbing		Х	Х					
220529	Hangers & Supports for Plumbing & Piping Equipment		Х	х					
220553	Identification for Plumbing		Х	Х					
220700	Plumbing Insulation		Х	Х					
221116	Domestic Water Piping		Х	Х					
221119	Domestic Water Piping Specialties		Х	Х					
221316	Sanitary Waste and Vent Piping		Х	Х					
221319	Sanitary Waste Piping Specialties		Х	Х	Х	Х			
224000	Plumbing Fixtures		Х	Х					Х
Notes:	 ¹ For Starters and Variable Frequency Drives ² Requires Review & Approval of calibrated balance valves from T & B Contractor ³ See Specific Specification Section for Test & Certification Requirements 								

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Bronze ball valves.
 - 2. Bronze swing check valves.

B. Related Sections

- 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 2.
- 3. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
- 4. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

- 2. ASME B31.1 for power piping valves.
- 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use levers or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bronze Ball and Check Valves:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.
 - c. Hammond Valve.
 - d. Lance Valves.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.

2.2 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:

- 1. Hand Lever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig
 - c. CWP Rating: 200 psig
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded **OR** solder joint.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Chrome plated brass
 - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

- A. Class 125, Lead-Free Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig
 - c. Body Design: Horizontal or vertical upwards flow.
 - d. Body Material: ASTM B 584-C8936, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.5 DRAIN VALVES

A. For Plumbing Systems: Provide ball valve with threaded hose end and cap with chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Use the following valves for series indicated
 - 1. Plumbing Water Services: 3" and smaller: Ball Valve
 - 2. Plumbing Water Services; 2-1/2" and larger: Butterfly valve or Ball Valve
 - 3. Plumbing Bypass; all sizes: Globe Valve
 - 4. Plumbing Balancing: Calibrated Balancing Valve
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 125 or Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron or Bronze Ball Valves: Class 150.
 - 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze or stainless-steel disc.
 - 4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 - 5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring or weight.
 - 6. Iron, Center-Guided Check Valves: Class 125 or Class 150, globe or resilient seat.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Fastener systems.
- B. Related Sections:
 - 1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.
- C. Refer to individual piping sections for hanger spacing requirements.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment .

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing

Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
- C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
- D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 22.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
 - 2. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system and NFPA Standard No. 14 when used as a component of a standpipe system, NFPA 99 shall be used for medical gas systems.
 - UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Hangers, supports, and components shall be listed and labeled by a NRTL where used for fire protection piping systems. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 4. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.
- C. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."

D. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports:
 - a. ANVIL International
 - b. B-Line Systems Inc.
 - c. Erico
 - d. Grinnell
 - e. Hubbard Enterprises (Supports for domestic water piping)
 - f. PHD Manufacturing, Inc.
 - g. Specialty Products Co. (Supports for domestic water piping).
 - h. Unistrut Metal Framing Systems
 - i.
 - 2. Shield and Thermal Shield Inserts:
 - a. ANVIL International
 - b. B-Line
 - c. Erico
 - d. Grinnell
 - e. Pipe Shields, Inc.
 - f. Snapp Itz
 - g. Value Engineered Products, Inc.
 - h.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. General: Provide factory- fabricated hangers and supports complying with MSS SP-69, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select hangers and supports to suit pipe size and loading.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
- D. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.
- 3.3 HANGER AND SUPPORT INSTALLATION
 - A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
 - B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
 - C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
 - D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
 - E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder driven fasteners subject to approval of Architect and Structural Engineer. Each fastener shall be capable of holding a test load of 1000 pounds whereas the actual load shall not exceed 50 pounds.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic 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 and within 1'-0" of each horizontal elbow.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Existing Construction:
 - 1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Support fire-water piping independently from other piping systems.
- O. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers without isolation are not acceptable.
- P. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.
- Q. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.
- R. Where practical, support riser piping independently of connected horizontal piping.
- S. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.
- T. Securely anchor and support plumbing domestic water piping in chases or walls using pipe positioning system. Use factory manufactured clamps and brackets connected to fixtures, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.
 - 1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture, not by clamping to waste/vent piping.
 - 2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material. Duct tape shall not be used.

- U. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:
 - 1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.
 - 2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
 - 3. Hangers for piping shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
 - 4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.
- V. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - 2. Install MSS SP-58, Type 40, protective shields on all insulated piping 2 inches and less (except where required to be clamped). Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used.
 - b. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "zip strips".

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizingrepair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use thermal-hanger shield inserts for insulated piping and tubing.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types: Note: provide rubber protection spacers between clamps and bare piping on piping where type 24, 26 and 59 clamps are used, oversize rubber spacer on multiple pipe hangers for compensating movement.
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, where off-center closure for hanger installation before pipe erection is required.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. Adjustable Band Hangers (MSS Type 9): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
 - 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of insulated, stationary pipes NPS 1/2 to NPS 8.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb
 - b. Medium (MSS Type 32): 1500 lb
 - c. Heavy (MSS Type 33): 3000 lb
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
- J. Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use hangers which are vertically adjustable 1-1/2-inch minimum after piping is erected.
- N. Install piping with minimum rod sizes and maximum spacing as specified in individual sections and per plumbing code.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Codes and Standards:
 - 1. Existing Building Standards: Comply with the existing lettering size, length of color field, colors and identification method as presently exists in the existing building unless otherwise indicated.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe labels.
 - 2. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Pipe Labels
 - a. Actioncraft Products, Inc.
 - b. Brady Corporation.

- c. Brimar Industries, Inc.
- d. Carlton Industries, LP.
- e. Champion America.
- f. Craftmark Pipe Markers.
- g. emedco.
- h. Kolbi Pipe Marker Co.
- i. LEM Products Inc.
- j. Marking Services, Inc.
- k. Seton Identification Products.
- 2. Valve Tags
 - a. Actioncraft Products, Inc.
 - b. Brady Corporation.
 - c. Brimar Industries, Inc.
 - d. Carlton Industries, LP.
 - e. Champion America.
 - f. Craftmark Pipe Markers.
 - g. emedco.
 - h. Kolbi Pipe Marker Co.
 - i. LEM Products Inc.
 - j. Marking Services, Inc.
 - k. Seton Identification Products.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction. Furnish 1-inch-thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. or greater. Cut length to extend 2inches beyond each end of plastic pipe marker. Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length if there is an existing system.
- B. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2inch.
 - 3. Self-adhesive backing.
- C. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Steel spring or non-metallic fasteners.
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2inches wide; full circle at both ends of pipe marker, tape lapped 3inches.
 - 3. Strapped-to-pipe (or insulation) application of semi- rigid type, with manufacturer's standard stainless-steel bands.
 - 4. Self-Adhesive backing.

- D. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system, if remodel, and abbreviate only as necessary for each application length.
- E. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated comply with ANSI A13.1 for colors or to match existing building standard identification.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers (3/16" letters and 3/8" numbers for plastic) tag to be 1.5" for brass or laminate and 1.125" for plastic.
 - 1. Tag Material: 19 ga. brass, 3/32" laminate manufacturer's standard plastic, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
 - 3. Color: Fill engraving with black enamel for brass. For plastic and laminate, provide size, shape, and color combination as specified or scheduled for each system.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 15 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule: Per ANSI
- D. Match color and system.

3.4 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground- type plastic line marker with metal detector strip, located directly over buried line at 6 inches to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For large fields and similar installations, mark edge pipelines of field.

3.5 VALVE-TAG INSTALLATION

- A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.
 - 1. Building services main shut-off valves
 - 2. Each individual system main shut-off valves
 - 3. Each individual system riser shut-off valves
 - 4. Each individual system floor shut-off valves
 - 5. Each individual system major branch shut-off valves
- B. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.
- C. Where more than one major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.
- D. Valve-Tag Application Schedule: Provide valve tags on all plumbing systems, size, shape and color scheme per ANSI. Refer to Part 2 for size and shape.

- Valve-Tag Size and Shape: Per ANSI Valve-Tag Colors: Per ANSI Letter Colors: Per ANSI 1.
- 2.
- 3.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

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. Insulation Materials:
 - a. Calcium silicate.
 - b. Fiberglass/ Mineral fiber
 - c. Flexible elastomeric
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
- B. Related Sections include the following:
 - 1. Division 22 Section "Hangers and Supports for Plumbing and Piping Equipment"
 - 2. Division 23 Section "HVAC Insulation."

C. Definitions

- 1. ASJ: All Surface Jacket.
- 2. FSK: Foil Scrim Kraft.
- 3. MRT: Mean Temperature Rating.
- 4. NRTL: Nationally Recognized Testing Laboratory
- 5. PCF: Pounds per Cubic Foot.
- 6. PSF: Pounds per Square Foot.
- 7. SSL: Self-sealing Lap
- D. Codes and Standards:
 - 1. International Energy Conservation Code, currently adopted version.
 - 2. ASHRAE 90.1, latest edition.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, fire hazard indexes and maximum use temperature.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing if any.

1.7 SCHEDULING

- 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. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 - 1. Mechanical Insulation:
 - a. Aeroflex.
 - b. Armacell
 - c. CertainTeed
 - d. Einsulation
 - e. Johns Manville Corp.
 - f. Knauf Fiber Glass
 - g. Manson
 - h. Owens-Corning Fiberglas Corp.
 - i. Pittsburgh Corning Corp.
 - j. PABCO, Inc.
 - k. Rubatex Corp.
 - I. Thermal Structures
 - 2. Jacketing & Covering Products:
 - a. Alpha Associates, Inc.
 - b. Ceel-Co
 - c. Childers
 - d. Polyguard
 - e. Venture Tape
 - f. Zeston
 - 3. Adhesives, Mastics, Sealants:
 - a. Childers Products, Fimasco Corporation
 - b. Foster Products Corporation, H.B. Fuller Company
 - c. ITW TACC, Division of Illinois Tool Works
 - d. Marathon Industries, Inc.
 - e. Mon-Eco Industries, Inc.
 - 4. Tapes :
 - a. Avery Dennison Corporation, Specialty Tapes Division
 - b. Compac Corp.
 - c. Ideal Tape Co., Inc. An American Bilrite Company
 - d. Venture Tape

- 5. Field Applied Cloths :
 - a. Alpha Associates, Inc.
- 6. Field Applied Jackets :
 - a. Childers Products
 - b. Johns Mansville
 - c. PABCO Metals Corporation
 - d. P.I.C. Plastics, Inc.
 - e. Proto PVC Corporation
 - f. RPR Products, Inc.
 - g. Speedline Corporation
- 7. Securement :
 - a. C&F Wire
 - b. Childers Products
 - c. PABCO Metals Corporation
 - d. RPR Products, Inc.

2.2 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint. "K" factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.
- F. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2. Permeability of 0.00 perm. Preformed pipe insulation with factory-applied all-service jacket with self-sealing lap. "K" factor shall be maximum 0.28 at 50°F MRT, 0.29 at 75°F MRT, 0.31 at 100°F MRT, 0.38 at 200°F MRT and 0.45 at 300°F MRT.
- G. Flexible Elastomeric, Closed Cell Piping Insulation: ASTM C 534. Water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slit to be slipped over piping as a single piece. "K" factor shall be maximum 0.245 at 50°F MRT, 0.25 at 75°F MRT and 0.26 at 90°F MRT.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 4. Color: Aluminum.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 4. Color: White.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches
 - 2. Thickness: 11.5 mils
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

- A. Bands:
 - 1. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 - 2. Stainless: ASTM A 167 or A240/A 240M. type 305 or 315, 0.015 inches thick, 3/4" wide with wing or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. All systems shall be insulated in accordance with the locally adopted energy codes or requirements of this specification section, whichever is more stringent.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- C. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.
- D. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- F. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- G. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

- H. 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.
- I. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- J. Install multiple layers of insulation with longitudinal and end seams staggered.
- K. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- L. Keep insulation materials dry during application and finishing.
- M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- N. Install insulation with least number of joints practical.
- O. Maintain integrity of vapor barrier jackets on cold pipe insulation and protect to prevent puncture or other damage.
 - 1. Do not use staples or tacks on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
 - 3. Seal fitting covers with PVC tape.
 - 4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identity item covered.
- P. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. 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.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- Q. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- R. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.

- 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- S. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- T. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- U. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- V. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Non-Fire Rated Interior Wall and Partition Penetrations: Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Divisions 07 and 22 for Firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Divisions 07 and 22.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. General: 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 on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.
- C. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- D. 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 vaporbarrier 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.
 - For services not specified to receive a field-applied jacket except for flexible elastomeric, 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.
- E. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels,

and equipment. 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.

- F. 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 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 (50 mm) 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.

3.6 CELLULAR GLASS INSULATION

- A. Apply in a single layer. Secure to pipe with 1/2-inch-wide aluminum bands.
- B. For all applications, apply all-purpose Kraft paper/aluminum foil/vinyl coating ASJ jacket. Seal all lap and butt joints with self-seal vapor barrier tape.

3.7 CALCIUM SILICATE INSULATION

- A. Apply in a single layer. Secure to pipe with 1/2-inch-wide aluminum bands.
- B. For indoor applications, provide canvas jacketing. Adhere joints of jacketing and provide a finish coat of sealant as recommended by the manufacturer.

3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

- B. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- C. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping unless noted otherwise
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. All Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water (140°F and lower):
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation with ASJ-SSL Jacket: 1-1/2 inch thick.

3.12 EXISTING INSULATION REPAIR

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.
- B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- C. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.
- B. Related Requirements:
 - 1. Site/Civil documents for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: Submit industry standard and manufacturers technical product data, installation instructions, and dimensional drawings for each type of pipe and fittings. Submit schedule showing pipe or tube weight, fittings and joint type for each piping system.

1.4 INFORMATIONAL SUBMITTALS

- A. Refer to Division 1, Section 220500 "Common Work Results for Plumbing", and Basic Requirements for administrative and procedural requirements for submittals
- B. Certification of Compliance with ASME, NSP-61 and UL fabrication requirements.
- C. Welding Certifications: Submit reports as required for piping work
- D. Brazing Certifications: Submit reports a required for piping work.
- E. Test reports as specified in Part 3 of this section
- F. Manufacturer and product data for lead free solder with material breakdown.
- G. System purging and disinfecting activities report.
- H. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Construction Manager's written permission.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. Currently adopted local plumbing code
 - 2. NSF Standard 61: "Drinking Water System Components"
 - 3. ASME B 31.9 "Building Services Piping" for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 4. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for Qualifications for Welding Processes and Operators
 - 5. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of water distribution systems.
 - 6. Local utility Department requirements
 - 7. Local Cross Connection Control Manual
 - 8. Local Engineering Standards
- B. Manufacturers Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Each manufacturer or contractor shall be responsible for the quality of soldering and brazing done by their organization and shall repair or replace any work not in accordance with these specifications.
- D. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

1.7 DELIVER, STORAGE AND HANDLING

- A. Store pipe in manner to prevent sagging and bending
- B. Cap ends of piping when being stored.
- C. Store all materials per manufacturer's recommendations

1.8 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad, minimum of 6" from edges. Concrete, reinforcement and formwork requirements are specified in Division 3.

B. Coordinate the installation of pipe sleeves for foundation wall and floor penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Plastic to Metal Transition Fittings:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - d. Uponor.

2. Dielectric Unions

- a. A.Y. McDonald Mfg. Co.
- b. Capitol Manufacturing Company.
- c. Central Plastics Company.
- d. HART Industrial Unions, LLC.
- e. Jomar Valve.
- f. Matco-Norca.
- g. Watts; a Watts Water Technologies company.
- h. Wilkins.
- i. Zurn Industries, LLC.
- 3. Dielectric Flanges
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a Watts Water Technologies company.
 - e. Wilkins.
 - f. Zurn Industries, LLC.
- 4. Dielectric Flange Insulating Kits
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
- 5. Dielectric Nipples
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.

2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- 2.3 COPPER TUBE AND FITTINGS
 - A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) and ASTM B 88, Type K (ASTM B 88M, Type A) water tube, drawn temper.
 - B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - E. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for generalduty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: tube.
- C. Color: natural.

2.6 TRANSITION FITTINGS

A. General Requirements:

- 1. Same size as pipes to be joined.
- 2. Pressure rating at least equal to pipes to be joined.
- 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 175 psig (1200 kPa).
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig (1035 kPa).
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F 1545.
 - 3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Civil documents and Section 220500 for excavating, trenching, and backfilling. At minimum, provide 6" sand bed prior to backfill with native soil.

3.2 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design and the applicable referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install drains in pressure pipe systems at al low points in mains and risers consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded end nipple and cap with chain.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Section 220509 for materials.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500.
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500.

3.4 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 pipes, tubes, and fittings before assembly.
- C. 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 ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis or band hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

- 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
- 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
- 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
- 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- 6. NPS 6: 10 feet with 5/8-inch rod.
- 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
- E. Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code. For fixtures with hot water service, extend hot water recirculation line out to fixtures greater than 20' away from main or loop hot water line down to the fixture.
- F. Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection, provide drain valve on drain connection. Provide backflow preventor as shown as required. For connections 2-1/2" and larger, use flanges instead of unions.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

- 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of watersample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 6 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solderjoint fittings; and soldered joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

- 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
- 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
- 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
- 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
 - 2. Balancing valves.
 - 3. Temperature-actuated, water mixing valves.
 - 4. Strainers.
 - 5. Outlet boxes.
 - 6.
 - 7. Drain valves.
 - 8. Water-hammer arresters.
 - 9. Air vents.
 - 10. Flexible connectors.
- B. Related Requirements:
 - 1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Drain Valves
 - a. Crane
 - b. Milwaukee
 - c. NIBCO
 - d. Apollo
 - e. Hammond
 - f. Watts Regulator
 - 2. Strainers
 - a. Crane
 - b. Milwaukee
 - c. NIBCO
 - d. Apollo
 - e. Hammond
 - f. Lance
 - g. Watts Regulator
 - 3. Vacuum Breakers
 - a. Woodford Manufacturing Co
 - b. Apollo
 - c. Nidel
 - d. Watts
 - 4. Balancing Valves
 - a. Armstrong
 - b. Bell & Gossett
 - c. NIBCO
 - d. TACO
 - e. Watts
 - f. Apollo
 - g. Therm-Omega-Tech Circuit Solver
 - 5. Thermostatic Mixing Valves
 - a. Leonard
 - b. Bradley
 - c. Symmons

- d. Powers
- e. Armstrong
- f. Lawler
- g. Zurn
- 6. Flexible Connectors
 - a. MetraFlex
 - b. Hyspan
 - c. Wheatley
- 7. Water Hammer Arrestors
 - a. Precision Plumbing Products
 - b. Sioux Chief

2.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.4 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Standard: ASSE 1001.
 - 2. Size: NPS 1/4 to NPS 3 as required to match connected piping.
 - 3. Body: Lead Free Bronze, spill resistant design suitable for indoor or outdoor installation, with vent seal diaphragm designed to seal air vent prior to opening the check valve. Suitable for use with downstream valves. Provided wit ball valve shutoffs and test cocks.
 - 4. Inlet and Outlet Connections: Threaded.
 - 5. Finish: Chrome plated.

2.5 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 - 2. Body: //Brass or bronze.
 - 3. Size: Same as connected piping, but not larger than NPS 2
- B. Cast-Iron Calibrated Balancing Valves:
 - 1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 - 2. Size: Same as connected piping, but not smaller than NPS 2-1/2

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

- 1. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
- 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 3. Body: Bronze body with corrosion-resistant interior components.
- 4. Temperature Control: Adjustable.
- 5. Inlets and Outlet: Threaded.
- 6. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
 - 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 - 5. Drain: Pipe blowdown valve with cap plug on 2-1/2 and larger.

2.8 OUTLET BOXES

- A. Clothes Washer Outlet Boxes:
 - 1. Mounting: Recessed.
 - 2. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
 - 3. Faucet: Separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 - 4. Supply Shutoff Fittings: Quarter turn NPS 1/2 ball valves and NPS 1/2 copper, water tubing, integral shock arrestors.
 - 5. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

2.9 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 3/4
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.
 - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. Standard: ASSE 1010.
- 2. Type: Metal bellows or Copper tube with piston and EPDM O-rings.
- 3. Size: ASSE 1010, Sizes AA and A through F.

2.11 FLEXIBLE CONNECTORS/SEISMIC FLEX JOINTS

- A. Flexible Hose Connectors
 - 1. Provide flexible hose expansion loop(s) as indicated on the contract drawings or as required to accommodate any thermal expansion, contraction or seismic movement of the piping systems.
 - 2. Flexible hose expansion loops shall be manufactured complete with two parallel sections of corrugated metal house, compatible braid, 180 deg return bend, with inlet and outlet connections. Field fabricated loops shall not be acceptable.
 - 3. Flexible loops shall be capable of movement in the $\pm X$, $\pm Y$ and $\pm Z$ planes.
 - 4. Flexible hose expansion loops shall impart no thrust loads to system support, anchors or building structure.
 - 5. For flammable liquid or gas service up to 4", flexible expansion loops shall be CSA/AGA certified.
 - 6. All flexible hose expansion loops shall be manufactured in accordance with the documented manufacturers weld procedure specifications. The procedure qualification record shall be used to document the execution of this procedure and shall follow the general "guidelines" of ASME Section IX. Each individual welder shall conform to the inhouse procedure qualification record and be qualified prior to each production lot. The testing of each individual welder shall be documented in a welding procedure qualification record.
 - 7. Corrugated Hose
 - a. Stainless Steel
 - 1) B.1.1 Type 304
 - 2) B.1.2 Type 321
 - 3) B.1.3 Type 316
 - 8. Braid
 - a. C.1 304 Stainless steel braid shall be used for any series 300 stainless steel hose.
 - b. C.2 Bronze braid shall be used for any bronze hose
 - 9. Fittings materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.
 - 10. Flexible hose expansion loops shall have a factory-supplied, hanger/support lug located at the bottom of the 180 deg return.
 - 11. Flexible hose expansion loop(s) shall be furnished with a plugged FPT to be used for a drain or air release vent.

Loop Size	FPT Size
1"-6"	3/8"
8" & larger	1/2"

12. The operating pressure shall be based on burst pressure with a 4 to 1 safety factor.

2.12 AIR VENTS

- A. Bolted Construction Automatic Air Vents:
 - 1. Body: Bronze
 - 2. Pressure Rating and Temperature: 125 psig minimum pressure rating at 140°F
 - 3. Float: Replaceable, corrosion resistant metal
 - 4. Mechanism and Seat: Stainless Steel
 - 5. Size: NPS 3/8
 - 6. Inlet and Vent Outlet End Connections: Threaded
- B. Welded Construction Automatic Air Vents.
 - 1. Body: Stainless steel
 - 2. Pressure Rating: 150 psig minimum pressure rating
 - 3. Float: Replaceable, corrosion resistant metal
 - 4. Mechanism and Seat: Stainless Steel
 - 5. Size: NPS 3/8 minimum inlet
 - 6. Inlet and Vent Outlet End Connections: Threaded

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with union inlet and union outlet shutoff valves and bypass with memorystop balancing valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve and thermometer (2" diameter minimum) on outlet.
 - 1. Install cabinet-type units surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.
- F. Install wall hydrants in wall with barrel length to prevent freezing. Secure in wall.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install wall reinforcement between studs.

- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install cabinet-type units surface mounted on wall as specified.
- I. Install supply-type, trap-seal primer valves only when approved by Engineer, with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- J. Install drainage-type, trap-seal primer valves only when approved by Engineer, as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- K. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, autoclaves, pre-rinse spray hose, etc. Install in accessible location. Refer to detail on drawings. Provide access doors in accordance with architectural recommendations if an isolation valve is installed.
- L. Tailpiece trap primers: Pipe with 3/8" chrome plated brass tubing from primer connection into wall. Pipe within wall with copper to poly under floor to drain trap.
- M. Install expansion fittings:
 - 1. Install flexible hoses for seismic applications.
 - 2. Install rubber expansion fittings for pump applications.

3.2 CONNECTIONS

A. Comply with requirements for grounding of equipment in Division 26.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Water pressure-reducing valves.
 - 3. Calibrated balancing valves.
 - 4. Outlet boxes.
 - 5. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Drain Valves: Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of

horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves use ball valves.

- B. Balance Valves: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.
- C. Install pressure regulating valves with inlet and outlet shutoff valves, and balance valve bypass.
- D. Install shock arresters at all water connections to equipment with flush valves, quick closing valves, including, but not limited to: water closets, urinals, clinical service sinks, dishwashers, disposals, clothes washers, ice makers, autoclaves, pre-rinse spray hose, solenoid valves, etc. Install in accessible location. Provide hinged metal access panel doors in accordance with architectural recommendations and provide isolation valve.

Fixture Unit Rating	P.D.I Size
1-11	A
12-32	В
33-60	С
61-113	D
114-154	E
155-330	F

1. Units shall be sized in accordance with the following schedule:

E. Install air vents at high points in piping. Provide ball shut off valve. Provide discharge piping turned down to allow discharge into bucket.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principal backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Inspections: Inspect domestic specialties as follows:
 - 1. Do not enclose, over, or put into operation system until it has been inspected an approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the Local Authority Having Jurisdiction, at least 48 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 after the system is roughed-in but before concealing or closing in piping 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 ensure compliance with the requirements of the plumbing code.
- 3. Reinspection: Whenever the plumbing official finds that piping system will not pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official
- 4. Reports: Prepare inspection reports, signed by the plumbing official.
- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 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, which have been altered, extended, or repaired prior to use.
 - 2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, AWWA C652 or 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 does not remain in the water coming from the system.
 - 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.
- B. Prepare reports for all purging and disinfecting activities.
- C. Set field-adjustable pressure set points of water pressure-reducing valves.
- D. Set field-adjustable flow set points of balancing valves.
- E. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

3.7 SYSTEM START UP

- A. Fill the system.
- B. Before operating the system perform these steps:

- Open valves to full open position. Close drains, valves, hydrants, and sill cocks. Remove and clean strainers. 1.
- 2.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
- B. Related Requirements:
 - 1. Civil documents for sanitary sewerage piping and structures outside the building.
 - 2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping" **OR** 220548.13 "Vibration Controls for Plumbing Piping"

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: 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 service according to requirements indicated:
 - 1. Notify Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to , the following:
 - 1. Cast Iron Pipe and Fittings
 - a. AB&I
 - b. Charlotte
 - c. Tyler Pipe
 - 2. Standard Duty CISPI Couplings
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Clamp-All Corp.
 - d. Dallas Specialty & Mfg. Co.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company, LLC
 - g. Stant.
 - h. Tyler Pipe
 - 3. Cast Iron Hubless Piping Couplings
 - a. Charlotte Pipe and Foundry Company.
 - b. MG Piping Products Company.
 - c. Clampall
 - d. Ideal Tridon

2.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.4 HUB AND SPIGOT, CAST IRON PIPE AND FITTINGS

- A. Pipe and fittings to meet ASTM A70
- B. Gaskets to comply with ASTM C564 rubber.
- 2.5 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
 - A. Pipe and Fittings: ASTM A 888 and CISPI 301.
 - B. Standard Duty Hubless Couplings:
 - 1. ASTM C1277 and CISPI 31
 - 2. 304 stainless steel corrugated shell with stainless steel bands and tightening devices with ASTM C564 rubber sleeve with pipe stop.
 - C. Cast-Iron, Hubless-Piping Couplings:
 - 1. Standard: CISPI-310 and ASTM C 1277.
 - 2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.6 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Galvanized Pressure Pipe: Steel ASTM A 53/A 53M Type E, standard with ends to match joint used.
- D. Galvanized Steel Pipe Nipples: ASTM A733, Schedule 50 galvanized seamless steel pipe.
- E. Galvanized Gray iron Threaded Fittings: ASME B16.4 Class 125 Standard pattern.
- F. Malleable iron unions: Galvanized, Class 150, ASME B16.39 flex body with ball and socket metal tot metal bronze seat surfaces.
- G. Cast Iron Flanges: ASME B16.1, Class 125 with B16.21, full face hat, non-metallic, 1/8: maximum thickness. Asbestos free. Use ASME B18.2.1 carbon steel bolts and nuts.
- H. Galvanized Grooved Fittings: ASTM A536 ductile iron casting, ASTM A47/A47M malleable iron casting, ASTM A 234/A234M forged steel or ASTM A106/A106M steel pipe formed to mastch ASTM A53/A53M steel pipe with AWWA C606 grooved ends.
- I. Grooved couplings: ASTM F1476, Type I. Include housing and keys with EPOM gasket, bolts and nuts.

2.7 SPECIALTY PIPE FITTINGS

- Α. **Transition Couplings:**
 - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 2. Unshielded, Nonpressure Transition Couplings:
 - Standard: ASTM C 1173. a.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end. C.
 - End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC. 2)
 - For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe 3) materials being joined.
 - 3. Shielded, Nonpressure Transition Couplings:
 - Standard: ASTM C 1460. a.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - End Connections: Same size as and compatible with pipes to be joined. C.

PART 3 - EXECUTION

3.1 EARTH MOVING

Α. Comply with requirements for excavating, trenching, and backfilling specified in Civil documents. At minimum, provide 6" sand bed above and below prior to backfill with native soil.

3.2 **PIPING INSTALLATION**

- Α. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- Β. 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 at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. For Seismic Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Install 1-inch-thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install steel piping according to applicable plumbing code.
- O. All below grade plastic piping shall meet ASTM D2321-89 requirements
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Plumbing Specialties:

- 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
- 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Division 22.
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Division 22.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Division 22.

3.3 JOINT CONSTRUCTION

- A. Join hub and spigot cast iron pipe with gasket joints per CISPI Cast Iron Pipe & Fittings Handbook.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.

- 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
- 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
- 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- 6. Equipment: Connect waste piping as indicated.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Install detectable warning tape within 6" of finish grade on exterior piping.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.

- 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10foot head of water (30 kPa).
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
- 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 5. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Note: Standard duty coupling may be used for waste and vent piping for up to 2 stories only.
- B. NOTE: PVC waste and vent may not be used in return air plenums.
- C. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Service wight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 4. PVC pipe with socket fittings and solvent cement joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service wight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service wight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. PVC pipe with socket fittings and solvent cement joints.

- 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service wight cast iron with hub and spigot gasket joints and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; coupled joints.
 - 3. PVC pipe with socket fittings and solvent cement joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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. Cleanouts.
 - 2. Floor Drains
- B. Related Requirements:
 - 1. Section 221423 "Storm Drainage Piping Specialties" for roof and overflow drains.
 - 2. Site/Civil Documents for "Sanitary Drainage Piping" for sewer drainage piping and piping specialties outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. Plumbing Code Compliance: Comply with applicable portions of Local Plumbing Code.
 - 2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products and installation of soil and waste systems.
 - 3. ASSE Compliance: Comply with applicable ASSE Standards pertaining to materials, products and installation of soil and waste systems.
 - 4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems
 - 5. PVC Pipe: Only Contractors personnel which have received training in the installation of this material and meet the manufacturers qualifications shall do the assembly of such material.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of flashing and roof penetrations
- B. Coordinate flashing materials installation of roofing, waterproofing and adjoining substrate work
- C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing an slope of slab to drains.
- D. Coordinate with installation of sanitary sewer systems as necessary to interface building drains with drainage piping systems.
- E. Coordinate all penetrations with Structural Engineer
- F. Coordinate all installations with work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Cast Iron Exposed Cleanouts
 - 1. Jay R. Smith Mfg. Co.
 - 2. Josam Company.
 - 3. MIFAB, Inc.
 - 4. Tyler Pipe
 - 5. Watts.
 - 6. Zurn Industries, LLC.
- C. Cast Iron Exposed Floor Cleanouts
 - 1. Jay R. Smith Mfg. Co.
 - 2. Josam Company.
 - 3. Oatey
 - 4. Sioux Chief Manufacturing Co
 - 5. Tyler Pipe
 - 6. Watts.
 - 7. Zurn Industries, LLC.
- D. Cast Iron Wall Cleanouts
 - 1. Jay R. Smith Mfg. Co.
 - 2. Josam Company.
 - 3. MIFAB, Inc.
 - 4. Tyler Pipe
 - 5. Watts.
 - 6. Zurn Industries, LLC.
- E. Cast Iron Floor Drains

- 1. Jay R. Smith Mfg. Co.
- 2. Josam Company.
- 3. MIFAB, Inc.
- 4. Tyler Pipe
- 5. Watts.
- 6. Zurn Industries, LLC.
- 7. Commercial Enameling

2.2 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.3 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. Standard: ASME A112.36.2M.
 - 2. Size: Same as connected drainage piping
 - 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Raised-head, bronze plug.
 - 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
 - 1. Standard: ASME A112.36.2M for adjustable housing, cast-iron soil pipe with cast-iron ferrule or threaded, adjustable housing cleanout.
 - 2. Size: Same as connected branch.
 - 3. Type: Adjustable housing, Cast-iron soil pipe with cast-iron ferrule or Threaded, adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Required.
 - 6. Outlet Connection: Inside calk, Spigot or Threaded.
 - 7. Closure: brass/bronze plug.
 - 8. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
 - 9. Frame and Cover Material and Finish: Rough bronze.
 - 10. Frame and Cover Shape: Round.
 - 11. Top Loading Classification: Light Duty.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Standard: ASME A112.36.2M. Include wall access.
 - 2. Size: Same as connected drainage piping.
 - 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure Plug:
 - a. Brass/bronze

- b. Raised head.
- c. Drilled and threaded for cover attachment screw.
- d. Size: Same as or not more than one size smaller than cleanout size.
- 5. Wall Access: Round, deep, chrome-plated bronze or flat, chrome-plated brass or stainless-steel cover plate with screw.
- 6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
- D. Site Surface Cleanout: Cast iron body ferrule with raised head brass plug, medium duty cast iron manhole cover and ring 12-inch diameter to be set in concrete pad, Neenah No. R-1791-A

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, castiron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
 - 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.

2.5 FLOOR DRAINS (FD)

- A. Floor Drain types, designation and sizes are indicated on drawings.
- B. Toilet Rooms and Finished Areas: Round cast iron body with flashing collar, seepage holes, and clamping ring when installed with membrane, 6" round nickel bronze adjustable strainer head with secured square hole grate, bottom outlet, and cast iron trap with primer connection. Provide center pin torx security screws on grate for all detention floor drains.
- C. Boiler and Mechanical Rooms: Round cast iron, light duty, shallow body drain with flashing collar, seepage holes and cast iron clamping ring, when used with membrane, 8 inch round tractor type non tilt, slotted grate with sediment bracket, bottom waste outlet.
- D. Sterilizer Drain and Waste Funnel: Round cast iron body with flashing collar, weep holes and clamping ring, when used with membrane 6" round nickel bronze adjustable strainer head, with secured square hole grate, 6" x 2-1/2" oval nickel bronze funnel attached to top grate, bottom outlet, cast iron trap and primer fitting.
- E. Ice Maker or Drip Pan Drain, Recessed Top Grate: Round cast iron body with flashing collar, weep holes, and clamping rings when used with membrane. Provide 7" round nickel bronze adjustable strainer head with loose set recessed square hole grate, bottom waste outlet with cast iron trap and primer connection. Top outside edge of drain to be set flush with finished floor.

2.6 FLOOR SINKS (FS)

- A. Floor drain type designations and sizes are indicated on drawings.
- B. Indirect Waste Drain Kitchen Equipment: Square, cast iron, porcelain enameled interior, sump body drain 6-inch-deep x 8-inch square with flashing collar, weep holes, and cast iron clamping ring, square nickel bronze removable half top grate, dome bottom strainer, bottom waste outlet, cast iron trap with primer connection.
- C. Dish Wash Machine Kitchen: Square cast iron, porcelain enameled interior, sump body drain, 16-inch square x 12 inch deep with 16-inch square nickel bronze removable half top grate, dome bottom strainer, bottom waste outlet, cast iron trap with primer connection.
- D. Large Sterilizers and Cartwashers: Square cast iron, porcelain enameled interior, sump body drain, 12-inch square x 10 inch deep with 12-inch square nickel bronze removable half top grate, dome bottom strainer, bottom waste outlet, cast iron trap and primer connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Install piping in accordance with Local Authority Having Jurisdiction (AHJ), except where more stringent requirements are indicated.
- B. Inspect piping before installation to detect apparent defects. Mark defective materials and promptly remove from site.

- C. Verify all dimensions by field measurements. Verify that all drainage, vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design and referenced standards.
- D. Verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to installations.
- E. Examine rough in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- F. Examine walls, floors, roof and plumbing chases for suitable conditions where piping and specialties are to be installed
- G. Do not proceed until unsatisfactory conditions have been corrected.
- H. Refer to Division 2 for trenching and backfill requirements.

3.2 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
 - 5. At each toilet group
 - 6. At egress of building
 - 7. At sinks and urinals on grade
 - 8. Where required by plumbing code.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Lubricate metallic cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leakproof joint.
- E. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install reinforcement for wall-mounting-type specialties.
- J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is required. Prime all traps unless noted otherwise.
- K. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide minimum 13-inches diameter cleanout cover flush to floor centered over backwater valve cover. Cleanout cover shall be of adequate size to remove backwater valve cover for service.
- L. All floor drains are to be provided with P-trap the same size as the floor drain unless otherwise noted on mechanical drawings.
- M. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated and extend cleanouts to floor or wall above. Line cleanouts are not acceptable unless otherwise noted on the drawings.
 - 1. As required by plumbing code.
 - 2. At each change in direction of piping greater than 135 degrees below slab
 - 3. At base of each vertical soil or waste stack
 - 4. At sinks and urinals on grade
 - 5. At egress of building (surface cleanout)
 - 6. At each toilet group.
- N. Cleanouts Covers: Install floor and wall cleanout covers, types as indicated, and in accessible locations.
- O. Flashing Flanges: install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes
- P. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturers instructions.

3.3 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by the plumbing code.
- C. Install piping adjacent to equipment to allow service and maintenance.

3.4 PIPE AND TUBE JOINT CONSTRUCTION

A. Install pipes and pipe joints in accordance with Division 22.

3.5 INSTALLATION OF FLOOR DRAINS

- A. Install floor drains in accordance with manufactures written instructions and in locations indicated.
- B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Coordinate floor slopes and exact drain locations with Architectural drawings.
- C. Trap all drains connected to the sanitary sewer with minimum trap size that of drain connected.
- D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- E. Position drains so that they are accessible and easy to maintain.

3.6 FLASHING INSTALLATION

- A. Comply with requirements in Division 07 for flashing.
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07.
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- H. Provide flashing membrane for all floor drains in structure above slab on grade level; see flashing detail on mechanical drawings.
- I. Provide flashing for all floor drains, floor cleanouts in wet areas and shower drains above grade. Make watertight with underslab moisture vapor barrier. Refer to Division 7 for requirements of vapor barriers. Flashing shall extend at least 24 inches from drain rim into floor membrane or on structural floor. Fasten flashing to drain clamp device and make watertight, durable joint. Provide flashing collar extension with all drains and cleanouts installed above grade.

3.7 LABELING AND IDENTIFYING

- A. Label Piping and Accessories
 - 1. Pipe labeling is specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. Do not enclose, cover or put into operation drainage and vent piping system until it has been pressure tested, inspected and approved by the Local Authority Having Jurisdiction.
- B. During the progress of the installation, notify the plumbing official having jurisdiction, at least 48 hours prior to the time such inspection must be made. Perform tests specified in Division 22 in the presence of the plumbing official.
- C. Perform tests and inspections and prepare test reports.
- D. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.10 ADJUSTING AND CLEANING

- A. Clean interior of piping. Removed dirt and debris as work progresses
- B. Clean drain strainers and traps. Remove dirt and debris.

END OF SECTION 221319

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 22 Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings and accessories, appliances, appurtenances, equipment and supports associated with plumbing fixtures.
- B. Products furnished but not installed under this Section include:
 - 1. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appurtenances, and equipment provided by Owner.
 - 2. Plumbing fittings (including faucets) and piping indicated for fixtures, appliances, appliances, appliances, and equipment specified in other sections.
- C. Products installed but not furnished under this Section include:
 - 1. Owner supplied fixtures, as indicated.
 - 2. Accessories, appliances, appurtenances, and equipment specified in other sections requiring plumbing services or fixture related devices, as indicated.

1.3 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience or improved appearance to a fixture but is not essential to its operation
- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

- G. Fixture: Installed receptor connected to the water distribution system that receives and makes available potable water and discharges the used liquid or liquid borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor except when used in a general application where terms "Fixture" and Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.
- H. Roughing In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
 - 1. Carrier: Floor mounted support for wall mounted water closet and support fixed to wall construction for wall hung fixture.
 - 2. Chair Carrier: Support for wall hung fixture having steel pipe uprights that transfer weight to the floor.
 - 3. Chair Carrier, Heavy Duty: Support for wall hung fixture having rectangular steel uprights that transfer weight to the floor.
 - 4. Reinforcement: Wood blocking or steel plate built into wall construction for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts specific to fixture and normally supplied with it required to complete fixture assembly and installation.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for each type of plumbing fixture specified including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components and finishes.
 - 2. Wiring diagrams for field installed wiring of electrically operated units.
- B. Product Data: Submit product data and installation instructions of each fixture, faucet, specialty, accessory and trim specified or shown on plumbing fixture schedule; clearly indicate rated capacities of selected models.
- C. Shop Drawings: Submit rough-in drawings with brand names on each sheet and item. Detail dimensions, rough-in requirements, required clearances and methods of assembly of components and anchorages. Coordinate requirements with architectural casework shop drawings specified in Division 6 for fixtures installed in countertops and cabinets. Furnish templates for use in casework shop drawings.
- D. Wiring Diagrams: Submit manufacturer electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed. Coordinate and provide matrix of mechanical and electrical requirements as specified in Division 22.
- E. Color Charts: Coordinate fixture color with Architect and submit manufacturers standard color charts for cabinet finishes and fixture colors.

- F. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured plumbing fixture, valve and trim. In addition to providing in the submittals, include this data, product data and shop drawings with operations and maintenance manuals.
- G. Submit certification of compliance with specified performance verification requirements and IPC, NSF, ANSI, UL, and ASHRAE Standards.

1.5 QUALITY ASSURANCE

- A. ADA Requirements: Comply with requirements of Americans with Disability Act. Provide Fixtures complying with ADA accessibility requirements.
- B. Regulatory Requirements: Comply with requirements of ANSI Standard A117.1 "Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People" and Public Law 90 480 "Architectural Barriers Act, 1968" with respect to plumbing fixtures for the physically handicapped.
- C. Regulatory Requirements: Comply with requirements of ATBCB (Architectural and Transportation Barriers Compliance Board) "Uniform Federal Accessibility Standards (UFAS) 1985 494 187" with respect to plumbing fixtures for the physically handicapped.
- D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NTRL) as defined in OSHA Regulation 1910.7.
- E. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.
- F. Codes and Standards
 - 1. Current Adopted Plumbing Code
 - 2. NSF Standard 61: "Drinking Water System Components"
 - 3. ASHRAE Standard 18: "Methods of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration"
 - 4. ARI Standard 1010: "Self-Contained, Mechanically Refrigerated Drinking Water Coolers"
 - 5. UL Standard 399: "Drinking Water Coolers"
 - 6. Drinking Water Act Current Edition
 - 7. Department of Public Health and Environment Regulations
 - 8. Cross- Connection Control Manual: Current Edition
 - 9. ANSI Standard A117.1: "Standard on Accessible and Usable Buildings and Facilities"
 - 10. Accessibility Guidelines and Standards of the United States Access Board
 - 11. Current Appliance and Equipment Standards of the United States Department of Energy
- G. Where fixtures are indicated on the architectural drawings and intended to be ADA Compliant, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures

and related trim which meets the ADA requirements. Such indication may be shown by note on floor plans or schedules, by clearance dimensions or areas on the plans or other graphics or notes on elevations.

- 1.6 DELIVERY, STORAGE AND HANDLING
 - A. Deliver plumbing fixtures in manufacturer's protective packing, crating and covering.
 - B. Store plumbing fixtures on elevated platforms in a dry location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Water Closets:
 - a. American Standard
 - b. Kohler
 - c. Zurn
 - d. Toto
 - e.
 - 2. Lavatories:
 - a. American Standard
 - b. Kohler
 - c. Zurn
 - d. Toto
 - 3. Stainless Steel Sinks:
 - a. Elkay
 - b. Just
 - c. Moen
 - 4. Showers:
 - a. Best Bath
 - b. Fiberglass Systems
 - c. Aquatic
 - d. Freedom
 - e. Floreston
 - f. Manstone
 - g. Fiat
 - h. Lasco
 - i. Kohler
 - j. Prefabricated Showers

- 5. Outlet Boxes:
 - a. Guy Gray
 - b. Symmons
 - c. Sioux Chief
- 6. Toilet Seats:
 - a. Bemis
 - b. Beneke
 - c. Church
 - d. Kohler
 - e. Olsonite
 - f. Sperzel
 - g. American Standard
- 7. Flushometers:
 - a. Sloan
 - b. Zurn
 - c. American Standard
 - d. Kohler
 - e. Toto
- 8. Commercial/Industrial Cast Brass Faucets:
 - a. American Standard
 - b. Chicago Faucet
 - c. Delta Faucet
 - d. Kohler
 - e. Symmons
 - f. T&S Brass
 - g. Hydrotek
 - h. Elkay
- 9. Fixture Supplies, Stops, Traps:
 - a. McGuire
 - b. Brasscraft
 - c. Dearborn
- 10. Protective Pipe Covers:
 - a. McGuire
 - b. TruBro
- 11. Fixture Carriers and Supports:
 - a. Josam
 - b. Smith (Jay R)
 - c. Wade
 - d. Zurn
 - e. Watts

2.2 PLUMBING FIXTURES, GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components and supports as specified. All fixtures to be lead free per NSF 61 App 6, AB1953.
- B. Refer to schedule on drawings.
- C. All fixtures to be white unless otherwise noted.
- D. Provide a thermostatic mixing valve that meets ANSI Z358.1 requirements for emergency fixtures.
- E. Provide a cane apron for non-high/low drinking fountains and water coolers shown to protrude into the walkway.
- F. Water Closets:
 - 1. Fixture Color: White unless specified otherwise. Coordinate with architectural
 - 2. Action: Siphon jet
 - 3. Rim: Elongated round front
 - 4. Trim: All trim shall be chrome plated, cast brass, or copper tube. Plastics or metal alloy base type material will not be acceptable.
 - 5. All ADA installation for operating handles shall meet ANSI 117.1 requirements.
 - 6. Cast iron or red brass threaded nipples for wall hung fixture connections to carrier.
 - 7. Provide fully glazed trapways. Partial glazing is not acceptable.
- G. Lavatories
 - 1. Material: Plastic formed or enameled steel lavatories are not acceptable.
 - 2. Fixture Color: White, unless specified otherwise. Coordinate with architectural
 - 3. Mounting: Lavatories specified or scheduled as wall hung shall be supported from floor mounted top and bottom bearing plate or concealed arm carrier. Wall mounted wood or metal blocking hangers will not be permitted. Counter mounting, self-rimming or composite countertop with integral bowl as specified or scheduled.
 - 4. Faucet hold drilling: Drilling shall be provided by the fixture manufacturer to match the required fixture mounting and accessories specified by this and other sections of the plans and specifications. Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering lavatories.
 - 5. Size and style of listed acceptable units shall match the specified or scheduled unit including appearance, shrouds, enclosures, soap depressions, front or rear overflows, flat slab rim, splash rack, shelf back side shields, etc.
- H. Stainless Steel Sinks:
 - 1. Material: Type 304, 18-gauge stainless steel
 - 2. Fixture Color: No.4 satin finish for stainless steel. White, for enameled cast iron, unless specifically specified otherwise. Composites only as specified.
 - 3. Mounting: Wall mounted and carrier mounted sinks shall be installed per manufacturer recommendations and instructions.
 - 4. Faucet hole drillings shall match the faucet configuration and accessories specified in the mechanical and architectural documents, i.e., dishwasher air gaps, liquid dispensers, remote drain operators, eye washes, etc., when mounted in the sink back ledge. NOTE: Faucet hole covers will not be acceptable. Contractor to coordinate prior to ordering sinks.
 - 5. Stainless steel sinks to be sound deadened with undercoating.

- I. Prefabricated Showers:
 - 1. Color: White, unless otherwise specified
 - 2. Provide center drain with a brass or stainless-steel shower drain cover.
 - 3. Floor shall have a slip resistant, textured bottom.
 - 4. Provide reinforcement of shower where grab bars are specified.

2.3 FAUCETS

- A. Faucets, General: Unless otherwise specified, provide faucets that are cast brass with polished chrome plated finish.
- B. Alternate faucet controls, i.e., self-closing, knee operated, foot operated, etc. shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
- C. Lavatory Trim:
 - 1. All lavatory faucets shall be provided with 1/4 -turn handles, laminar flow controls in lieu of aerators.
 - 2. All lavatory faucets shall be provided with ceramic disc cartridges.
 - 3. Faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district
 - 4. Infrared faucets must be provided with integral stops.
- D. Sink Trim
 - 1. All sink faucets shall be provided with 1/4 turn handles, laminar flow controls in lieu of aerators.
 - 2. All sink faucets shall be provided with ceramic disc cartridges.
 - 3. Alternate faucet controls, i.e., self-closing, knee operated, foot operated, etc., shall be provided complete with all necessary anchoring and mounting devices recommended and supplied by the device manufacturer.
 - 4. All sink faucets shall be chrome plated brass complying with restrictions for lead content for the requirements of the jurisdiction or district. Types include hand, foot, knee, infra-red or heat sensing type operations.
 - 5. Infrared faucets must be provided with integral stops.
- E. Shower Trim
 - 1. Shower valves shall be balanced-pressure type, ASSE 1016/ASME A112.1016.
 - 2. The shower control valve shall limit the maximum water supply temperature to not exceed 120°F.
 - 3. Inlets and Outlet: 1/2"
 - 4. Integral service stop

2.4 FITTINGS, EXCEPT FAUCETS

- A. Provide 1/4 turn convertible angle stops whether angle or straight for all applications.
- B. Fittings, General: Unless otherwise specified, provide fittings fabricated of brass with a polished chrome plated finish.

- C. Lavatory Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 3/8" by 12" flexible chrome plated tubing riser outlet.
- D. Lavatory Traps: Cast Brass, 1-1/4" NPS adjustable P-trap with clean out, 17-gauge tubular waste to wall and wall flange.
- E. Sink Supplies and Stops: 1/4 turn ball angle stop having 1/2" NPS inlet with wall flange and 1/2" by 12" flexible chrome plated tubing riser outlet.
- F. Sink Traps and Garbage Disposer: Cast Brass, 1-1/2" NPS adjustable P-trap with cleanout, 17gauge tubular waste to wall and wall flange.
- G. Sink Continuous Waste: Polished chrome plated, tubular brass, 1-1/2", 17 gauge, with brass nuts on slip inlets and of configurations indicated.
- H. Supply and drain plumbing service fittings not listed above shall be as specified and as scheduled.
- I. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
- J. Escutcheons: Polished chrome plated, sheet steel wall flange with friction clips.
- K. Provide fittings specified as part of a fixture description in lieu of fitting requirements above.
- L. Hot water supply shall always be located on the left side of fixture and the cold supply shall always be located on the right side of fixture.
- M. ADA accessible Lavatories and Sinks: Provide white, molded antimicrobial vinyl cover for stops supplies, trap, and tailpiece. Pipe coverings shall comply with ASME A112.18.9 or ASTM C1822.
- N. Stops and Supplies for Water Closets: Polished, chrome-plated, brass ball and stem, loose key, angle stop having 1/2" inlet and 3/8" O.D. x 12; long chrome plated copper supply riser or braided stainless steel flexible tubing; outlet with collar, wall flange and escutcheon. Quantity to match trim specified. Deliver all handles to Owner.

2.5 FLUSHOMETERS

- A. Provide flushometers compatible with fixtures with features and of consumption indicated.
- B. Construction: Cast brass body, brass or copper pie or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation except where other type is specified.
- C. Finish: Exposed metal parts shall be polished chrome plated except components installed in a concealed location may be rough brass or unfinished.
- D. Flushometers: Furnish with the following features:
 - 1. Non hold open feature
 - 2. ADA actuator on handicapped fixtures mounted on wide side of fixture.
 - 3. Seat bumper on stop
 - 4. Bedpan washer diverter valve, spray head and support (where specified)

- 5. Trap primer connection
- 6. Furnish flushometers with factory set or field adjusted maximum water consumption to match fixture.

2.6 TOILET SEATS

- A. General: Provide toilet seats compatible with water closets of type, color and features indicated.
- B. Toilet Seats: Extra heavy-duty, 500lb static weight load, commercial/industrial type, elongated, open front, solid plastic, with stainless steel hinge post and check hinge.
- C. Provide permanent anti-microbial treatment by the manufacturer.

2.7 PLUMBING FIXTURE SUPPORTS

- A. Supports: 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. Chari Carriers: Supports with steel pipe uprights for wall hanging lavatories and 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" by 4" wood blocking between studs or 1/4" by 6" 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Install plumbing fixtures and specified components in accordance with designations and locations indicated on drawings.
- 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 fixtures supported from wall construction
 - 2. Chair carriers for the following fixtures
 - a. Wall hanging lavatories and sinks
 - 3. Reinforcement for the following fixtures
 - a. Fixtures required to be secured to wall

3.3 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb in accordance with fixture manufacturers written installation instructions, rouging in drawings and referenced standards.
- B. Install floor mounted, floor outlet water closets with closet flanges and gasket seals.
- C. Install wall hanging, back outlet water closets and urinals with gasket seals.
- D. All wall hung fixtures shall be supported from the building structure with floor mounted carriers. Do not support from walls.
- E. Fasten floor mounted fixtures and special fixtures having holes for securing fixture to wall construction to reinforcement built into walls.
- F. Fasten wall mounted fittings to reinforcement built into walls.
- G. Fasten counter mounting type plumbing fixtures to casework.
- H. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- I. Install trap on fixture outlet except for fixtures having integral trap.
- J. 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.
- K. Seal fixtures to walls, floors and counters using a sanitary type, one part, mildew resistant, silicone. Match sealant color to fixture color.
- L. Flush valves shall be anchored behind walls to eliminate push-pull, horizontal or vertical movement.

- M. All flush valves shall have a properly sized water hammer arrestor.
- N. Set prefabricated showers, shower receptors and mop basins in a level bed of cement grout; material shall be as recommended by manufacturer or as specified by Architect.
- O. Install fixture water stop valves in accessible locations. Hot water supply shall always be located on left side of fixture and the cold supply shall always be located on the right side of fixture.
- P. Provide cleanouts as shown on drawings or per the applicable Plumbing Code
- Q. Chrome plated cap nuts for wall hung fixtures shall be installed with strap wrench to prevent marring.
- R. Fixtures shall be product of one manufacturer and must be manufactured in the USA per Division 22.
- S. Install hose end faucets and hose connection with field backflow preventers to meet local Cross Connection Control Manual regulations and current jurisdictional codes.
- T. Solidly attach floor mounted water closets to floor flanges.

3.4 CONNECTIONS

- A. 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 dipping systems and plumbing equipment specified in other sections of Division 22.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.5 ADA ACCESSIBILITY

- A. Review Mechanical and Architectural drawings to determine fixtures requiring AD Accessibility. Notify Architect/Engineer of any physical conflicts preventing full dimensional compliance prior to beginning work.
- B. Comply with the installation requirements of ANSI A117.1 and "Accessibility Guidelines and Standards of the United States Access Board" with respect to plumbing fixtures for the physically handicapped. Arrange flush valve/flush tank handles with proper orientation to meet ADA requirements.

3.6 FIELD QUALITY CONTROL

- 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.
3.7 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at electric water coolers, faucets, shower valves and flushometers having controls to provide proper flow and stream.
- C. Replace washers of leaking and dripping faucets and stops.
- D. Clean fixtures, fittings and spout and drain strainers with manufacturers recommended cleaning methods and materials.
- E. Review the data in Operating and maintenance Manuals. Refer to Division 1 Section "Project Closeout".

3.8 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities except when approved in writing by the Owner.

END OF SECTION 224000

SECTION 23 05 00 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 21, 22, and 23 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Related Sections: Refer to all sections in Division 21, 22, and 23. Refer to Division 26 specification sections and Division 26 drawings.
- C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.
- D. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY

A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Divisions 21, 22, and 23. It expands and supplements the requirements specified in Division 1.

1.3 MECHANICAL INSTALLATIONS

- A. The Contract Documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, Contractor shall take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not

intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

- F. Before any work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as intended without interferences between systems, structural elements or work of other trades.
- G. Verify all dimensions by field measurements.
- H. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.
- I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- K. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- L. Make allowance for expansion and contraction for all building components and piping systems that are subject to such.
- M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset the system as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
- N. In general, all "static" piping systems shall be routed as high as possible, i.e. fire protection systems. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
- O. The Contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, opening/closing of all valves, draining/refilling all mechanical systems and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the O & M manuals.

1.4 COORDINATION

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for coordination of all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.

- B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:
 - 1. Fire Protection and Fire Alarm Contractor shall provide shop drawings to all other Division 21, 22, and 23 Contractors.
 - 2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 21, 22, 23 and 26 Contractors and shall furnish the same information involving control devices to the appropriate Division 21, 22, and 23 Contractor.
 - 3. Furnish building equipment (elevator, food service, medical, technology, etc) information to Div 21, 22, and 23 contractors.
- C. Existing Conditions:
 - 1. Carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey prior to developing 3D drawing.
 - 2. Contractor shall be responsible for showing all existing conditions on the 3D coordination drawings.
 - 3. Provide proper coordination of mechanical work with existing conditions.
 - 4. Report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS

- A. General:
 - 1. Coordinate all work to conform to the progress of the work of other trades.
 - 2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work when such corrections are required for proper installation of other work.
- B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:
 - 1. Equipment and required clearances
 - 2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
 - 3. Ductwork mains
 - 4. Plumbing vent piping
 - 5. Low pressure ductwork and air devices.
 - 6. Electrical and communication conduits, raceways and cable tray.
 - 7. Domestic hot and cold water
 - 8. Hydronic piping
 - 9. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
 - 10. DDC control wiring and other low voltage systems.
 - 11. Fire alarm systems.
- C. Chases, Inserts and Openings:
 - 1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
 - 2. Check sizes and locations of openings provided. Including the access panels for equipment in hard lid ceilings and wall cavities.

- 3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to Division 1 and Division 23.
- G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- H. Coordination with Electrical Work: Refer to Division 1 and 26.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR

- A. The construction of this project requires the Contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of coordination shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
 - 1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
 - 2. Any system not fully detailed
 - 3. Fire protection systems
 - 4. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents or catalogued by the manufacturer.
 - 5. Temperature controls systems
 - 6. Refrigeration systems
 - 7. Seismic restraint systems
- D. Design Limitations:
 - 1. The Contractor shall not modify the Engineers design intent in any way.
 - 2. The Contractor shall not change any pipe size or equipment size without prior written approval from the Engineer.
 - 3. The Contractor shall conform to the SMACNA Duct Construction Standards when modifying the ductwork layout to avoid collisions.
 - 4. Back-to-back 90° fittings on duct system shall not be installed under any circumstance.
 - 5. Bull nosed tees on piping systems shall not be installed under any circumstance.
 - 6. Internal tie rods shall not be used. Brace duct externally.

1.7 PROJECT CONDITIONS

- A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Field verify all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.
- D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.
- E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.
- F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.
- G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.
- H. Coordinate all services shutdown with the Owner; provide temporary services. Coordinate any required disruptions with Owner, one week in advance.
- I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES

- A. Refer to Division 1.
- B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.

- C. Comply with the local and state codes adopted by the Authorities Having Jurisdictions at the time of permit application, including referenced standards, amendments and policies. See code declaration information on the drawings
- D. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- E. The handling, removal and disposal of regulated refrigerants and other materials shall be in accordance with U.S. EPA, state and local regulations.
- F. The handling, removal and disposal of lead-based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.
- G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.11 PERMITS AND FEES

- A. Refer to Division 1.
- B. The Contractor shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities, unless directed otherwise by the General Contractor/Owner – IN WRITING.
- C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS

- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
- B. All systems shall be installed to meet NFPA and IBC Seismic requirements.
 - 1. Where any conflicts arise the more stringent requirements shall be applicable.
 - 2. The design of the seismic requirements shall be the full responsibility of the Contractor.

1.13 TEMPORARY FACILITIES

- A. Light, Heat, Power, Etc.: Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
- B. Use of Permanent Building Equipment for Temporary Heating or Cooling: Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. Steam and hydronic systems shall be flushed and chemically treated. Ductwork and air moving equipment shall be cleaned to an "AS New" condition. All filters required for the construction period shall be equivalent to the filters required for the final installation. All filters shall be replaced at the time of substantial completion. The guarantee period of all equipment used shall not start until the

equipment is turned over to the Owner for his use. A written record of maintenance, operation and servicing shall be turned over to the owner prior to final acceptance.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and Division 1.
- B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.
- C. Materials and equipment of equivalent quality shall be submitted for substitution prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
 - 1. Substitutions shall be allowed <u>only</u> upon the written approval of the Architect/Engineer NO EXCEPTIONS.
 - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications and scheduled performance or which does not have prior approval.
- D. Bidders opting to bid or propose comparable products (either a product by a listed acceptable manufacturer in the respective specification section or a substitution request) are responsible for:
 - 1. Confirming the equipment they are bidding will fit in the space available, incorporating equipment's clearance requirements.
 - 2. Coordination of any variance from basis-of-design in weight, electrical requirements, other utility requirements, etc. with other trades.
 - 3. Inclusion in the bid of any applicable costs for changes in prime bidder's and their sub bidders' work required to accommodate the utilization of the comparable product.
 - 4. The contractor shall bear any and all responsibility including any changes to mechanical, plumbing, electrical, structural or architectural design. These changes shall be clearly identified and presented to the Design Team.

1.15 MECHANICAL SUBMITTALS

A. General

- 1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
- 2. Contractor shall provide a submittal schedule appropriate for the size and schedule of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
- 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.

- 4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Sub-Contractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section. Submittals that are not complete with the required information will not be reviewed and will be sent back to be corrected.
- 5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
- 6. An index shall be provided which includes:
 - a. Product
 - b. Plan Code (if applicable)
 - c. Specification Section
 - d. Manufacturer and Model Number
- 7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder or as required by Division 1.
- B. Basis of Design: The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the basis of design and provided for the establishment of size, capacity, grade and quality. If the contractor proposes alternates or substitutions in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.
- C. All equipment shall conform to the State and/or local Energy Conservation Standards.
- D. Contractor Review: Submittal of shop drawings, product data and samples will be accepted only when submitted by and stamped by the General Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data submitted from Subcontractors and material suppliers directly to the Engineer will not be processed unless prior written approval is obtained by the Contractor.
- E. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive equipment data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the Operating and Maintenance Manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the MECHANICAL SUBMITTAL CHECKLIST, at the end of this section; supplemental requirements are listed in each Division 21, 22, and 23 Sections.
- F. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
 - 1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
 - 2. Construction means or methods

- 3. Coordination of the work with other trades
- 4. Construction safety precautions
- G. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- H. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- I. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. If more than two submittals (either for product data, shop drawings, record drawings, or test and balance reports) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.
- K. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- L. Required Submittals: Provide submittals for each item of equipment specified or scheduled in the contract documents. See table at the end of this section.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

- A. Product Listing:
 - 1. Prepare listing of major mechanical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect. A sample schedule is included at the end of this section to complete this requirement.
 - a. Provide all information requested.
 - b. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION."
 - 2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
 - 3. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units and similar items used in work, except as otherwise indicated.
 - a. Provide products which are compatible within systems and other connected items.
- B. Product Data:

- 1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
- 2. Delete or mark-out portions of pre-printed data which are not applicable.
- 3. Where operating ranges are shown, mark data to show portion of range required for project application.
- 4. For each product, include the following:
 - a. Sizes.
 - b. Weights.
 - c. Speeds.
 - d. Capacities.
 - e. Piping and electrical connection sizes and locations.
 - f. Statements of compliance with the required standards and regulations.
 - g. Performance data.
 - h. Manufacturer's specifications.
- C. Shop Drawings:
 - 1. Shop Drawings are defined as mechanical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
 - 2. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.
- D. Test Reports:
 - 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
 - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
 - 3. Submit test reports as required for O & M manuals.
- E. Operation and Maintenance Data: See separate paragraph of this specification section.
- F. Record Drawings: See separate paragraph of this specification section.

1.17 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Division 1 Sections on Transportation and Handling and Storage and Protection.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.
- C. Check delivered equipment against contract documents and submittals.

- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.
- E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.
- F. Provide factory-applied plastic endcaps on each length of pipe and tube. Maintain endcaps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.
- G. Protect stored ductwork, pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.
- I. Protect sheet metal ductwork and fittings. Elevate and store above grade and cover ends with waterproof wrapping.

1.18 DEMOLITION

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, piping or ductwork and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.
 - 1. Return existing thermostats and humidistats to the owner.
 - 2. Return all demolished control valves and devices to the Owner.
 - 3. Return existing unused/not relocated slot ceiling diffusers to the Owner.
- C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.
- D. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken for the hazardous material removal, which is not a part of the work to be done under this Division.

1.19 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

- B. Refer to Division 1.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.
- F. Perform cutting, fitting and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work;
 - 2. Remove and replace defective work;
 - 3. Remove and replace work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed work as specified for testing;
 - 5. Install equipment and materials in existing structures;
 - 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect /Engineer observation of concealed work.
- G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, and other mechanical items made obsolete by the new work.
- H. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Temporary partitions must not impede access to building egress.
 - 1. ICRA procedures must be maintained during construction.
- J. Locate identify and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover. Cover openings in ductwork to remain. Protect equipment and systems to remain.

1.20 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.
- C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.
- C. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 8 for access door specification and Division 23 for duct access door requirements.
- D. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.
- E. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
- F. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.
- G. Access doors in fire-rated walls and ceilings shall have equivalent U.L. label and fire rating.
- H. Final installed conditions shall accommodate accessibility and replacement of system components that regularly require service and replacement. This includes control devices, sensors, motors, etc.. Such devices shall not be permanently obstructed by building systems such as piping, ductwork, insulation, drywall, etc.

1.22 NAMEPLATE DATA

A. Provide permanent operational data nameplate, refer to the section on Mechanical Identification, on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Coordinate with Owner for specific requirements.

1.23 LUBRICATION OF EQUIPMENT

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Contractor shall properly lubricate all mechanical pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.
- C. Furnish the Engineer with a typewritten list included in the O&M manuals of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.24 CLEANING

- A. Refer to Division 1.
- B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

1.25 RECORD DOCUMENTS

- A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.
- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
- C. Mark Drawing Prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping or ductwork relocated more than 1foot-0inches from where shown on the drawings.
- D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
- E. Mark equipment and fixture schedules on drawings to indicate manufacturer and model numbers of installed equipment and fixtures.
- F. Reference to change order numbers, RFIs, etc., are not acceptable as-builts.
- G. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme:
 - 1. Red shall indicate new items, deviations and routing.
 - 2. Green shall indicate items removed or deleted.
 - 3. Blue shall be used for relevant notes and descriptions.
- H. At the completion of the project, obtain from the Architect a complete set of the Mechanical Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the Architect/Engineer. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents to the Architect/Engineer. This contract will not be considered completed until these record documents have been received and reviewed by the Architect/Engineer.
- I. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.26 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1.
- B. No later than four (4) weeks prior to the completion of the project provide one complete set of Operating and Maintenance Manuals, or as specified in Sections of Division 1 (whichever is more stringent).
- C. The testing and balancing report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation time frame requirements. Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.
- D. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 - 1. The job name and address and contractor's name and address shall be identified at the front of the electronic submittal.
 - 2. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 3. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions. Provide any test reports and start-up documents.
 - 4. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 5. Servicing instructions, lubrication charts and schedules, including Contractor lubrication reports.
 - 6. Manufacturer's service manuals for all mechanical equipment provided under this contract.
 - 7. Include the valve tag list.
 - 8. Name, Address and Telephone numbers of the Sub-contractors and local company and party to be contacted for 24-hour service and maintenance for each item of equipment.
 - 9. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
 - 10. Complete recommended spare parts list.
 - 11. Mechanical System and Equipment Warranties.
 - 12. Copies of all test reports shall be included in the manuals.
 - 13. Provide manuals with dividers for major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
 - 14. Final schedule of values with all mechanical change order costs included and identified.
 - 15. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up PDF format readable by Bluebeam is preferred.
- E. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.27 PROJECT CLOSEOUT LIST

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

B. The Contractor shall be responsible for the following Mechanical Submittal Checklist either by performing and/or coordinating such items prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements. (Checklist is located at the end of this section.)

1.28 WARRANTIES

- A. Refer to the Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case the entire mechanical system shall be warranted no less than one year from the time of acceptance by the Owner.
- B. Compile and assemble the warranties specified in Division 21, 22, and 23,**include the Operating and Maintenance Manuals.**
- C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.29 CONSTRUCTION REQUIREMENTS

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
 - 1. Up to date record drawings.
 - 2. Submittals
 - 3. Site observation reports with current status of all action items.
 - 4. Test results; including recorded values, procedures, and other findings.
 - 5. Outage information.

1.30 MECHANICAL SUBMITTAL CHECKLIST

	Item	Requirements							
<u>Cree</u>		Submittals			Supplemental		Factory	Training	Extra
Spec Section		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³	Rep Super- Vision At Site	Req'd At Site	Material
230500	Equipment Warranties			Х					
230500	O&M Manuals		Х	Х		Х			Х
230500	Record Drawings	Х	Х	Х					
230510	Basic Piping Materials And Methods		х	х	х	x			
230523	Valves		Х	Х					
230529	Hangers and Supports	Х	Х	Х					
230548	Vibration and Seismic Control	Х	Х	Х	Х	Х			
230553	Mechanical Identification		Х	Х					Х

	Item	Requirements							
Spec Section		Submittals			Supplemental		Factory	Training	Extra
		Shop Drawings	Product Data	Include In O & M	Test ³	Report ³	Rep Super- Vision At Site	Req'd At Site	Material
230593	Testing ,Adjusting and Balancing	Х		X	Х	x			
230700	Mechanical Insulation		Х	x					
230900	Instrumentation and Control for Mechanical	х	х	х		x	x	х	
232316	Refrigeration Specialties		Х	Х					
233113	Metal Ducts	Х	Х	Х	Х	Х			
233300	Air Duct Accessories		Х	Х		х			Х
233600	Air Terminals Units		Х	Х					
233713	Diffusers, Registers & Grilles		Х	Х					Х
238126	Ductless Split Systems		Х	X					
Notes:	 ¹ For Starters and Variable Frequency Drives ² Requires Review & Approval of calibrated balance valves from T & B Contractor ³ See Specific Specification Section for Test & Certification Requirements 								

1.31 MECHANICAL EQUIPMENT CONNECTION SCHEDULES

- A. Mechanical Equipment:
 - 1. Refer to Mechanical Equipment Schedules on the drawings.
 - 2. All equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule coordinated by the contractor and submitted prior to bid. The exact furnishing and installation of the equipment is left to the Contractors involved and manufacturers installation instructions. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load
			voltage)
1. Mechanical Equipment Motors			
 2. Special Equipment (i.e., elevators, etc.) a. Motors b. Magnetic Motor Starters c. Disconnect Switches d. Thermal OL Switches e. Manual Operating Switches 			
 Motor Starters, combination motor starter/disconnect and Variable Frequency Drives Automatically controlled, with or without HOA switches. Manually controlled. Starters integral with motor control center including control relays and transformers. Combination Starter/Disconnects 			
4. Pushbutton stations, pilot lights			
5. Disconnect switches, thermal overload switches, manual operating switches.			
6. Multi-speed switches			
7. Control relays, transformers.			
8. Non-load voltage control items.			
 Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc. 			
10. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
11. Control circuit outlets			
a. Load voltage control items such as line voltage thermostats not connected to control panel systems.			
b. Non-load voltage control items.			
c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.			

ITEM SUBMITTAL TO BE FILLED OUT BY CONTRACTOR PRIOR TO BID	FURNISHED BY	SET BY	CONTROL WIRING (non-load voltage)
d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.			
e. Control circuit outlets			
 Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc. 			
13. Fire protection controls (Including flow switches)			
14. Duct smoke detectors, including relays for fan shutdown.			
15. Temperature Control Panel			
16. Interlocks			

G = General, Division 13 or 14

M = Mechanical, Division 23

E = Electrical, Division 26

V = Vendor or Factory – Installed wiring

END OF SECTION 23 05 00

SECTION 23 05 10 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Refer to Division 1 and Section 23 05 00 "Common Work Results for Mechanical" for administrative and procedural requirements for submittals.
- B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.
- C. Welding Certifications: Submit reports as required for piping work.
- D. Brazing Certifications: Submit reports as required for piping work.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- C. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as follows: B31.1 Power Piping Code / B31.2 Fuel Gas Piping Code / B3.1.3 Process Piping/ B31.5 Refrigeration Piping / B31.9 Building Service Piping Code.
- D. Before any welding is performed, the contractor shall submit to the Architect/Engineer, or his authorized representative, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by ASME Boiler and Pressure Vessel Code.
- E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.
- F. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where

type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS

- A. Black Steel Pipe: ASTM A 53, Grade B, type E, electric resistance welded (2" and larger)
- B. Black Steel Pipe: ASTM A 53, Grade A, type F, continuous welded (sizes below 2")
- C. Seamless Steel Pipe: ASTM A 53, Grade B, type S or A106 high temperature.
- D. Cast-Iron Flanged Fittings: ANSI/ASME B16.1, including bolting (Class 125 and 250).
- E. Cast-Iron Threaded Fittings: ANSI/ASME B16.4 (Class 125 and 250).
- F. Malleable-Iron Threaded Fittings: ANSI/ASME B16.3; plain or galvanized as indicated (Class 125 and 300).
- G. Malleable-Iron Threaded Unions: ANSI B16.39, Class 150, 250 or 300; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metalto-metal seats (iron, bronze or brass); plain or galvanized as indicated (Class 150, 250 and 300).

2.3 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn temper, except as otherwise indicated.
- B. ACR Copper Tube: ASTM B 280.
- C. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
- D. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
- E. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).
- F. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
- G. Cast-Copper Flared Tube Fittings: ANSI B16.26.
- H. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300).
- I. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
 - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- B. Soldering Materials: All soldering materials shall be lead free.
 - 1. 95-5 Tin-Antimony: ASTM B 32, Grade 95TA. Melting Range 450-470 degrees F.
 - 2. Silver-Tin Alloy: Fed. Spec. QQ-S-571E, NSFC2. Melting Range 430 to 530 degrees F.
 - 3. Flux: All flux shall be lead free, water soluble, and compatible with the solder and the materials being joined. ASTM B813-93.
- C. Brazing Materials: Except as otherwise indicated, provide brazing materials to comply with installation requirements.
 - 1. Comply with AWS A5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
 - a. Copper phosphorus -Bcup-5, 15 percent solder content, melting range 1190 to 1480 degrees F.
 - b. Silver BAg-36, 45 percent silver, cadmium-free. Melting range 1195 to 1265 degrees F.
- D. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.
 - 1. Manufacturer: Subject to compliance with requirements, provide piping thread sealant material of the following:
 - a. The Rectorseal Corporation

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated

service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.

- 1. Comply with ANSI B31 Code for Pressure Piping.
- 2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
- 3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- 4. Use fittings for all changes in direction and all branch connections.
- 5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- 6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- 7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- 8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- 9. Install drains in pressure pipe systems at all low points in mains, risers, and branch lines consisting of a tee fitting, ³/₄ inch ball valve, and short ³/₄ inch threaded end nipple and cap with chain.
- 10. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- 11. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 23, Sections 23 05 18 and 23 05 09 for materials.
- 12. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals (See Section 23 05 18). Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
- 13. Anchor piping to ensure proper direction of expansion and contraction.
- 14. Coordinate foundation and all other structural penetrations with structural engineer.
- B. Refrigerant Piping:
 - 1. General: Install refrigerant piping in accordance with ASHRAE Standard 15 "The Safety Code for Mechanical Refrigeration."
 - 2. Install piping in as short and direct arrangement as possible to minimize pressure drop.
 - 3. Install piping for minimum number of joints using as few elbows and other fittings as possible.
 - 4. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
 - 5. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
 - 6. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

- a. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- 7. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- 8. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- 9. Slope refrigerant piping as follows:
 - a. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
 - b. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - c. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - d. Liquid lines may be installed level.
- C. Condensante Drain Piping:
 - 1. Condensate drain piping from air conditioning unit coil condensate drain pan shall be of the sizes shown on the drawings.

3.3 PIPING SYSTEM JOINTS

- A. General: Provide joints of type indicated in each piping system.
- B. Refrigerant Piping:
 - 1. Ream ends of pipe and tubes and remove burrs
 - 2. Fill pipe with dry nitrogen and purge during brazing to prevent scale buildup
 - 3. Braze joint per AWS Brazing handbook
 - a. Use Type BCuP (copper phosphorus) alloy for copper to copper joints
 - b. Use BAg (cadmium silver) to join copper to bronze or steel
 - 4. Leak Test:
 - a. Comply with ASME 331-5 Chapter VI
 - b. Test high and low side piping separately
 - 1) Fill system with dry nitrogen to test pressure
 - 2) Test joints and fittings with leak detector at all joints
 - 3) Remove leaking joints with new materials and retest. Once test is correct and system holds pressure for 24 hours evacuate to 500 micrometers and hold for 12 hours. Break vacuum with nitrogen and re-evacuate to 500 micrometers and hold for 2 hours. Break vacuum with refrigerant and charge per manufacturer requirements.

3.4 PIPING APPLICATION

A. Equipment Drains and Overflows, Cooling Coil Drain Pan Piping, Condensate Drains:

- 1. Type "M" or "DWV" copper.
- B. Refrigerant Piping:
 - 1. Type ACR copper, cleaned, dehydrated and capped at the factory. Wrought copper fittings, brazed joints with nitrogen purge.

3.5 PIPING TESTS

- A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible and remove control devices before testing. Test each section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
- B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.
- C. Work to be installed shall remain uncovered until the required tests have been completed.
- D. Piping which is to be concealed shall be tested before being permanently enclosed.
- E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.
- F. Give a minimum of twenty-four hours' notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of owner, agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.
- G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.
- H. All costs involved in these tests shall be borne by Contractor.
- I. System Tests
 - 1. Compressed Air or Nitrogen Test: Compressed air tests may be substituted for hydrostatic tests only when ambient conditions or existing building conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing. For tests of this type, the piping system shall be subjected to the gas pressure indicated for that specific system. The piping capped or plugged and water-pumped with oil free air, or a nitrogen bottle shall be introduced into the entire system to the pressure specified. The system shall maintain that pressure for the duration of a soapy water test of each joint.
 - 2. Test all refrigerant piping systems with nitrogen at 300 psig pressure on high side of system, and at 150 psig pressure on low side of system. Maintain pressure without loss for a time period of not less than 4 hours. After test has been completed, the piping shall be evacuated by means of a vacuum pump for a period of not less than 24 hours or until system has been completely evacuated.

- 3. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- 4. Drain test water from piping systems after testing and repair work has been completed.

3.6 ADJUSTING AND CLEANING

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
 - 1. Inspect pressure piping in accordance with procedures of ASME B31.
- B. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- C. Chemical Treatment: Provide hydronic systems with a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing. Refer to 232500.

END OF SECTION 230510

SECTION 230529 – HANGERS AND SUPPORTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
 - 2. Duct Hangers: SMACNA Duct Manuals
 - 3. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-69.
 - 4. NFPA Compliance: NFPA 99 shall be used for medical gas systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
- C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
- D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers and Supports:

- a. B-Line Systems Inc.
- b. ANVIL International
- c. PHD Manufacturing, Inc.
- d. Unistrut Metal Framing Systems
- e. Erico
- f. Grinnell
- 2. Duct Cable Hangers and Supports:
 - a. Gripple Inc.
 - b. Ductmate Industries
 - c. Grip Lock Systems

2.2 PIPE HANGERS & SUPPORTS

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-69.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
 - 3. Comply with MSS_SP58 types 1 through 58
 - 4. Oversize hanger for insulated piping
- B. Adjustable Clevis Hanger: MSS Type.
 - 1. Steel and Copper Pipe, size 3/8" thru 30", Type 1.
 - 2. Non-insulated Copper Pipe, size 1/2" thru 4", Type 1. (PVC Coated)
 - 3. Insulated pipe oversize hanger to accommodate insulation.
- C. Pipe Clamps: MSS Type.
 - 1. Steel Pipe, size 3/4" thru 24", Type 8, 3 or 42.
 - 2. Copper Pipe, size 1/2" thru 4", Type 8, 3 or 42 (PVC Coated).
- D. U Bolts: MSS Type .
 - 1. Steel Pipe, size 1/2" thru 30" Type 24
 - 2. Copper Pipe, size 1/2" thru 8", Type 24 (PVC Coated).
- E. Straps: MSS Type 26.
- F. Hanger Rods: Continuous threaded steel, sizes as specified.
- G. Hangers:
 - 1. Hot Pipes:
 - a. 1/2" through 1-1/2": Adjustable wrought steel ring.
 - b. 2" through 5": Adjustable wrought steel clevis.
 - c. 6" and Over: Adjustable steel yoke and cast iron roll.

- 2. Cold Pipes:
 - a. 1/2" through 1-1/2": Adjustable wrought steel ring.
 - b. 2" and Over: Adjustable wrought steel clevis.
- 3. Multiple or Trapeze: Structural steel channel (with web vertical and engineered for the specific applications), with welded spacers and hanger rods. Provide cast iron roll and base plate for hot pipe sizes six inches and over. Provide hanger rods one size larger than for largest pipe in trapeze. If the deflection at center of trapeze exceeds 1/360 of the distance between the end hangers, install an additional hanger at mid-span or use a larger channel.
- H. Wall Supports for Horizontal Steel Pipe:
 - 1. $\frac{1}{2}$ inch through 4inches: Offset or straight j-hook.
 - 2. 4 inches and Over: Welded steel bracket Type 31, 32 or 33 and wrought steel clamp. Provide adjustable steel yoke and cast-iron roll Type 44 for hot pipe 200 degrees F and over and for sizes six inches and over.
- I. Supports for Vertical Pipe: Steel riser clamp. Type 8 or 42.
- J. Upper Attachments:
 - 1. For attaching hanger rods to structural steel I-beams:
 - a. Provide adjustable beam clamp, MSS-Type 20, 21, 28, 29, or 30. Attach to bottom flange of beam.
 - 2. For attaching hanger rods to bar joists:
 - a. When bottom chord is constructed of structural steel angles, provide square washer. Place hanger rod between backs of the two angles and support with the washer and dual locking nuts on top of the angles. Spot weld washer to angles.
 - b. When bottom chord is constructed of round bars, provide Elcen No. 137 bar joint washer or equal.

2.3 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- PART 3 EXECUTION
- 3.1 INSPECTION
 - A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Review Structural Drawings to obtain structural support limitations.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. Provide Shop Drawing showing method and support locations from structure.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

- A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
- B. Existing Construction:
 - 1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. 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. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
- C. Prevent electrolysis and abrasion in support of copper tubing by use of hangers and supports which are plastic coated, or with EPDM isolation strips. Duct tape or copper coated hangers are not acceptable.
- D. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.
- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.
- G. Insulated Piping: Comply with the following installation requirements.
 - 1. Shields: Install galvanized steel protection shields, on all insulated piping 2 inches and less, except where required to be clamped. Where necessary to prevent dislocation, strap shield to pipe with wire ties or "Zip Strips".
- H. Place a hanger within one foot of each horizontal elbow.
- I. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.
- J. Support vertical steel and copper piping at every story height but at not more than 15 foot intervals for steel and 10 feet for copper.
- K. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers. Provide rubber oversized inserts on pipe clamps to allow movement.
- L. Where practical, support riser piping independently of connected horizontal piping.
- M. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.
- N. Prevent copper tubes from making contact with steel brackets/hangers using fire retardant poly inserts or other dielectric material. Duct tape is not allowed.

3.5 SHEET METAL DUCT HANGERS AND SUPPORTS

- A. Provide in accordance with SMACNA HVAC duct construction standards.
- B. Cable duct support systems:
 - 1. Type ZA2 Zinc housing with stainless steel spring.
 - 2. Galvanized high tensile steel cable provided by the same manufacturer as the fastener system.
 - 3. Select hangers and cables for a minimum of 5:1 working load safety factor.
 - 4. Cable duct support systems shall not be used in chlorinated or swimming pool environments.
 - 5. Provide 316 stainless steel fastener and cable when used for support of stainless steel or aluminum ductwork.
- C. Additional Hanger Requirements:
 - 1. 2" to 24" from flexible connections of fans.
 - 2. 2" to 24" from the outlets or flexible connections of VAV control units or mixing boxes.
 - 3. 12" to 36" from the main duct to the first hanger of long branch ducts.
 - 4. 2" to 12" from the ends of all branch ducts and linear diffuser plenums.
 - 5. 2" to 24" from fire damper break-away joints.
 - 6. Hangers at throat and heal of round or square elbows 48" or greater in diameter or width.

3.6 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours at welded surfaces match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe. Cut off the bottom of threaded rods so they are no more than one rod diameter below the bottom nut.
- B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230553 – IDENTIFICATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Existing Building Standards: Comply with the existing building identification system for lettering size, length of color field, colors and identification method unless otherwise indicated.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Schedules: Submit valve schedule for each piping system. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for identification (if any). Only tag valves which are intended for emergency shut-off and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut off valves. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
- B. Mechanical Identification: Equipment signs, pipe labels, duct labels, valve tags, and stencils
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Brimar Industries, Inc.
 - 4. Carlton
 - 5. Industrial Safety Supply Co., Inc.
 - 6. Kolbi
 - 7. Seton Name Plate Corp.
 - 8. PVC Specialties
 - 9. Marking Services, Inc. (MSI)

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Insulation: Furnish 1-inch-thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F. or greater. Cut length to extend 2inches beyond each end of plastic pipe marker.
- C. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2inch.
- D. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.
- E. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, duct markers.
- B. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.
- C. Nomenclature: Include the following:
 - 1. Direction of air flow.
 - 2. Duct service (supply, return, exhaust, etc.)

2.5 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2inches wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6inches, 2-1/2inches wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4inch high letters and sequenced valve numbers 1/2inch high, and with 5/32inch hole for fastener.
 - 1. Provide 1-1/2inch diameter tags, except as otherwise indicated.
 - 2. Fill tag engraving with black enamel.
- B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), and solid brass S- hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.
- C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

- A. General: Install markers or stencils to identify air supply, return, exhaust, intake, outdoor, and relief ductwork and duct access doors with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color). For Existing building identification, match the method which exists in the building.
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.
- D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.
3.3 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers and identification for all piping installed on project. Use nomenclature and abbreviations as listed on drawings, in the schedules and legends. Submit list with product submittal for review.
- B. General: Install pipe markers of the following type on each system indicated to receive identification and include arrows to show normal direction of flow. Existing building identification shall match the existing method in the building.
- C. Plastic pipe markers, color per ASME A13.1, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
- E. Near each valve and control device.
- F. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
- G. Near locations where pipes pass through walls or floors/ceilings or enter non-accessible enclosures.
- H. At access doors, manholes and similar access points which permit view of concealed piping.
- I. Near major equipment items and other points of origination and termination.
- J. Spaced intermediately at maximum spacing of 25 feet along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.
- K. On piping above removable acoustical ceilings.
- L. Install identification and label the following piping systems:
 - 1. Heating Water supply and return
 - 2. Refrigerant piping
 - 3. "All" piping installed in project. Use name as listed in legends and schedules.

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.
 - 1. Building services main shut-off valves.
 - 2. Each individual system main shut-off valves.
 - 3. Each individual system riser shut-off valves.
 - 4. Each individual system floor shut-off valves.
 - 5. Each individual system major branch shut-off valves.

- B. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.
- C. Where more than one major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.

3.5 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers testing and balancing of environmental systems described herein and specified under Division 23. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm.

TEST, ADJUST AND BALANCE THE FOLLOWING MECHANICAL SYSTEMS AND THE MECHANICAL EQUIPMENT ASSOCIATED WITH THESE SYSTEMS:

- a. General Systems and Equipment Procedures.
- b. Air Side Systems and Equipment
 - 1) Supply/Return Air Systems
 - 2) General Exhaust Systems
- c. Hydronic Systems and Equipment
 - 1) Hydronic coils
- d. Refrigeration Systems and Equipment
 - 1) General
- e. Control Systems and Equipment
 - 1) General

1.2 QUALIFICATIONS OF CONTRACTOR

- A. The Mechanical Contractor shall procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. An independent contractor is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity, which installs mechanical systems.
- B. The actual fieldwork shall be performed by qualified technicians who are currently certified by the Testing, Adjusting and Balancing Bureau (TABB), the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC) certification agencies.
- C. The Testing & Balancing Contractor shall have a minimum of three years experience in testing and balancing mechanical systems.
- D. The Test & Balance Contractor shall have previous experience in testing and balancing variable air volume laboratory fume hood systems in the last two years. Qualification submission must include a detailed resume describing past project experience in laboratory variable air volume

systems, a list of projects, including peoples' names, phone numbers and addresses of references.

1.3 APPROVAL OF CONTRACTOR

- A. The following firms are preferred contractors to complete the work. Any Testing and Balancing firm desiring to offer their services for this work and who are not listed below, shall submit their qualifications to the Architect //OR Engineer, not less than [seven (7)] working days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.
 - 1. Blue Sky
 - 2. NWESI
 - 3. Evolve
 - 4. Accurate Air
 - 5. BST
- B. Firms who are not listed, or who have not received prior approval shall not be approved to complete work on this project.

1.4 CODES AND STANDARDS

- A. ASHRAE: ASHRAE Handbook, Applications Volume, Testing, Adjusting, and Balancing Chapter.
- B. NEBB: "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems."
- C. SMACNA: "HVAC Systems-Testing, Adjusting & Balancing."

1.5 PRELIMINARY SUBMITTALS

- A. Within ten (10) days of award of the contract the Mechanical Contractor shall submit the name of the Test and Balance Contractor who will be performing the work. The submittal shall include a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB, AABC, or TABB certification agencies. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work without prior approval of the Engineer, who are not included in the submittal, shall be grounds for rejecting the test and balance report and the project in whole.
- B. Meet all requirements of Section 23 05 00 "Common Work Results for Mechanical" as applicable.
- C. Submit a list of all instrumentation to be used on an individual project and include calibration dates. Submit calibration curves. If more than one instrument of a similar type is used, a comparison of individual readings should be made. The variation between instrument readings should not exceed plus or minus 5%.

1.6 FINAL REPORTS

- A. Refer to Division 1 for supplemental requirements.
- B. The Testing and Balancing Contractor shall submit the final testing and balancing report at least fifteen (15) calendar days prior to substantial completion, unless noted otherwise in Division 1. Report contents shall be per Part 3 of this Section.
- C. Meet all requirements of Section 23 05 00 "Common Work Results for Mechanical" as applicable.
- D. If more than two reports are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

1.7 SEQUENCING AND SCHEDULING

- A. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.
- B. Prepare a project schedule. Schedule shall indicate critical path of the balancing process and shall incorporate both requirements of other contractors necessary to meet test and balance commitments and process flow of test and balance work. Coordinate with general and mechanical contractors and insert critical steps into project master schedule.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES – REMODEL WORK

A. In remodel area, a complete preliminary test and balance report shall be accomplished prior to any work. Any obvious deficiencies shall be identified at that time. A complete report of all readings, recommendations, etc. shall be submitted to the Engineer.

3.2 GENERAL SYSTEM AND EQUIPMENT PROCEDURES

- A. Balance all air and water flows at terminals within +10% to -5% of design flow quantities. Notify Contractor/Engineer/Architect in writing of conditions detrimental to the proper completion of the test and balance work. Provide the Contractor/Architect/Engineer with a copy of the notification.
- B. Pressure relationships indicated on drawings shall take priority over air quantities.
- C. Mark equipment settings with paint, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

- D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommend by the original installer.
- E. Measure, adjust and report equipment running motor amps and power factor, KW, rated motor amperage, listed motor power factor, voltage, and all nameplate data. Perform these measurements for all equipment operational modes.
- F. Check and adjust equipment belt tensioning.
- G. Check keyway and setscrew tightness. Report any loose screws and notify Mechanical Contractor prior to equipment balancing.
- H. Record and include in report all equipment nameplate data.
- I. Verify that all equipment safety and operating controls are in place, tested, adjusted and set prior to balancing.
- J. Verify that manufacturer start-up has occurred per specification prior to balancing.

3.3 AIR SIDE SYSTEMS AND EQUIPMENT PROCEDURES

- A. In addition to the procedures identified under each specific heading below, provide general data required by 3.3 above.
- B. Filters shall be restricted to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final airflows for fans. Check fan motor amps with clean filters and simulated loaded filters, and report for each piece of equipment. Equipment shall be supplied with clean filters upon completion of balance. Balance and report air quantities.
- C. Supply/Return Air Systems:
 - 1. Balance and report supply and return diffuser/grille quantities. Air diffusion patterns shall be set as noted on drawings and to minimize objectionable drafts and noise.
 - 2. Provide full pitot traverses in duct mains downstream of supply fans, upstream of return fans, and in each zone duct downstream of a multizone unit. For VAV systems perform these at the system diversity condition (if any). Balance and report air quantities.
 - 3. Provide full pitot traverses at each air terminal or duct coil. For VAV systems, perform these at zone maximum air condition. Balance and report air quantities.
 - 4. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.
 - 5. Balance and report the above measurements in all system operational/modes.
 - a. Minimum outside air and 100% outside air economizer mode.
 - b. VAV maximum zone air condition and system diversity condition.
 - c. Unoccupied mode.
 - d. Two-speed fan, both speeds.
 - e. VFD bypass mode and full system demand.
 - 6. Report final adjusted K-factors for all terminal boxes.
- D. General Exhaust Systems:

- 1. Balance and report exhaust grille quantities. Report objectionable noise.
- 2. Provide full pitot traverses at each individual exhaust riser and at each exhaust fan. Balance and report.
- 3. Report design air device inlet or outlet size, actual inlet or outlet size, design and actual velocity through the orifice, for each terminal in the system.

3.4 REFRIGERATION SYSTEMS AND EQUIPMENT

- A. General.
- B. Evaporator Coils:
 - 1. Measure and report temperature upstream and downstream of evaporator coils at all stages of cooling at all design air quantities. Calculate and report coil face velocities.

3.5 CONTROL SYSTEMS AND EQUIPMENT

- A. General:
 - Operate all temperature control systems with the temperature control contractor's representative for proper sequence of operation. Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air system flow measurement stations including VAV terminals shall be calibrated against a Pitot tube traverse or air diffuser capture hood. Balancing Contractor shall assure accuracy of all flow measurement devices or shall report their failure to be accurate.
 - 2. Work with the Controls Contractor to set minimum outside air damper positions.
 - 3. Work with the Controls Contractor to optimize VAV duct static pressure, VFD pump hydronic system pressure differential and building pressure.

3.6 REPORT OF WORK

- A. The Testing and Balancing Contractor shall submit electronic copies of the final testing and balancing report at least fifteen (15) calendar days prior to the Mechanical Contractor's request for final inspection.
- B. A complete reduced set of mechanical contract drawings (showing each system) shall be included in the report with all equipment, flow measuring devices, terminals (outlets, inlets, coils, fan coil units, schedules, etc.) clearly marked and all equipment designated. The test and balance contractor can obtain drawing files from Cator, Ruma, & Associates for development of these drawings.
- C. Data shall be reported per Part 3 of this Section on standard NEBB, TABB, or AABC forms. Generate custom forms that contain the information in this Section when a standard form does not exist for a piece of equipment. All forms shall be fully filled out for this report. When additional information is required by this Section, it shall be provided
- D. The report shall include a list of all equipment used in the testing and balancing work.
- E. Report systems for excessive sound and vibration per the sound and vibration inspection and testing portions of this specification.

- F. Substantial completion of this project will not take place until a satisfactory report is received. The Testing & Balancing Contractor shall respond and correct all deficiencies within seven (7) days of receiving the Engineer's written review of the balancing report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the Engineer.
- G. The report shall be signed by the supervising registered professional engineer and affixed with their registration stamp, signed and dated in accordance with state law.

3.7 GUARANTEE OF WORK

A. The Testing & Balancing Contractor shall guarantee the accuracy of the tests and balance for a period of 90 days from date of final acceptance of the test and balance report. During this period, the Testing & Balancing Contractor shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.

END OF SECTION 230593

SECTION 230700 – INSULATION FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical 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. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc. label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.
- D. Definitions
 - 1. ASJ: All Surface Jacket.
 - 2. FSK: Foil Scrim Kraft.
 - 3. MRT: Mean Temperature Rating.
 - 4. NRTL: Nationally Recognized Testing Laboratory
 - 5. PCF: Pounds per Cubic Foot.
 - 6. PSF: Pounds per Square Foot.
 - 7. SSL: Self Sealing Lap
- E. Codes and Standards:
 - 1. International Energy Conservation Code, currently adopted version.
 - 2. ASHRAE 90.1, latest edition.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 - 1. Mechanical Insulation:
 - a. Johns Manville Corp.
 - b. Owens-Corning Fiberglas Corp.
 - c. Knauf Fiber Glass
 - d. Manson
 - e. CertainTeed
 - f. Einsulation
 - g. Armacell
 - h. Pittsburgh Corning Corp.
 - i. Aeroflex.
 - j. PABCO, Inc.
 - k. Rubatex Corp.
 - I. Thermal Structures
 - 2. Jacketing & Covering Products:
 - a. Childers
 - b. Ceel-Co
 - c. Zeston
 - d. Alpha Associates, Inc.
 - e. Venture Tape
 - f. Polyguard

2.2 PIPING INSULATION MATERIALS

- Fiberglass Piping Insulation: ASTM C 547, Class I unless otherwise indicated. ASJ-SSL Jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, Beach Units puncture 50 oz. in/in, permeability 0.02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint.
 "K" factor shall be maximum 0.23 at 75°F MRT, 0.24 at 100°F MRT, 0.29 at 200°F MRT and 0.36 at 300°F MRT.
- B. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2. Permeability of 0.00 perm. Preformed pipe insulation with factory-applied all-service jacket with self-sealing lap. "K" factor shall be maximum 0.28 at 50°F MRT, 0.29 at 75°F MRT, 0.31 at 100°F MRT, 0.38 at 200°F MRT and 0.45 at 300°F MRT.
- C. Calcium Silicate Piping Insulation: ASTM C533, Type I. "K" factor shall be maximum 0.538 at 500°F mean temperature, ASTM C165 compression strength >100 psi for 5 percent compression, transverse strength 200 psi for 5 percent compression, flexural strength 60 psi.

- D. Flexible Elastomeric, Closed Cell Piping Insulation: ASTM C 534, Type I. Water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slit to be slipped over piping as a single piece. "K" factor shall be maximum 0.245 at 50°F MRT, 0.25 at 75°F MRT and 0.26 at 90°F MRT.
- E. Jackets for Piping Insulation:
 - 1. ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
 - 2. Fitting Covers: UV resistant PVC, pre-molded fitting covers, flame spread 25, smoke developed 50. PVC tape for cold systems, serrated tacks or PVC tape for hot systems.
 - Self-Adhesive Laminate Jacketing: Heavy duty multilayered laminate coated with an acrylic pressure sensitive adhesive. Embossed aluminum surface. Zero permeability vapor barrier for insulation cladding and jacketing applications. Superior resistance to weathering, mold, UV, and extreme environmental conditions.
 - a. Product thickness (flat): 17.5 mils
 - b. Product Thickness (embossed): 24.0 mils
 - c. Peel Adhesion: 100 oz/in
 - d. Tensile Strength: 187 lb/in
 - e. Puncture: 68 lbs
 - f. Water Vapor Transmission Rate (ASTM E96): 0.0
 - g. Service Temperature: -94 to 248 °F
 - h. VentureTape 1579GCW-E (VentureClad Plus) or equivalent.
 - 4. Aluminum Jacketing: Manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16" corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be 0.016" thick minimum. Provide matching factory fabricated covers for 90-degree and 45-degree elbows, tee fittings, flange fittings valve bodies, blind ends, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.
 - 5. PVC Jacketing: UV resistant PVC, 30 mil thick, flame spread 25, smoke developed 50, factory cut and curled to fit outside diameter of insulated pipe. Solvent weld adhesive for sealing joints and seams.
 - 6. Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized Mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, flanges, valves, and other fittings. Alpha Associates Style TGH-1000 or equal.
 - 7. Cloth Jacketing Material: Not less than 8 oz. per square yard with adhesives, cement and sealer as recommended by insulation manufacturer for the intended application. PVC premolded fitting covers shall not be provided.
- F. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- G. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

2.3 DUCTWORK INSULATION MATERIALS

- A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class I, 450°F temperature limit, density of 3 PCF. "K" value shall be maximum 0.23 at 75°F mean temperature, vapor transmission rating shall not exceed 0.02 perms, FSK facing.
- B. Round Surface Semi-Rigid Fiberglass Blanket Insulation: ATSM C 612, Class I, 450°F temperature limit, 2.5 PCF density "K" value of 0.25 max at 75°F mean temp, FSK facing. Orientation of fibers shall be perpendicular to facing to facilitate application on round surfaces.
- C. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, 3/4 lbs per cu. ft. density. "K" value shall be maximum 0.30 at 75°F mean temperature, 250°F temperature limit, vapor transmission rating shall not exceed 0.02 perms, FSK facing.
- D. Flexible Elastomeric Closed Cell Insulation: ASTM C534, Type II, "K" value shall be a maximum 0.28 at 75°F mean temp, 220°F Temperature limit, water vapor permeability rating of 0.10 perm inches or less.
- E. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient. Type I maybe used for all at Contractors option.
 - 1. Aluminum Jacketing: The jacketing shall be manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16-inch corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be 0.016 inches thick minimum. Where available, provide matching factory fabricated covers for 90-degree and 45-degree elbows, tee fittings, branch fittings, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.
 - 2. Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized Mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, and other fittings. Alpha Associates Style TGH-1000 or equal.
 - 3. Flexible closed cell elastomeric insulation shall be coated with two coats Armaflex WB Finish or other UV and weather coating. Barrier product recommended by the insulation manufacturer.
- F. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- G. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 MINIMUM INSULATION REQUIREMENTS

A. All mechanical systems shall be insulated in accordance with the locally adopted energy codes or the requirements of this specification section, whichever is more stringent.

3.2 GENERAL

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Insulation shall be installed to allow maintenance and replacement of system components without compromising the insulation integrity or vapor barrier on cold systems.
- C. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

3.3 HVAC PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on steam condensate piping between steam trap and union; and on hot piping unions, flexible connections, and expansion joints. Insulation may be omitted inside of cabinet unit heaters, convectors and fan coils for hot piping. Cold piping insulation inside fan coil unit cabinet may be omitted provided piping is located over drain pan. Hot and cold piping routed inside air handler units shall be insulated. Omit insulation on strainers in heating water strainers operating below 200°F.
 - B. Sub-Freezing Piping (39°F and Lower):
 - 1. Application Requirements: Insulate the following piping systems:
 - a. Refrigerant suction lines between evaporators and compressors.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Above Ground, Inside Building, Elastomeric:
 - 1) 1/2-inch-thick insulation on pipe sizes smaller than 1 inch.
 - 2) 1-inch-thick insulation on pipe sizes 1 inch to 6 inch.
 - 3) 1.5-inch-thick insulation on pipe sizes 8 inch and larger.
 - b. Above Ground, Exterior, Cellular Glass:
 - 1) 3/4-inch-thick insulation on pipe sizes smaller than 1 inch.
 - 2) 1.5-inch-thick insulation on pipe sizes 1 inch to 8 inch.
 - 3) 2-inch-thick insulation on pipe sizes larger than 8 inch.
 - C. Cold Piping (40 to 60°F):

- 1. Application Requirements: Insulate the following piping systems:
 - a. Cold condensate drain piping.
- 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Above Ground, Inside Building, Fiberglass:
 - 1) 1/2-inch-thick insulation on pipe sizes 1-1/4 inch and smaller.
 - 2) 1-inch-thick insulation on pipe sizes 1-1/2 inch and larger.
 - b. Above Ground, Exterior, Cellular Glass:
 - 1) 1-inch-thick insulation on pipe sizes 1-1/4 inch and smaller.
 - 2) 1.5-inch-thick insulation on pipe sizes 1-1/2 inch and larger.

3.4 DUCTWORK SYSTEM INSULATION

- A. Insulation Omitted: Do not insulate lined ductwork unless additional wrap is required to meet Energy Code.
- B. Application Requirements: Insulate the following ductwork and equipment:
 - 1. Outdoor air intake ductwork and plenums between air entrance and HVAC unit inlet.
 - 2. Mixed air ductwork and plenums between air entrance and HVAC unit inlet.
 - 3. HVAC supply ductwork between HVAC unit discharge, and room terminal outlet unless ductwork is specified to be lined.
 - 4. HVAC return ductwork in unconditioned spaces or exterior; except omit insulation when ductwork is specified to be lined.
 - 5. HVAC plenums and unit housings not pre-insulated at factory or lined.
 - 6. Rigid oval or round supply air ductwork.
 - 7. Induced draft fan scrolls.
- C. Insulate outdoor, supply, return, makeup and ERV exhaust air ducts with R-6 blaknet insulation with FSK Jacket. If duct is outside envelope use R-12.

3.5 INSTALLATION OF PIPING INSULATION

- A. General: 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 on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

- E. Maintain integrity of vapor-barrier jackets on cold pipe insulation and protect to prevent puncture or other damage.
 - 1. Do not use staples or tacks on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
 - 3. Seal fitting covers with PVC tape.
 - 4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.
- F. Neatly bevel and seal insulation at all exposed edges.
- G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- I. See equipment insulation for removable insulation on accessible piping components.
- J. See Section 23 05 29 for insulation inserts and shields. Butt pipe insulation against pipe hanger insulation inserts. For all piping apply wet coat of vapor barrier lap cement on butt joints and seal all joints and seams with 3-inch-wide vapor barrier tape or band.
- K. Flexible Elastomeric Piping Insulation:
 - 1. Install unslit, by slipping over piping prior to joining, or install pre-insulated soft copper tubing.
 - 2. Seal butt ends with adhesive.
- L. Cellular Glass Insulation:
 - 1. Apply in a single layer. Secure to pipe with $\frac{1}{2}$ inch wide aluminum bands.
 - 2. For indoor applications, apply all-purpose Kraft paper/aluminum foil/vinyl coating jacket. Seal all lap and butt joints with self-seal vapor barrier tape.
 - 3. For outdoor applications, apply aluminum rubber/Tedlar jacketing as described below.
- M. Calcium Silicate Insulation:
 - 1. Apply in a single layer. Secure to pipe with 1/2-inch-wide aluminum bands.
 - 2. For indoor applications, provide canvas jacketing. Adhere joints of jacketing and provide a finish coat of sealant as recommended by the manufacturer.
- **N.** Piping Exposed to Weather: Protect outdoor insulation from weather by installing aluminum or self-adhesive laminate jacketing
 - 1. Aluminum jacketing shall be secured by 1/2-inch-wide stainless steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose pre-fabricated sealing and fastening systems, submit samples and product data for approval.
 - 2. Install self-adhesive laminate jacketing in accordance with the manufacturer's instructions.

3.6 INSTALLATION OF DUCTWORK INSULATION

- A. General: 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.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage.
 - 1. Avoid the use of staples on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation has been installed. Sound attenuators do not qualify for this omission.
- G. Flexible Fiberglass Insulation: Cut back insulation to provide a 2 inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above. Install with a maximum of 25% compression to maintain the manufacturer published installed R-value.
- H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on all external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.
- I. Adhere flexible elastomeric sheets to clean oil-free metal surface by compression fit method and full coverage of adhesive. Seal butt joints with same adhesive. For exterior ductwork, notch insulation at reinforcements and joint flanges to provide a smooth surface, unless the reinforcements or joints would penetrate the insulation. Provide a minimum ½ inch cap over any penetrating item. Stagger all joints and seams on multi-layer insulation.
- J. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing aluminum or self-adhesive laminate jacketing
 - 1. Fabricate rectangular ductwork to have a minimum 1/2" per foot slope on the top surface, and/or slope insulation to prevent ponding.
 - 2. Aluminum jacketing shall be secured by 1/2-inch-wide stainless steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose pre-fabricated sealing and fastening systems, submit samples and product data for approval.

3. Install self-adhesive laminate jacketing in accordance with the manufacturer's instructions. Seal all joints with minimum 4" wide tape having the same properties as the main jacketing system.

3.7 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

3.8 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230700

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, materials and services necessary for a complete, new and functional building automation system (BAS) to allow for automated control of equipment and systems as indicated on the drawings and described herein. Drawings are diagrammatic only and sequences are provided to communicate control intent. It is the responsibility of the contractor to submit on and install a controls system (control points, hardware, software, database and graphics) that will accomplish the design intent, meet safety requirements and integrate, as applicable, to packaged and 3rd party controls.
- B. The Contractor shall become aware of the Method of Procedure requirements outlined in Division 1. When applicable, work affecting systems that must continue to operate to support the owner or the function of the facility will be guided by a written and approved method of procedure. Change orders will not be considered for time associated with planning and executing Method of Procedure requirements.
 - 1. When applicable, the Contractor shall leave operable existing controls in operation until the BAS is tested and proven operative. At that point, and with concurrence from the Owner and the Engineer, the Contractor shall be responsible for removing existing controls that are no longer necessary. Start-up of the BAS system, and any installation work that requires the interruption of the normal operation of any piece of equipment, shall be scheduled with the Owner. If the interruption of the normal operation of any piece of equipment during normal working hours is unacceptable to the Owner, then it shall be scheduled during after-hours (nights or weekends).
- C. When portions of the scope involve modifications or updates to existing control systems the Control System Contractor shall provide new modified control system using new control devices to replace existing devices as indicated. The contractor shall inspect the existing conditions prior to submitting a proposal and recommend enhancements to the scope that mitigate the owner's risk or deliver a higher level of functionality to the end users. Existing temperature control system control devices, dampers, operators, wiring, conduit, air piping, valves, etc. not being modified and which are no longer utilized, shall be removed to the maximum extent possible, and not abandoned in place.
 - 1. When applicable, existing functional temperature control devices to be removed shall be returned to the Owner in good condition.
- D. The Control Contractor (BAS Systems Integrator) will be responsible for support, commissioning, testing and performance verification. At a minimum the contractor shall plan to accomplish the following tasks in support of commissioning activities (reference the commissioning plan and associated specifications for additional requirements where applicable):
 - 1. Coordinate sequence submittal review activities with the engineer, owner and commissioning agent.
 - 2. Perform, document and submit for review calibration verifications and pre-functional testing.

- 3. Support commissioning agent led and authored functional testing and performance verification
- 4. Establish trends and, when applicable, configure trend databases to allow for future system evaluation
- 5. Train the owner's personnel as required by other sections of this specification.
- E. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner or Architect/Engineer in writing prior to bid. Unless approved otherwise, all products (including hardware, software and firmware revisions) used in this installation shall have been used in at least twelve (12) projects prior to this installation. The previous sites may be located anywhere in the U.S.A. This requirement is not intended to restrict the Contractor to the use of any outdated equipment. Therefore, all products used in this installation shall also be currently under manufacture and have projected availability for at least ten years after completion of the contract. If the above requirements are mutually exclusive, the Contractor shall include a specific statement to this effect in the Bid.
- F. Provide electrical work as required, complying with requirements of Division 23, Division 26 and Division 27 sections including, but not limited to raceways, wires, cables, electrical identification, supporting devices and electrical connections for equipment. The demarcation of work and responsibilities is illustrated by the following table are "typical" in our experience and should be used to by bidding contractors (unless other specific direction has been provided by the owner or GC) to ensure that all scope is covered. The GC will ultimately direct work on this project and the contractor shall coordinate with the GC and other divisions on the project prior to installation.

Work	Furnish	Install	Low Volt. Wiring/Tube	Line Power
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
VAV box controller	BAS	23	BAS	26
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers (non-factory)	BAS	23	N/A	N/A
Automatic valves	BAS	23	BAS	N/A
VAV boxes	23	23	N/A	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BAS	23	BAS	BAS
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
Power distribution system monitoring interfaces	26	26	BAS	26
Concrete and/or inertia equipment pads and seismic bracing	23	23	N/A	N/A
BAS interface with Chiller controls	BAS	BAS	BAS	BAS
Chiller controls interface with BAS	23	23	BAS	26
Elect. baseboard heating control (note 1)	23	26	N/A	26

"TYPICAL" BAS RESPONSIBILITY MATRIX:

WESTERN IDAHO YOUTH SUPPORT CENTER 308 EAST HAWAII AVENUE NAMPA, ID 83686

Work	Furnish	Install	Low Volt. Wiring/Tube	Line Power
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Smoke Detectors	26	26	26/BAS	26
Fire/Smoke Dampers (note 2)	23	23	BAS	26
Fire Dampers	23	23	N/A	N/A
Chiller Flow Switches	23	23	BAS	N/A
Boiler wiring	23	23	23	23
Water treatment system	23	23	23	26
Variable speed drives	23	26	BAS	26
Refrigerant monitors	BAS	BAS	BAS	26
Computer Room A/C Unit field-mounted controls	23	23	BAS	26
Fire Alarm shutdown relay interlock wiring	26	26	26	26
Fire Alarm smoke control relay interlock wiring	26	26	BAS	26
Fireman's Smoke Control Override Panel	26	26	26	26
Fan Coil Unit controls	BAS	BAS	BAS	26
Cabinet/Unit Heater controls (note 3)	BAS/23	26/BAS	BAS	26
Packaged RTU space mounted controls	23	BAS	BAS	26
Packaged RTU factory-mounted controls	23	23	BAS	26
Packaged RTU field-mounted controls	BAS	BAS	BAS	26
Cooling Tower Vibration Switches	23	23	26	26
Cooling Tower Level Control Devices	23	23	26	26
Cooling Tower makeup water control devices	23	23	26	26
Starters, HOA switches	26	26	N/A	26
Control damper actuators	BAS	BAS	BAS	26

Note (1) Electric Baseboard Heating Controls – for line voltage stand-alone controls: furnished by Division 23 Mechanical Contractor who furnishes the baseboard units; line voltage controls installed and connected by Division 26 Electrical Contractor. Alternately, controls may be furnished and installed by BAS Systems Integrators for projects requiring Baseboard Heating controls to be integrated into the BAS. Refer to Section 230993 SEQUENCE OF OPERATIONS.

Note (2) Fire/Smoke Dampers: As required, BAS Systems Integrator to provide and ensure OPEN/CLOSE control of Fire/Smoke dampers as coordinated between BAS HVAC systems sequences, controls and overrides, and the Fire Alarm system control status priorities and overrides.

Note (3) Cabinet/Unit Heater Controls – for line voltage stand-alone controls: furnished by Division 23 Mechanical Contractor who furnishes the Cabinet/Unit Heaters; line voltage stand-alone controls installed and connected by Division 26 Electrical Contractor. Alternately, controls may be furnished

and installed by BAS Systems Integrators for projects requiring Cabinet/Unit Heater controls to be integrated into BAS. Refer to Section 230993 SEQUENCE OF OPERATIONS.

- G. Control Contractor shall review, identify and field coordinate location requirements for all necessary control sensors and devices which may be installed by others including the following, but not limited to:
 - 1. Automatic control valves.
 - 2. Flow meters and switches.
 - 3. Outside, return and exhaust air dampers for the supply fan/return fan systems.
 - 4. Modulating dampers.
 - 5. Required wells for insertion thermostats and/or temperature sensing wells.
 - 6. Pressure Sensors.
 - 7. Special Systems and Instrumentation where identified in the Contract Documents.
- H. Refer to other Division 23 sections for installation of instrument wells, valve bodies and dampers in mechanical systems.

1.2 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "on" condition is represented by one discrete signal level and an "Off" condition is represented by a second discrete signal level.
- C. BAS: The total integrated system of operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Systems Integrator and to be interfaced to the associated work of other related trades.
- D. BAS Systems Integrator: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS work.
- E. Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BAS network.

- I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances to provide a single coherent BAS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: Personal Computer from a recognized major manufacturer or a virtual equivalent provided by, or with the consent of the owner.
- L. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BAS Systems Integrator's expense to the designated third-party trade contractor for installation. BAS Systems Integrator shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.
- M. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.
- N. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.
- P. Software: The term "software" and its derivatives when used in this Division shall mean all programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.
- Q. Special Systems: Where identified in the Contract Documents, "Special Systems" refer to any system that requires precise control of variables including but not limited to flow, temperature, and humidity. Such systems may be required for certain laboratory, healthcare, vivarium holding, cleanroom, manufacturing, and other facilities.
- R. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- S. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- T. The following abbreviations and acronyms may be used in describing the work of this Division:

AHJ	Authority Having Jurisdiction
AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
BTL	BACnet® Testing Laboratories
CPU	Central Processing Unit
DDC	Direct Digital Control
DI	Digital Input

DO	Digital Output
EEPROM	Electronically Erasable Programmable Read Only Memory
EMI	Electromagnetic Interference
EOR	Engineer of Record
HD	High Definition
HOA	Hand-Off-Auto
I/O	Input/Output
IT	Information Technology
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NC	Normally Closed
NO	Normally Open
OAT	Outdoor Air Temperature
OEM	Original Equipment Manufacturer (Private label)
OWS	Operator Workstation
PC	Personal Computer
ppm	parts per million
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RH	Relative Humidity
ROM	Read Only Memory
RTD	Resistance Temperature Device
TCP/IP	Transmission Control Protocol/Internet Protocol
UPS	Uninterruptible Power Supply
VAC	Volts, Alternating Current
VAV	Variable Air Volume
VDC	Volts, Direct Current
VPN	Virtual Private Network
VSD	Variable Speed Drive
WAN	Wide Area Network

1.3 SPECIAL SYSTEMS

- A. It shall be the Contractor's responsibility to identify and become familiar with any Special Systems that may be required based upon the nature of the facility use. Such systems may require custom and flexible control algorithms and concepts including cascading controls, PID loops, and precise instrumentation to meet the specified setpoints and tolerances. The Contractor shall be required to submit pre-bid Requests for Clarification to the project Architect/Engineer as needed to address any questions regarding the specific requirements of the project.
- B. Special Systems may require advanced commissioning including but not limited to resiliency testing, operational troubleshooting, and challenge testing. Where Special Systems are identified in the Contract Documents, the Contractor shall identify scope requirements for such testing including direct involvement in the commissioning process and proposed schedule impacts for completion of such testing. Where such Systems or requirements are not explicitly identified in the Contract Documents, the Contractor shall adhere to the Request for Clarification procedure described herein.

1.4 QUALITY ASSURANCE

- A. Contractors Qualifications: Firms regularly engaged in installation and commissioning and servicing of digital control equipment, of types and sizes required, whose firm has been in business in similar service for not less than 5 years. Where Special Systems are identified in the Contract Documents, contractor shall submit (3) examples of similar projects completed within (5) years prior to the current project.
- B. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall have worked with the Control System Manufacturer products for not less than two years' time.
- C. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall be factory-certified on the Control System Manufacturer' control system and shall have documented certification from the manufacture. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
- D. Only those manufacturers specified are allowed to bid temperature controls. All bidders shall make available, upon the Owner's request, open book unit pricing of all materials and labor.
- E. All bidders must have a local office capable of supporting and servicing this installation in the area of the project site. Provide office location, staff qualifications and distance from project site as a portion of the bid package.
- F. Codes and Standards:
 - 1. All equipment and the installation shall comply with the requirements of all applicable local and national codes including but not limited to the currently enforced edition of the International Building, International Fire, International Mechanical and all applicable codes of the National Fire Protection Association including the National Electrical Code.
 - 2. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by UL, C-UL and comply with NEMA standards.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
- G. It will be the responsibility of the Contractor to work in cooperation with the Owner and with all other contractors and employees rendering such assistance and so arrange his work such that the entire project will be delivered complete in the best possible condition and in the shortest time.
- H. Contractor shall be responsible to fully test and validate their system prior to commissioning, training, or turnover. The owner shall not be responsible for additional cost incurred by the project for rework predicated by incomplete, non-operable or deficient systems.
- I. Contractor is responsible to fully support the owner's commissioning process as outlined in the applicable commissioning specifications, commissioning plans and as directed by the commissioning agent.

1.5 SYSTEM DESCRIPTION

A. The BAS shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network

located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. Any and all components of the BAS that are connected via field bus or IP network, including the building controllers, advanced application controllers, application specific controllers, smart sensors, servers and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system.
- C. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The System Integrator administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any field controller, the control system shall continue to operate independently. Failure of the operator workstation(s) (OWS) shall have no effect on the field controllers, including those involved with global strategies.
- D. Where necessary and as dictated elsewhere in these Specifications, a BACnet computing device with the ability to route the same trend log data to an external SQL database shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard database platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification. The contractor shall be responsible to coordinate with the OWNER to understand if an existing instance of SQL will be utilized or if the contractor is to provide and install a dedicated instance for this application.
- E. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 3. Diagnostic monitoring and reporting of BAS functions.
 - 4. Energy management.
 - 5. Standard applications for terminal HVAC systems.
 - 6. Enterprise-wide information and control access.
 - 7. Offsite monitoring and management access.
- F. All points of typical user interface shall be on standard computing devices that do not require the purchase of any special software from the BAS manufacturer for use as a building operation terminal. The primary point of interface on these devices will be a standard Web Browser.
 - 1. Any software required to access, program, maintain or modify the various controller types that comprise the Building Automation System shall be provided to the owner at no additional costs at the conclusion of the project.

1.6 LICENSES AND PROPRIETARY INFORMATION

A. The OWNER shall be the named license holder of all software and system agreements associated with the work. The OWNER shall agree to a manufacturers standard license agreement as a condition of this contract. The OWNER shall not be constricted by the Manufacturer to **FULL** access to the software and programming associated with the system. Access does not include the source code which is proprietary to the Manufacturer.

- B. Project Documentation: All custom software, programs, code, databases, graphic files and drawings (whether hard copy or electronic based files) prepared for this system shall be the exclusive property of the Owner and shall not be reproduced or distributed without prior written permission from the Owner.
- C. The use or reference to the Owner or any of its subsidiaries or any of the facility automation projects shall not be used by the Manufacturer or Contractor in any promotional media, including advertisements, sale brochures, annual reports and client references or endorsements, without prior written permission from the Owner. The Owner reserves the right to restrict or refuse access to any or all of its facilities.

1.7 SUBMITTALS

- A. In addition to the requirements set forth in Division 1 and Division 23 general submittal requirements, the following must be included in the shop drawing submittals:
 - 1. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements indicated.
 - a. Control diagrams: Use at least one individual sheet for each major HVAC system.
 - b. HVAC system flow diagram with sensing, control and interlock devices.
 - c. Internal control panel layouts, control panel cover layouts, pneumatic connections inside control panels.
 - d. Internal control panel layouts, control panel cover layouts, electrical connections inside control panels.
 - e. Ladder-type wiring diagrams showing interlock, monitoring and control wiring to and from equipment provided by Division 25 and Division 26, including control systems equipment.
 - f. Communications wiring schematic drawings indicating interconnections between controllers, servers, workstations and other peripherals.
 - g. Integration points lists which illustrate and indicate the contractor's plan to integrate to third party devices. Points list should clearly define points that required to execute the sequence of operations, points that will be monitored for information and maintenance purposes, points that will be illustrated on the graphical interface and points that will not be mapped into the database (points that return now intrinsic value to operators or the control of the equipment).
 - h. Provide a summary of all hardwired and software points (regardless of whether they appear in drawings or sequences).
 - i. Flow-chart control sequences that represent the contractor's plan to implement the operating intent defined in the drawings and specifications.

- a. Graphics storyboard submittal illustrate representative graphics for each equipment type, device summary table, energy monitoring and other unique graphical interface as required by the project. A list of the color graphic screens (storyboard) to be provided at a minimum:
 - i. Building rendering and/or campus depiction
 - ii. Riser/one-line/Architectural diagrams
 - ii. Flow Diagrams of all equipment/ systems that is controlled and monitored
 - iii. Floor plan that identify all locations of equipment and/or systems
 - iv. Each storyboard graphic shall display the following if applicable:
 - 1. Inputs
 - 2. Outputs
 - 3. Set point Adjustment
 - 4. Schedules
 - 5. Command on/off
 - 6. Programs
 - 7. Trend logs
 - 8. Outside conditions
 - 9. Alarms
 - 10. Datasheets
- 2. Descriptive data and sequence of operations for operating user and application software, including complete operator's manual and programmer's manual.
- 3. Proposed layout of all control transformers for valves, controllers and devices. Clearly indicate the transformer size, connected maximum load and expected operating load (accounting for diversity).
- 4. Point to point and basic function commissioning forms to be used on site for the start, test and check of control components and systems.
 - a. List of specific personnel who will be involved in the system installation and commissioning.
 - b. Instrumentation to be used for testing and calibrating during point to point and basic function testing.
- 5. Pre-Functional performance test documentation and procedures to be used in commissioning control sequences.
- 6. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
- 7. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
- 8. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
- 9. Compressor sizing calculations if required.
- 10. Specific locations for 110 VAC power required for control panels
- B. Contract Closeout Submittals: In compliance with Division 1.
 - 1. Operating and Maintenance Manuals, including:

- a. Backup software copies including system graphics.
- b. Actual control sequence programming with comment line for each programming statement.
- c. Trend list
- d. Shop drawings and product data in Project Record format.
- e. One laminated, non-fading, appropriate size, not to exceed 11 inch by 17 inch copy of each air handling system and each major control system (e.g., heating water, chilled water, etc.).
- 2. Special warranty conditions, special servicing conditions, and expanded warranty or service contract proposals.
- 3. List of recommended spare parts and calibration tools for owner's maintenance staff. Submittal data and shop drawings shall be prepared and submitted in the following formats:
- C. Existing Systems Inventory
 - 1. Where applicable, provide a complete and current BAS site inventory for all existing field and supervisory controllers to be integrated into the new BAS including manufacturer, model number, firmware version, available updates, battery condition, integrations, controlled equipment, and point counts.
 - 2. Site inventory shall be provided on a separate, new USB compatible flash drive.
- D. The BAS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
- E. Submittals shall be in defined packages. Each package shall be complete, shall only reference itself, and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
- F. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Systems Integrator where filing is necessary. Provide a copy of all related correspondence and permits to the Owner
- G. When the Architect/Engineer requires, the Contractor will resubmit with the corrected or additional submittal data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully reviewed.
- H. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description
- I. Contractor agrees that shop drawing submittals processed by the Architect/Engineer are not change orders, that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Architect/Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. The Contractor shall be responsible for space requirements, configuration, performance, changes in bases, supports, structural members and openings in structure, and other apparatus that may be affected by their use.
- J. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents in the form of design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Architect/Engineer, the design drawings and specifications shall control and shall be followed. If

alternates do not meet these requirements, it shall be this Contractor's responsibility to remove them and install material originally specified, at no cost to the Owner.

1.8 DELIVERY, STORAGE AND HANDLING

A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent any equipment damage, and to eliminate all dirt and moisture from equipment. Store all equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND CONTRACTORS

- A. Subject to compliance with requirements, install one of the following systems:
 - 1. Alerton Technologies
 - 2. Automated Logic
 - 3. Delta
 - 4. Honeywell
 - 5. Schneider
 - 6. Andover
 - 7. KMC
 - 8. Distech
 - 9. Sauter Controls
 - 10. Other approved equal

2.2 GENERAL PRODUCTS DESCRIPTION

- A. The BAS shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The BAS shall consist of the following:
 - 1. Building Controllers.
 - 2. Application Controllers.
 - 3. Equipment Controllers.
 - 4. Sensors and Actuators.
 - 5. Local Display Device(s).
 - 6. Mobile Access Portal(s) / Portable Operator's Terminal(s).
 - 7. Dedicated and Mobile Distributed User Interface(s).
 - 8. Network processing, data storage, servers, routers and communications equipment.
 - 9. Other components required for a complete and working BAS.
- C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
 - 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 - a. Hardware points shall not be shared across controllers
 - 2. The System shall maintain all settings and overrides through a system reboot, power outage or other non-destructive power or network disruption.

2.3 BAS SYSTEM ARCHITECTURE

- A. Automation Network
 - 1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 - 2. The BAS shall network multiple user interface clients, application and data servers, automation engines, system controllers and application-specific controllers including but not limited to:
 - a. Building Controllers.
 - b. Advanced Application Controllers.
 - c. Application Specific Controllers.
 - d. Smart Sensors.
 - e. Routers.
 - f. Data Servers.
 - g. Third Party BACnet controllers and peripheral devices with compatibility listed by BACnet International.
 - h. Additional select Field Devices as required.
- B. All BAS devices on the automation network shall be capable of operating at a minimum communication speed of 100 Mbps, with full peer-to-peer network communication.
- C. Network Security To protect the BAS from unauthorized users and computer hackers the Automation Network shall support HTTPS with TLS 1.2 between components, including the Application and Data Server(s), Building Controllers, Mobile User Interfaces and Site Management Portals. Self-signed certificates are installed on supported products, with the option of configuring trusted certificates. Computing devices supplied by the BAS vendor will automatically shut down unused ports to deter unauthorized access. All network switches shall be managed switches.
- D. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

2.4 CONTROL NETWORK

A. Building Controllers shall provide supervisory control over the control network and shall selectively support the following communication protocols:

- 1. BACnet Standard Master-Slave/Token-Passing (MS/TP) Bus Protocol ASHRAE SSPC-135:
 - a. The BCS shall be BTL certified and carry the BTL Label.
 - b. The BCS shall be tested and certified as a BACnet Building Controller (B-BC).
- 2. Lon Works enabled devices using the Free Topology Transceiver (FTT-10a).
- 3. Modbus® TCP and RTU.
- B. Building and equipment controllers shall provide either BACnet Ethernet or BACnet IP "Peer-to-Peer" communications and shall operate at a minimum communication speed of 100Mbps. Application controllers shall operate at a minimum communication speed of 76Kbps.
- C. Control network shall support digital controllers as indicated in plans and specifications.
- D. Default control network communication protocol for this project shall be BACnet/ IP.
- E. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet/IP or BACnet MS/TP Bus.
- F. The PICS will be made available on request by other trades and their vendors prior to bidding.

2.5 NETWORK ACCESS

A. The Contractor shall coordinate closely with the Owner, Engineer and the Commissioning agent to establish the mechanism and ability to access the BAS from remote locations (Remote Access). In most instances the owner will provide a dedicated portal (public static IP) for the system global controller. In some instances, the owner may not accept the inherent risks of allowing the BAS to be accessible remotely or connected to their internal network.

2.6 INTEGRATION

- A. Hardwired
 - 1. Analog and digital signal values shall be passed from one system to another via hardwired connections.
 - 2. There will be one separate physical point on each system for each point to be integrated between the systems.
- B. Direct Protocol (Integrator Panel)
 - 1. The BAS system shall include appropriate hardware equipment and software to allow bidirectional data communications between the BAS system and third-party manufacturers' control panels. The BAS shall have the ability to receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
 - 2. All data required by the application shall be mapped into the Automation Engine's database and shall be transparent to the operator.
 - 3. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BAS software features such as: Control Software, Energy

Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and LAN Communications.

- C. BACnet Protocol Integration BACnet
 - 1. The neutral protocol used between systems will be BACnet IP and comply with the ASHRAE BACnet standard 135 without the use of gateways, unless otherwise allowed by this Section of the technical specifications, specifically shown on the design drawings. If used, gateways shall support the ASHRAE Standard 135 BACnet communications protocol.
 - 2. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - 3. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.
- D. Performance Standards. The system shall conform to the following:
 - 1. Graphic Display: The system shall display a graphic with 20 dynamic points with all current data within 10 seconds.
 - 2. Graphic Refresh: The system shall update a graphic with 20 dynamic points with all current data within 8 seconds.
 - 3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects shall start to adjust within 2 seconds.
 - 4. Object Scan: All changes of state and change of analog values will be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will have been current within the previous 60 seconds.
 - 5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
 - 6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. The System Integrator shall be responsible for selecting execution times consistent with the mechanical process under control.
 - 7. Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
 - 8. Multiple Alarm Annunciation: All workstations on the network must receive alarms within 5 seconds of each other.
 - 9. Network Speed: Minimum 100 Mbps between area and system controllers and all controllers residing on an RS-485/ MSTP network must have a minimum of 76 Kbps.
 - 10. Reporting Accuracy: The system shall report all values with an end-to-end accuracy as listed as or better than those listed in Table 1.
 - 11. Stability of Control: Control loops shall maintain measured variable at set point within the tolerances listed in Table 2.

2.7 FIELD DEVICES

- A. General
 - 1. Field device materials and enclosure ratings shall be suitable for the environment they are exposed to. Instruments located in outdoor instruments shall be NEMA 4 or NEMA 3R.
- B. Electric/Electronic

- 1. Temperature Sensors
 - a. General:
 - 1) Sensors shall be 1000 ohm Platinum or Balco RTDs with the following minimum performance.
 - a) Temperature Coefficient of Resistivity (TCR) of .00385 ohm/ohm/°C for platinum RTD's or .00396 ohm/ohm/°C for Balco RTD's.
 - b) Accuracy of 0.1% at 32 degrees F (Class B) for platinum RTDs and +0.1% at 70 degrees F for Balco RTDs.
 - c) Operating range of 0 to 99% Relative Humidity non- condensing.
 - 2) Thermistors will be acceptable in lieu of RTD provided thermistor carries 5 year guarantee that device will maintain its accuracy within tolerance of ± 0.20°C(0.36°F) between 0°C(32°F) and 65.5°C(150°F), and -17.5°C(0.5°F) between -29°C(-20°F) and 100°C(212°F).
 - If used, transmitters shall provide 2 wire, 4-20 mA current output signal proportional to specified temperature span of transmitter and compatible with DDC equipment.
 - b. Space Temperature Sensors and Thermostats:
 - 1) Coordinate with the architect and the owner to select the proper thermostat for each zone application.
 - Networked thermostats are generally acceptable and the application of unified sensors containing CO2, occupancy or other sensing elements are allowed where those additional sensors serve a specific functional application.
 - Unless otherwise noted each thermostat shall incorporate an accessible setpoint adjustment feature, digital display of space temperature, unoccupied override button and digital display of CO2 or other sensed parameters.
 - 4) Thermostat in a corridor, lobby, atrium, stairwell, lounge, restroom, or other public area (areas not designed for continuous occupancy) must be protected from vandalism and unauthorized adjustment. The contractor should provision for locking covers or coordinate to utilize blank cover (or flat plate) with no adjustment feature.
 - 5) Each thermostat must digitally display the current setpoint and temperature.

2.8 WIRING AND RACEWAYS

- A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26.
- B. All insulated wire to be copper conductors, UL labeled for 90C minimum service.
- C. All wire shall comply with the following:

<u>Color/Size/Wire</u> Red/18 TFF/MTW Stranded Black/18 TFF/MTW Stranded System 24VDC Positive 24VDC Negative Blue/14 THHN Stranded White/14 THHN Stranded Orange/18 TFF/MTW Stranded *Orange/Black Tracer/18 TFF/MTW Stranded Brown/18 TFF MTW Stranded *Brown/White Tracer/18 TFF/MTW Stranded Purple/14 THHN Stranded Gray/14 THHN Stranded Black/12 THHN Stranded White/12 THHN Stranded Blue 24 TSP Green CAT5 or 6 24VAC Hot 24VAC Neutral Inputs Inputs (ground) Outputs Outputs (ground) 24VAC Hot Interlock 24VAC Neutral Interlock 120VAC Hot 120VAC Neutral MS/TP & Modbus Wiring Ethernet

2.9 FIBER OPTIC CABLE SYSTEM

- A. Optical cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Section 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
- B. Connectors: All optical fibers shall be field terminated with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

2.10 ACTUATORS

- A. Electronic
 - 1. Design for direct mounting on the device and attachment to the driving shaft (damper actuator only); adjustable angle of rotation or range of actuation; and built in overload protection. Size each motor for 150% of the application requirement and with sufficient reserve power to provide smooth action.
 - 2. Modulating actuators shall use a 0-10 VDC or 4-20 mAD signal input to match DDC device AO signal output, and 24 VAC power. Three-wire, bi-directional motor actuators controlled by BO point pairs are acceptable on terminal valve boxes, terminal heating/reheat coils, and fan coil units only.
 - 3. Two-position actuators shall be a 120 VAC, two-wire, spring return. Spring actuation return actuation time shall be less than 30 seconds.
 - 4. Damper Actuators 95° rotation maximum, with built-in adjustable mechanical stop to limit rotation to that of the damper and/or to meet TAB requirements.
 - 5. End switches- Provide actuator with integral, adjustable-position indication end switches (one for each fully actuated position) when the actuated device is specified with an end switch binary input point(s).
- B. Provide valve actuators capable of close-off against a pressure greater than the respective pump system shut-off head.
- C. Failsafe: Provide spring-return failsafe upon load of power or control signal to the positions as follows:
 - 1. OA dampers- N.C.
 - 2. Mixed-air dampers- N.O.
 - 3. Relief- and exhaust-air dampers- N.O.

4. HW coil valves- no failsafe required.

2.11 DAMPERS

- A. Dampers: AMCA-rated, parallel or opposed-blade design as indicated; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Low-Leakage: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 5000.
 - 4. Ruskin Dampers or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The System Integrator shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.
- C. The System Integrator shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the System Integrator's work, and the plans and the work of others — the System Integrator shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the System Integrator's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the System Integrator to report such discrepancies shall be made by and at the expense of, this System Integrator.

3.2 INSTALLATION

- A. The Contractor shall install all equipment, control air piping/tubing, conduit and wiring parallel to building lines.
- B. All automatic control valves and control dampers furnished by the Temperature Control Contractor shall be installed under his supervision by the Mechanical Contractor.
- C. GENERAL INSTALLATION REQUIREMENTS

- 1. Spare conductor capacity, equal to a minimum of (2) additional sensors shall be provided to each underfloor sensor and pendant type sensors run.
- 2. Wiring shall be installed in conduit throughout; some exceptions are listed in the "Wiring" section of this specification.
- 3. Horizontal runs of conduit, trays, tubing or wiring shall be hung from structural members using new supports, or where feasible, utilizing existing temperature control conduit and piping. The Contractor shall verify adequacy of existing systems and warrant these systems as if they were new. Single runs of conduit, tubing or wire shall be by clevis ring and all thread rod. Multiple runs shall be by "Trapeze" or "Unistrut" supports. "Plumber's Strap" shall not be allowed. Maximum distance between supports shall be per the NEC. Existing supports shall only be used upon written concurrence by the Architect, Engineer or Owner.
- 4. All vertical runs of conduit or tubing shall be through new core drills. Existing core drills may be used if approved by the Owner. The installation shall be supported above each floor penetration using clamps to "Unistrut".
- 5. All wire that enters or leaves a building structure shall be installed with lightning protection per NEC.
- 6. All wire terminations shall be with compression type round hole spade lugs under a pan head screw landing; Stay-Kon or equivalent. All wire splices shall be with compression type insulated splice connectors or properly sized "wire-nut" connectors. Hand twisted, soldered and/or taped terminations or splices are not acceptable.
- 7. Where tubing, wiring or conduit penetrates floors or walls, sleeves with bushings shall be provided for tubing and wires. The conduit or sleeve opening shall be sealed with fire proof packing, so the smoke and fire rating of the wall or floor is maintained.
- 8. Under no circumstances shall wire, tubing, tray, J-boxes or any BAS equipment be run in, mounted on, or suspended from any of the telephone system's equipment, cable trays or support structure (Grey Iron).
- 9. All the material installed under this contract must be mounted on or supported from the building structure or supports furnished by this Contractor.
- 10. When connecting new pneumatic devices to existing air systems:
 - a. Air supplies shall be supplied from mains. Do not connect to branch lines.
 - b. Provide an isolation valve on air line connections to each air-controlled device which will be added.
 - c. Install 0-20 psi pressure gauges at all new air-controlled devices.
- 11. control and interlock wiring shall comply with national and local electrical codes and All Division 26 of this specification. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.
- 12. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirements.
- 13. All low-voltage wiring shall meet NEC Class 2 requirements and shall be color coded per Part 2 of this specification. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- 14. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- 15. All wiring in mechanical, electrical, or service rooms, or where subject to mechanical damage, shall be installed in raceway minimum of $\frac{3}{4}$ " at levels below 3m [10ft].
- 16. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- 17. Do not install wiring in raceway containing tubing.
- 18. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 3m [10ft] intervals.
- 19. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- 20. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- 21. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- 22. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the System Integrator shall provide step-down transformers.
- 23. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- 24. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- 25. Size of raceway and size and type of wire shall be the responsibility of the System Integrator, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.
- 26. Include one pull string in each raceway 2.5 cm [1"] or larger.
- 27. Use coded conductors throughout with different-colored conductors per Part 2 of this specification.
- 28. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- 29. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15cm [6"] from high-temperature equipment (e.g., steam pipes or flues).
- 30. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- 31. Adhere to Division 26 requirements where raceway crosses building expansion joints.
- 32. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- 33. The System Integrator shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- 34. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than ½" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- 35. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

3.3 EQUIPMENT PROTECTION AND COORDINATION

- A. Where existing walls are penetrated with conduit or piping, provide a fire stop assembly which meets or exceeds the original rating of the assembly. Refer to Division 23.
- B. Extreme care must be exercised while working in existing facilities and around operating equipment, particularly sensitive telephone switching and computer equipment. Close coordination with the Owner is required for the protection of this operating equipment from dust, dirt and construction material while maintaining the operational environment for the equipment. Under no circumstances shall the power or environmental requirements of the operating

equipment be interrupted during the installation and check-out without submitting to the Architect, Owner and Engineer for approval.

C. A detailed Method of Procedure (MOP) stating the steps to be taken, time schedule and impacted systems for the service interruption shall be submitted to the Architect for approval prior to beginning work. Refer to Division 1 and Division 23 for requirements.

3.4 CLEANUP

- A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of all grease, plaster, dust, or other foreign materials.
- B. Upon final completion of work in an area, vacuum and/or damp wipe all finished room surfaces and furnishings. Use extreme care in cleaning around telephone switching and computer equipment and under no circumstances shall water or solvents be used around this equipment.
- C. At the completion of the work and at the end of each workday, remove from the building, the premises, and surrounding streets, etc., all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

3.5 SOFTWARE, DATABASE AND GRAPHICS

- A. Software Installation: The Contractor shall provide all labor necessary to install, initialize, startup and debug all system software as described in this section. This includes any operating system software or other third-party software necessary for successful operation of the system.
- B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation. The point naming convention utilized on this project shall be clear and repeatable. Submit point names for review as indicated in other sections of this specification. Controller drawings shall indicate general point naming convention and that convention shall persist across the project.
 - 1. Configuration of the automation system database in a way that allows for easy export and consumption by 3rd parties is fundamental to any smart building application.
- C. Color Graphics: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays for all systems which are specified with a sequence of operation, depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the Owner.

3.6 TEMPERATURE CONTROL DRAWINGS

A. Upon completion of project and after record drawings of the temperature controls have been prepared and reviewed, the Contractor shall provide one (1) complete set of temperature controls drawings at each temperature control panel. Each set of drawings shall be laminated in a plastic coating. The drawings shall consist of only those control functions associated with the specific control panel and any relevant or pertinent network interface information.

B. The laminated drawings shall have a grommet connection attached to a metal cable or chain which is mechanically fastened to the temperature control cabinet.

3.7 START UP AND TESTING

- A. Fully commission all aspects of the BAS work.
- B. Acceptance Check Sheet
 - 1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
 - 2. Submit the check sheet to the Engineer and owner's commission agent for approval.
 - 3. The Engineer and commissioning agent will use the check sheet as the basis for acceptance with the BAS Systems Integrator.
 - 4. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the System Integrator may be exempt from the completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty. Control System Checkout and Testing
 - a. Startup Testing: All testing listed in this section shall be performed by the System Integrator and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of the system demonstration.
 - 1) The System Integrator shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 - 2) Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 3) Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
 - 4) Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
 - 5) Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The System Integrator shall check all control valves and automatic dampers to ensure proper action and closure. The System Integrator shall make any necessary adjustments to valve stem and damper blade travel.
 - 6) Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
 - 7) Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

- 8) Trends
- a. Check each trend log separately for configuration and correctness.
- b. Check that each physical point is being trended.
- C. Demonstration
 - 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the System Integrator has completed the installation, started up the system, and performed its own tests.
 - a. The tests described in this section are to be performed in addition to the tests that the System Integrator performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Section in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
 - 2. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
 - 3. The System Integrator shall provide at least two persons equipped with two way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the System Integrator.
 - 4. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 - 5. Demonstrate compliance with Part 1: "System Performance."
 - 6. Demonstrate compliance with Sequences of Operation through all modes of operation.
 - 7. Demonstrate complete operation of operator interface.
 - 8. Additionally, the following items shall be demonstrated:
 - a. DDC Loop Response: The System Integrator shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the System Integrator.
 - b. Optimum Start/Stop: The System Integrator shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started-and-stopped equipment, as well as temperature sensor inputs of affected areas.
 - c. Interface to the building fire alarm system where BACnet interface is available.
 - d. Operational/trend logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency shall be by change of value and/or time based on not more than 10 minutes.

Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The System Integrator shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

- D. VAV box performance verification and documentation:
 - The BAS Systems Integrator shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, no change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 - 2. The BAS Systems Integrator shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.
 - 3. Promptly rectify all listed deficiencies and submit a document summarizing completion to the Engineer.
- E. Test and Balance
 - 1. The System Integrator shall furnish tools such as laptop, power cords, interface cabling, Bluetooth/wireless interface devices, and interface software necessary to interface to the control system for test and balance purposes only.
 - 2. The System Integrator shall provide training in the use of these tools. This training will be planned for a minimum of two (2) hours.
 - 3. In addition, the System Integrator shall provide a qualified technician to assist in the test and balance process until the first four (4) terminal units are balanced.
 - 4. The tools used during the test and balance process shall be returned to the System Integrator at the completion of the testing and balancing.
- F. Performance Verification
 - 1. The installing contractor shall perform a complete Performance Validation (PV) of the Building management system three times throughout the project:
 - a. At project commissioning and turnover to customer.
 - b. At six (6) months of project operation.
 - c. Prior to twelve (12) months of project operation or end of warranty.
 - 2. Performance Verification shall include a complete and current Building Automation System site inventory including the following information at a minimum: a listing of all field and supervisory controllers with the following key attribute data; corresponding model numbers, firmware versions, available security updates, CPU and memory performance data, battery conditions, integrations, controlled equipment, and device and point counts.
 - 3. Performance Verification shall include a complete written evaluation of system configuration and performance in the following categories:
 - a. Security The Security evaluation shall include information about controllers that require security updates and conformance of user accounts to latest security rules and best practices.

- b. Energy Performance The Energy Performance and Savings evaluation shall identify opportunities through schedule and nightly setbacks, economizers, eliminating simultaneous heating and cooling and adding VSD to equipment.
- c. Comfort and Health The Comfort and Health evaluation shall identify temperature, pressure, and carbon dioxide values that deviate from desired set points that could lead to occupant discomfort.
- d. Reliability The Reliability evaluation shall identify overridden control points, control points creating excessive alarms, and opportunities to adding control points and trends to further enable system functionality.
- e. Standards The Standards evaluation shall identify conformance to published standards for point count, network performance and protocol standards.
- 4. Provide all reports as specified on a new, USB compatible flash drive

3.8 TRAINING

- A. Provide on-site instruction for up to 8 people.
- B. Entire system operating fundamentals 2 Hours
- C. Entire system operating and maintenance instruction 2 Hours
- D. Each unique air handling system type .5 Hour
- E. Train designated staff to enable them to perform the following:
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - e. Operate the workstation and peripherals.
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand system drawings, and Operation and Maintenance manual
 - k. Understand the job layout and location of control components
 - I. Access data from DDC controllers and ASCs
 - m. Operate portable operator's terminals
 - 2. Advanced Operators:
 - a. Make and change graphics on the workstation.
 - b. Create, delete, and modify alarms, including annunciation and routing of these
 - c. Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - d. Create, delete, and modify reports
 - e. Add, remove, and modify system's physical points
 - f. Create, modify, and delete programming

- g. Add panels when required
- h. Add operator interface stations
- i. Create, delete, and modify system displays both graphical and otherwise
- j. Perform DDC system field checkout procedures
- k. Perform DDC controller unit operation and maintenance procedures
- I. Perform workstation and peripheral operation and maintenance procedures
- m. Perform DDC system diagnostic procedures
- n. Configure hardware including PC boards, switches, communication, and I/O points
- o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
- p. Adjust, calibrate, and replace system components
- 3. System Managers/Administrators:
 - a. Maintain software and prepare backups
 - b. Interface with job-specific, third-party operator software
- F. Add new users and understand password security procedures Provide breakout pricing for additional offsite training at the vendors local facility training for 1 person (minimum of 1 week). Owner will be responsible for travel costs as applicable should they elect to purchase this additional training. The instructor(s) shall be factory-trained and Master Certified instructors experienced in presenting this material. Classroom training shall be done using a network of simulators of working controllers' representative of the installed hardware.
- G. Provide a minimum of (2) additional 2-hour sessions at owner's request during the warranty period (within 1 year).

3.9 WARRANTY

- A. The building control system, including all hardware and software components shall be warranted for a period of one year following owner's beneficial use of system. For phased project completion, the warranty shall also commence in phases. Any manufacturing defects arising during this period shall be corrected without cost to the owner.
- B. In addition to the hardware warranty, the Contractor shall correct any software sequences that do not meet the design intent or require modification to support building operations. The owner should contact the contractor prior to heavily modifying the system. If the contractor is unresponsive or if modification or repairs are required immediately (prior to the contractor's ability to respond) then repairs and modifications due to changes enacted by the owner's system operators during the warranty period will be corrected at no cost to the owner.
- C. Within the first 12 months of the warranty period, the contractor shall provide 8 hours of onsite customer support at the direction of the owner's representative.
- D. Contractor shall provide all necessary modems, proprietary hardware and software components for operators to monitor system functions remotely.
- E. All manufacturer software system revisions relating to manufacturer's design errors are to be provided and installed at no additional cost during the warranty period.

END OF SECTION 230900

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

DUCT SERVICE	TYPE/CONSTRUCTION	PRESSURE CLASS
Medium pressure supply air between fan and terminal box.	Galvanized sheet metal.	+6"
Low pressure supply air from discharge of terminal box/fan to air device.	Galvanized sheet metal (lined as noted on drawings).	+2"
Return air ductwork.	Galvanized sheet metal (lined as noted on drawings).	-2"
Low pressure general building exhaust.	Galvanized sheet metal (lined as noted on drawings).	-2"
Transfer ducts.	Galvanized sheet metal (lined as noted on drawings).	+2"
Sound elbows for return air grilles	Galvanized sheet metal (internally lined).	+2"
Residential dryer exhaust	Galvanized sheet metal	+2"

- B. Exterior insulation of metal ductwork is specified in other Division-23 sections and is included as work of this section.
- C. Refer to other Division-23 sections for ductwork accessories, hangers and supports.

1.2 DEFINITIONS

- A. Low Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to 2" or less, positive or negative pressure class.
- B. Medium or High-Pressure Duct: Duct required by the drawings, specifications, or referenced standards to be constructed to greater than 2" positive or negative pressure class.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.
- D. Codes and Standards:
 - 1. SMACNA Standards: Comply with the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.
 - 2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
 - 3. Air Diffusion Council (ADC) "Flexible Duct Performance and Installation Standards"
- E. SMACNA Industrial Construction Standards.
- F. Field Reference Manual: Have available for reference at project field office, copy of the current SMACNA "HVAC Duct Construction Standards, Metal and Flexible", and the current SMACNA "HVAC Air Duct Leakage Test Manual".

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for ductwork materials and products. Provide product data for manufactured joining systems. Include sound attenuation by octave band for sound rated flexible duct.
- B. Shop Drawings: Submit ¼" scaled fabrication and layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.
- C. Clean Duct Protocol Procedures: Submit written procedures confirming compliance with the clean duct protocol.
- D. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.
- E. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Divisions 1 and 23.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Protect ductwork, accessories and purchased products from damage during shipping, storage, and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Store ductwork inside elevated from floor on pallets and protected from weather, dirt, dust, and debris.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexible Ducts:
 - a. Flexmaster
 - b. Thermaflex
 - 2. Duct Take Off Fittings
 - a. Hercules Industries
 - b. Flexmaster
 - c. Thermaflex
 - d. Ominair

2.2 DUCTWORK MATERIALS

- A. Exposed Ductwork Materials: Where ductwork is exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains, dents, discolorations, labels, and other imperfections, including those which would impair painting.
- B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Provide flat seam construction where standing seams are a hazard to the Owner's operation personnel.

2.3 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.

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- C. Acoustical Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.
 - Unless otherwise noted, provide 1" thick, 1-1/2 lb density, fiberglass duct liner meeting ASTM C1071 Type I, NFPA 90A and 90B and TIMA (AHC-101) with minimum NRC (noise reduction coefficient) of 0.70 as tested per STM C 423 using an "A" mounting with minimum "K" factor of 0.25. Lining shall be U.L. approved, made from flame attenuated glass fiber bonded with a thermosetting resin with acrylic smooth surface treatment and factory applied edge coating. Materials shall conform to revised NFPA No. 90A Standards, with a maximum flame spread of 25 and maximum smoke development of 50.
- D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".
- E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.
- F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/ installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. All PVC coated exhaust ductwork shall be sealed with an approved chemical resistant sealant (P.V.S. #8-WB or approved equal). For outdoor ductwork, sealant shall also be U.V. resistant and weather resistant. Where ductwork is exposed to view in occupied spaces, utilize a clear, paintable duct sealant.
- G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
 - 1. For exposed stainless-steel ductwork, provide matching stainless steel support materials.
 - 2. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.
- H. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 10" W.C. positive, 5" negative for sizes up to 16" through a temperature range of -20°F to 250°F; 5500 fpm rated velocity. Contractor shall assume responsibility for supplying material approved by the authority having jurisdiction.
 - 1. All flexible duct shall be rated for sound attenuation. Inner core shall be black CPE supported by a galvanized steel helix, with minimum R-6 insulation and metalized reinforced outer jacket.
 - a. Flexmaster Type 1M

INSERTION LOSS dB (6-foot Section, Flexmaster 1M-R6, 500 FPM Air Velocity)									
Octave Band	125	250	500	1000	2000	4000			
8" Diameter	5	16	17	18	16	11			
12" Diameter	8	17	14	18	14	11			

2. Sound attenuation shall be as scheduled below:

- 3. Non-insulated flexible ducts shall be the same as insulated less the insulation and outer jacket.
- I. Duct Take Off Fittings to Individual Air Inlets & Outlets: Provide conical spin-in fittings at flexible or round sheet metal duct takeoffs. Where specifically shown on drawings, where the duct dimension does not allow for a conical spin-in, or at Contractor's option, provide 45° inlet rectangular to round duct take off fittings, with factory applied gasket. Fittings shall include butterfly type manual volume damper with locking quadrant handle and 2" insulation stand-off. Shafts shall be solid metal, rolled metal shafts are not acceptable.
- J. Duct take off fittings to air terminals: same as for individual air inlets and outlets, less the damper.

2.4 FABRICATION

- A. Fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match (-) mark sections for reassembly and coordinated installation.
- B. Fabricate ductwork of gauges and reinforcement complying with the latest SMACNA "HVAC Duct Construction Standards". Minimum 26 GA where ducts are within corridors.
- C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.
- D. If manufacturer flange joining systems are used as part of the reinforcing, the EI rating and rigidity class shall be equivalent to the reinforcing requirements of the standard. Submit manufacturer's product data.
- E. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows and offsets with center-line radius equal to 1.5 times the associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. 90° mitered elbows with turning vanes may be used where specifically shown on drawings. Mitered elbows or offsets of other than 90° shall not be used. Two 90° mitered elbows shall be separated by a minimum of 2 equivalent duct diameters. Use radiused "Ogee" for offsets less than 90°. Limit angular tapers to 30 deg. for contracting tapers and 20 deg. for expanding tapers. Divided flow fittings shall be 45° inlet branches, stationary splitters and elbows, or as shown on drawings.
- F. Elbows with sharp throat and radius heel are not allowed.
- G. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.
- H. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive and fasten with mechanical fasteners. Provide sheet metal nosing on all leading edges preceded by unlined duct, at duct openings, and at fan or terminal unit connections.

2.5 ROUND AND FLAT OVAL DUCTWORK

- A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized. Spiral lockseam construction. Individual runouts to air devices may be longitudinal seam.
- B. Gauge: In accordance with the SMACNA "HVAC Duct Construction Standards", minimum 26 gauge.
- C. Elbows: One piece construction for 90 deg. and 45 deg. elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Radius to centerline shall be 1.5 times duct diameter. Spot welded and bonded construction. Elbows on runouts to individual air devices may be pleated or adjustable.
- D. Divided Flow Fittings: 90 deg. tees, constructed with branch spot welded and bonded to duct fitting body, with minimum 2" flange shaped to fit main duct.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL DUCTWORK

- A. Duct Sealing:
 - 1. Seal all low-pressure ducts to SMACNA Seal Class "B".
 - 2. Seal all medium and high-pressure ducts to SMACNA Seal Class "A".
- B. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true-to-shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.
- C. Construct ductwork to schedule of operating pressures as shown on drawings.
- D. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.
- E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- F. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to

walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

- G. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.
- H. Penetrations: Where ducts pass through fire rated walls and do not contain fire or smoke dampers, protect with fire stop material installed in accordance with its listing. Where ducts pass through interior partitions or exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1-1/2". Fasten to duct only. Where ducts penetrate non-fire rated, mechanical, electrical, or acoustically sensitive walls, provide ½" to ¾" annular space between duct and wall, pack annular space with mineral wood insulation, and caulk both sides with non-hardening acoustical sealant.
- I. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.
- J. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards and Industrial Construction Standards.
- K. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.3 INSTALLATION OF DUCT TAKE-OFF FITTINGS

- A. Fully seal all joints.
- B. Sheet metal screw regulator arm to duct after balance is complete. Mark and date position of regulator arm.
- C. Insulation over regulator arm is not required.

3.4 INSTALLATION OF DUCT LINER

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.5 INSTALLATION OF FLEXIBLE DUCTS

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6' 0".
- B. Installation: Install in accordance with SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible" and ADC "Flexible Duct Performance and Installation Standards".

- C. Full inside diameter of flexible duct shall be maintained. Support to prevent kinking. Do not bend ducts across sharp corners of building elements such as joists.
- D. Flexible duct shall not be installed above an inaccessible ceiling unless the air device is set in a frame allowing access to both ends of the flexible duct.
- E. Install ducts fully extended. Do not install in the compressed state.

3.6 FIELD QUALITY CONTROL

- A. Leakage Tests: Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.
- B. General:
 - 1. Ductwork pressure tests shall be observed by Architect/Engineer prior to installation of insulation.
 - 2. Ductwork systems in ± 3 " W.G. pressure class and higher, regardless of system operating pressure, shall be tested in their entirety for leaks. Arbitrary sections of ductwork in ± 2 " W.G. and lower pressure class, regardless of system operating pressure, shall be tested as required by Architect/Engineer.
 - 3. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.
- C. Test Equipment:
 - 1. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test a reasonably large duct system section. Equipment shall have been calibrated within 2 years of the testing.
 - 2. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
 - 3. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
 - 4. Provide Dwyer magnehelic gauge with 0-.25" W.C. range for testing 0% leakage ductwork.
- D. Testing Pressures and Permissible Leakage:
 - 1. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
 - 2. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):

 $F = C_{L} (P)^{.65}$

Where:

e: F = Allowable leakage factor CFM/100 Sq. Ft. $C_L = Leakage Class$ P = Test pressure inches W.C.

3. Leakage class shall be as follows:

- a. Seal class A, Round or oval duct, $C_L = 3$.
- b. Seal class A, Rectangular duct, $C_L = 6$.
- c. Seal class B, Round or oval duct, $C_L = 6$.
- d. Seal class B, Rectangular duct, $C_L = 12$.
- e. Seal class C, Round or oval duct, $C_L = 12$.
- f. Seal class C, Rectangular duct, $C_L = 24$.
- 4. Record all tests using the procedure and forms in the above referenced standard.
- 5. All plenums and casings shall be tested by pressuring to the pressure class indicated and visually observing leakage and panel deflection.
 - a. No noticeable leakage shall be allowed.
 - b. Deflection shall be less than 1/8" per foot.

3.7 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where required for service, maintenance and inspection of ductwork accessories. See section 23 33 00.

3.8 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted clean and prepare surface for painting.
- B. Protection:
 - 1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
 - 2. Cover all stored ducts to protect from moisture, dust or debris.
 - 3. Maintain a cover on all ends of installed ductwork at all times, except when actually connecting additional sections of duct.
- C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.
 - 1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
 - 2. Ductliner in installed ductwork which has become wet must be completely removed and replaced.
 - 3. Torn ductliner may be repaired by coating with adhesive if damage is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.
- D. Protect lined duct from becoming wet or torn.
- E. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.
- F. Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 233113

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
- C. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers" and U.L. Standard 555S "Motor-Driven Fire/Smoke Dampers."
- D. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.
- E. SMACNA Compliance: All exhaust ducts comply with "Fire Damper and Heat Stop Guide".
- F. All fire dampers, smoke dampers, fire/smoke dampers and radiation dampers shall meet the latest local building code requirements.
- G. Actuators shall be UL 2043 listed for low smoke generation if installed in an environmental air moving plenum as required by NFPA 70 and the International Mechanical Code.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components. Include details of construction equipment and accessories being provided.
- C. Submittals for all damper types specified in this section shall include a schedule for each damper indicating net free area, actual face velocity and pressure drop (at sea level) based on net free area & the maximum air quantity which will be passing through the damper. Submittals without this information will be rejected.
- D. Submit Heresite duct/equipment protective coating product data sheets and application instruction.
- E. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

F. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dampers:
 - a. Greenheck
 - b. AWV
 - c. Air Balance, Inc.
 - d. Anemostat
 - e. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - f. Louvers & Dampers, Inc.
 - g. Penn Ventilator Co.
 - h. Pottorff
 - i. Ruskin
 - j. Nailor
 - 2. Turning Vanes:
 - a. Aero Dyne Co.
 - b. Airsan Corp.
 - c. Barb-Aire
 - d. Duro Dyne Corp.
 - e. Environmental Elements Corp.; Subs. Koppers Co., Inc.
 - f. Hart & Cooley Mfg. Co.
 - 3. Duct Hardware:
 - a. Ventfabrics, Inc.
 - b. Young Regulator Co.
 - c. Duro-Dyne Corp.
 - 4. Duct Access Doors:
 - a. Kees
 - b. Ductmate
 - c. Greenheck
 - d. Flexmaster
 - e. Cesco-Advanced Air
 - f. Duro Dyne Corp.
 - g. Flame Gard
 - 5. Flexible Connections:
 - a. Duro Dyne Corp.

- b. Ventfabrics, Inc.
- c. General Rubber Corp. (Process & Exhaust Only)

2.2 MANUAL VOLUME DAMPERS

- A. Low Pressure Rectangular Dampers (less than 2000 FPM and under 2" W.C. S.P. Differential):
 - 1. For 12" in height or larger, use multiple opposed blade type and close fitted to ducts. The frame and blades shall be constructed of 16 ga. galvanized steel with plated steel shaft mounted with synthetic bearings. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Damper panels shall not exceed 48" wide. Provide jack shafting when duct size required is greater than 48" wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle. Provide standoff bracket for insulated ducts. For flat oval and round ductwork, provide type C housing.
 - 2. For ducts less than 12" in height, frame shall be 18 ga. blade galvanized steel, steel axle with synthetic bearings locking quadrant handle and notched shaft end indicating damper position. Provide standoff bracket for insulated ducts.
- B. Low Pressure Round Dampers (less than 1800 FPM and under 1" W.C. S.P. differential):
 - 1. For low pressure spin-in fitting dampers serving individual returns/diffusers, see 23 31 13.
 - 2. Dampers 4" diameter through 18" diameter shall be 20 ga. galvanized steel frame and blade, utilize multi-blade square dampers with transitions for ducts over 18" diameter.
 - 3. Axle shaft shall be plated steel with retainers mounted on synthetic bearings with notched end shaft indicating damper position, locking quadrant and handle. Provide standoff brackets for insulated ducts.
 - a. Greenheck MBDR-50 or approved equivalent.

2.3 TURNING VANES

- A. Fabricated Turning Vanes: Provide fabricated 22-gauge, single blade or 24 gauge double bladed 4-1/2" radius, 3-1/4" spacing turning vanes and type 2, 4-1/2" wide runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards" Fig 2.3.
- B. Turning vanes as a part of PVC coated air systems shall be PVC coated.
- C. Do not use trailing edge turning vanes.

2.4 DUCT HARDWARE

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
- B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

C. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.5 DUCT ACCESS DOORS

- A. Access Doors for Low Pressure Rectangular Duct: Construct of same or greater gauge as ductwork served, provide double wall insulated doors for insulated ductwork. Exposed insulation adhered to door is not acceptable. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be air tight. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Where a hinged door cannot be fully opened a removable door may be used.
- B. Access Doors for Medium and High-Pressure Rectangular Duct: Insulated double wall round door and frame arranged for "Spin-In" installation, with continuous gasket in frame for door. Leakage of less than 0.5 cfm at 6" W.G.
- C. Flexmaster "Inspector Series Spin Door" or equivalent.
- D. Access Doors for Round Duct 20" and Less: Sandwich type door, constructed of an insulated double wall outer door connected to gasketed inner plate carriage bolts with hand knobs, and formed to fit the radius of the duct.
 - 1. Ductmate "Sandwich" or equivalent.
- E. Access Door for Round Duct Greater Than 20": 18" round insulated double wall access door in gasketed frame, attached to duct section similar to tee fitting.
- F. Access Doors for Flat Oval Duct: Use door specified for medium and high pressure rectangular duct in flat portion, use door specified for round duct in curved portion.
- G. Access Doors for use in Type I commercial cooking hood ductwork (grease exhaust): 16 ga Black Steel, or Stainless steel where used on stainless steel ducts. High temp ceramic fiber gasket rated to 2300 °F. Inner frame to support duct cutout and accept studs and bolts. Multiple studs with wing nut or wing bolts on door. Provide studs as required to accept exterior rated duct wrap to meet wrap assembly requirements. Provide handles. Door assembly shall be rated for temperatures up to 2300°F as required by NFPA 96 and shall be UL listed as a Hood and Duct Accessory. Flame Gard Grease Duct Access Door or equivalent.
- H. All access doors in other than standard galvanized steel duct systems shall be of the same material or with the same coating as the duct system.

2.6 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment. Shelf life shall be verified to not exceed six (6) months. Any sign of cracking on interior or exterior shall be cause for replacement immediately.

- B. Use the following product types for each application accordingly:
 - Indoor Equipment Non-Corrosive Air Systems: Heavy glass fabric, double-coated with DuPont's NEOPRENE, non-combustible fabric, fire retardant coating with good resistance to abrasion and flexing. Fabric shall be 30 oz per square yard, capable of operating at -10°F to 200°F, waterproof, air tight, 6 inches wide, complies with NFPA 90 and UL Standard #214. "Ventglas" Model as manufactured by VentFabric, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90 deg. elbows in supply, return and exhaust air systems, and elsewhere as indicated.
- C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
- E. Provide duct access doors whether shown or not for inspection and cleaning upstream of all coils, fans, automatic dampers, fire dampers (minimum 16" x 24" in ducts larger than 18"), fire/smoke dampers, duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication. Provide multiple access doors for large ductwork to provide adequate reach to equipment.
- F. Install fire dampers and smoke dampers in accordance with manufacturer's instructions.
- G. Provide fire dampers and smoke dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.
- H. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing.
- I. Provide balancing dampers on high pressure systems where indicated. Use splitter dampers only where indicated on Drawings.
- J. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration. Provide matching flanged backing frame with flexible connector where flanged fan connections are provided.

3.3 COORDINATION

- A. Coordinate with installers of other work to ensure that operators, reset devices, and fusible links are accessible at all fire, smoke, and fire/smoke dampers.
- B. Show access space on coordination drawings. Locate over lay-in ceilings and above corridors wherever practical.
- C. Order right/left/top/bottom arrangement as required to minimize field modifications.

3.4 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories after installation to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.
- B. After installation, test every fire, smoke, and fire/smoke damper for proper operation, provide letter to the Architect/Engineer certifying this work is complete and all dampers are functioning properly.
 - 1. Verify that each fire/smoke damper closes when the associated duct or space detector is tripped. Verify that air handlers shut down and outside air dampers close as dictated by the control sequence.
 - 2. Verify that air supply units shut down when smoke is detected by the associated duct detector. Verify that outside air dampers and system fire/smoke dampers close as dictated by the control sequence.
 - 3. Report any detectors or dampers that are malfunctioning. Report any discrepancies from the control sequence.

3.5 ADJUSTING AND CLEANING

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- B. Label access doors in accordance with Division-23 section "Mechanical Identification".
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.6 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 233300

SECTION 233713 – DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of air outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers.
 - 2. Wall registers and grilles.
- C. Refer to other Division 23 sections for ductwork, duct accessories; testing and balancing; not work of this section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number, furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

- 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 23.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air outlets and inlets wrapped in factory- fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Diffusers, Registers and Grilles:
 - a. Anemostat
 - b. Price
 - c. Carnes
 - d. Krueger
 - e. Titus
 - f. Metal-Aire
 - g. Carnes
 - h. Nailor

2.2 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on air device schedule.

2.3 REGISTERS AND GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall register and grille.
- D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on air device schedule.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
- B. Coordinate with other work, including duct work and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.3 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 238126 – DUCTLESS SPLIT SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The air conditioner system shall be a ductless split system consisting of a horizontal discharge, outdoor unit, a matched capacity indoor unit that shall be equipped with controller type as indicated on the drawings.
- B. Refer to other Division 23 Sections for automatic temperature controls not factory-installed and required for conjunction with packaged heating and cooling units; not work of this Section.
- C. Electrical Work: Refer to Division 23 Sections requirements of electrical provisions of mechanical work.

1.2 REFRIGERANTS

- A. All refrigerants used for each condensing unit shall be on the latest EPA list of approved refrigerants & environmentally friendly.
- B. No CFC based refrigerants shall be used.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. The units shall be tested by and bear the label of a Nationally Recognized Testing Laboratory.
- C. Performance Requirements: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with AHRI Standards.
- D. Codes and Standards:
 - 1. AHRI Compliance: Provide capacity ratings for packaged heating and cooling units in accordance with AHRI Standard 210/240 "Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment".
 - 2. ASHRAE Compliance: Construct refrigerating system of packaged heating and cooling units in accordance with ASHRAE Standard 15 "Safety Standard for Refrigeration Systems, most recent edition".
 - 3. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the UL or ETL label.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to packaged heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of packaged heating and cooling units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field- installed.
- D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 23.
- E. Maintenance Data: Submit maintenance data and parts list for each packaged heating and cooling unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 23.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle packaged heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged packaged heating and cooling units or components; replace with new.
- B. Store packaged heating and cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading packaged heating and cooling units, and moving units to final location for installation.
- D. Units shall be broken down and shipped in components as field conditions require. A factory authorized representative shall inspect the final installation to certify that the unit has been reassembled per factory recommendations and specifications.

1.6 WARRANTY

- A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
 - 1. Warranty Period: 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, limited by style of indoor unit, system cooling capacity size range and low ambient operation, provide products by one of the following:
 - 1. Mitsubishi.
 - 2. Daikin.

2.2 DUCTLESS SPLIT-SYSTEMS (1.5 TO 3.5 TONS NOMINAL)

- A. Indoor Units
 - 1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressor, evaporator, fans, filters, and unit controls. Provide capacities and electrical characteristics as scheduled.
 - 2. Wall-Mounted:
 - a. Cabinet: Enameled steel with removable panels on front and ends and discharge drain pans with drain connection.
 - b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and with thermal-expansion valve.
 - c. Fan: Direct drive, centrifugal fan.
 - d. Fan Motors: Comply with requirements in Section 230507 Motor, Drives, Motor Controllers and Electrical Requirements for Mechanical Equipment.
 - 1) Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.
 - e. Filters: Permanent, cleanable.
- B. Outdoor Units:
 - 1. General: Provide factory-assembled and tested packaged units as indicated, consisting of casing, compressors, evaporator, fans, filters, and unit controls.
 - 2. Provide capacities and electrical characteristics as indicated on drawings.
 - 3. Casing: Steel, finished with baked enamel with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gauge ports on exterior of casing.
 - 4. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Inverter controlled scroll.
 - b. Refrigerant Type: R-410A.
 - 5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler. Provide with manufacturer's optional coil coating for coastal areas.
 - 6. Fan: Aluminum-propeller type, directly connected to motor.
 - 7. Motor: Permanently lubricated, with integral thermal-overload protection.
 - 8. Mounting Base: Polyethylene.

- 9. Units specified for heat pump operation shall be provided with reversing valve and related controls to switch to heating mode.
- 10. Unit shall be capable of operating to the low ambient conditions indicated on the drawings.
- C. Accessories:
 - 1. Provide wired remote wall-mounted controller for each evaporator unit to control compressor and evaporator fan and shall control on/off operation, temperature set points and other settings.
 - 2. Automatic-reset timer to prevent rapid cycling of compressor.
 - 3. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
 - 4. Additional refrigerant for extended line lengths as defined by the manufacturer.
 - 5. Integral condensate pump for indoor unit, either factory-supplied/contractor-installed or provided complete by Division 23 Contractor.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which packaged heating and cooling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PACKAGED HEATING AND COOLING UNITS

- A. General: Install packaged heating and cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support: Install units from wall or overhead structure as required by manufacturer's installation instructions.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
 - 2. Ductwork: Refer to Division 23 Section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
 - 3. Connect all duct connections to unit with flexible connection. Provide manual damper, quadrant and lock.
- D. Air-Cooled Condenser Piping: Refer to Division 23 Section "Basic Piping Materials and Methods". Connect liquid and hot gas piping to unit as indicated by manufacturer's installation instructions included required piping accessories.

E. Drain Piping: Connect indoor unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1.5" deeper than fan pressure in inches of water.

3.3 FIELD QUALITY CONTROL

A. General: Start-up ductless split system units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.4 TRAINING

- A. Schedule a minimum of 4 hours of training with Owner. The manufacturer's representative and the Division 23 contractor shall be present. The training shall be coordinated by the Division 23 contractor and the Owner in conjunction with the other mechanical equipment on the project.
- B. Training:
 - 1. Train the Owner's maintenance personnel on start-up and shut-down procedures, troubleshooting procedures, and servicing and preventative maintenance schedules and procedures. Review with the Owner's personnel, the contents of the Operating and Maintenance Data specified in Division 1 and Section 23 05 00.
 - 2. Schedule training with Owner through the Architect/ Engineer with at least 7 days prior notice.

3.5 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts for each packaged heating and cooling unit:
 - 1. One set filters for each unit.

END OF SECTION 238126

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Definitions.
 - 2. Code compliance.
 - 3. Drawings and specifications.
 - 4. Submittals.
 - 5. Coordination drawings.
 - 6. Guarantee of installation.
 - 7. Record documents.
 - 8. Maintenance manuals.
 - 9. Delivery, storage and handling.
 - 10. Temporary Electrical services.
 - 11. Instruction of Owners personnel.
 - 12. Product Source Limitations
 - 13. Incentives and Rebates
- B. Furnish and install all materials and equipment and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete installation including all accessories and appurtenances required for testing the system. It is the intent of the drawings and specifications that all systems be complete, and ready for operation. All specified products shall be installed in accordance with all manufacturers' instructions and requirements.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and electrical equipment rooms.

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- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 CODE COMPLIANCE

- A. All work and materials shall comply with the latest rules, codes and regulations, including, but not limited to the following:
 - 1. Occupational Safety and Health Act Standards (OSHA).
 - 2. ANSI/IEEE C-2 National Electrical Safety Code.
 - 3. ADAAG (ADA) Standards Americans With Disabilities Act.
 - 4. CABO-ANSI Á117.1.
 - 5. IEEE Standards.
 - 6. Underwriter's Laboratory U.L. All products shall be U.L. Listed.
 - 7. NFPA National Fire Protection Association Codes and Standards of Installation.
 - a. NFPA 70 National Electric Code
 - b. NFPA 99 Standard for Health Care Facilities
 - c. NFPA 101 Life Safety Code
 - d. NFPA 110 Emergency and Standby Power Systems
 - 8. NECA Standard of Installation.
 - 9. NEMA Standard of Installation
 - 10. International Building Code
 - 11. International Fire Code
 - 12. International Energy Conservation Code.
 - 13. Facility Guidelines Institute (FGI) Guidelines for Design and Construction of Hospitals and Outpatient Facilities
- B. Work to be executed and inspected in accordance with local codes and ordinances. Permits, fees or charges for inspection or other services shall be paid for by this Contractor. Local codes and ordinances are to be considered as minimum requirements and must be properly executed without expense to the Owner; but do not relieve the Contractor from work shown that exceeds minimum requirements.

1.5 DRAWINGS AND SPECIFICATIONS

A. All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

BASIC ELECTRICAL REQUIREMENTS HA #23026-00 B. Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduits and wiring is not assured. Exact requirements shall be governed by architectural, structural and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, supports, attachment methods, etc., necessitated by such conditions shall be included in the bid. Check all information and report any apparent discrepancies before submitting bid.

1.6 SUBMITTALS

- A. General: Follow the procedures specified in Division 01 Section "SUBMITTALS".
- B. Substitutions and Material Submittals: By specific designation and description, standards are established for specialties and equipment.
- C. Other makes of specialties and equipment of equal quality will be considered, provided such proposed substitutions are submitted to the Architect for approval at least seven (7) calendar days prior to bid opening. A schedule showing make, type, manufacturer's name and trade designation of all materials and equipment proposed as a substitution shall be submitted together with a single copy of the manufacturer's complete specifications. A list of approved substitutions will be published as an Addendum.
- D. Within thirty (30) days after award of contract, the Contractor shall submit a schedule showing make, type, manufacturer's name and trade designation of all materials and equipment proposed for use and implementation. This schedule shall be accompanied by the manufacturer's complete specification, for each equipment item or materials used, give complete information as to listings, certifications, capacities, ratings, kind of material used, finish guarantee, etc., and such dimensions as are necessary to check space requirements. When approved, such schedule and drawing shall be in addition to these specifications and shall be in equal force in that no variation shall be permitted. The Architect is to be the sole judge as to the quality of any material offered as an equal. See General Conditions and Supplementary Conditions to the Contract.
- E. Design is based on equipment as listed in schedules on drawings and included in these specifications. All changes in foundations, bases, supports, connections, controls, space, openings, walls and ceilings and sound and vibration isolation, seismic support, and electrical and mechanical characteristics required by alternate equipment specified, submitted and approved shall be made at no additional cost to the Owner.
- F. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail; said approval does not in any way relieve the contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- G. Additional copies may be required by individual sections of these Specifications.
- H. Electronic Submittal Procedure
 - 1. Summary

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- a. Shop drawings and product data submittals shall be transmitted to Architect in electronic (PDF) format using the selected file transfer, a website service designed specifically for transmitting submittals between construction team members.
- b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
- c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
- 2. Procedures:

b.

- a. Create submittal log in file transfer service by inserting required submittals listed in individual specification section.
 - Submittal Preparation Contractor may use any or all of the following options:
 - 1. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the website.
 - 2. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via email.
 - 3. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
- c. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
- d. Contractor shall transmit each submittal to Architect using the file transfer website.
- e. Architect / Engineer review comments will receive email notice of completed review.
- f. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
- g. Submit paper copies of any reviewed submittals not submitted electronically at project closeout for record purposes in accordance with Division 01 Section "CLOSEOUT PROCEDURES."
- 3. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - a. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not a as Product Data.
 - b. Mark each copy of each submittal to show which products and options are applicable. Include the following information, as applicable.
 - 1. Manufacturer's catalog cuts.
 - 2. Manufacturer's product specification.
 - 3. Standard color charts.
 - 4. Statement of compliance with specified referenced standards.
 - 5. Testing by recognized testing agency.
 - 6. Application of testing agency labels and seals.
 - 7. Notation of coordination requirements.
 - 8. Availability and delivery time information.
 - For equipment, include the following in addition to the above, as applicable:
 - 1. Wiring diagrams showing factory-installed wiring.
 - 2. Printing performance curves.

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C.
C.

- 3. Operational range diagrams.
- 4. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- d. Submit Product Data before or concurrent with Samples. Submit Product Data in the following format.
 - 1. Electronic (PDF) format using file transfer service.
- 4. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions or the contract Documents or standard data.
 - a. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - 1. Identification of products.
 - 2. Schedules.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
 - 6. Relationship and attachment to adjoining construction clearly indicated.
 - 7. Seal and signature of professional engineer if specified.
 - b. Sheet Size: Except for templates , patterns, and similar full-size drawings, submit Shop Drawings on sheets a least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1067 mm)
 - Submit Shop Drawings in the following format:
 - 1. Electronic (PDF) format using file transfer service.
- 5. 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.
 - a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - b. Identification: Attach label on unexposed side of Samples that includes the following:
 - 1. Generic description of Sample.
 - 2. Product name and name of manufacturer.
 - 3. Sample source.
 - 4. Number title of application Specification Section.
 - c. 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.
 - 1. Sample not incorporated with Work, or otherwise designated as Owner's property, are the property of Contractor.
 - d. 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.
 - 1. Number of Samples: Submit three 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. Coordination Drawings: Comply with requirements specified in Division 01 Section "PROJECT MANAGEMENT AND COORDINATION."

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- 7. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects names and addresses, contact information of architects and owners, and other information specified.
- 8. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- 9. 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.
- 10. Manufacturer Certificates: Submit written statements on manufacture's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- 11. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- 12. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- 13. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indication and interpreting test results of material for compliance with requirements in the Contract Documents
- 14. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency
- 15. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "QUALITY REQUIREMENTS."
- 16. 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.
- 17. 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.
- 18. Field Test Reports: Submit reports indicating and interpreting results of field test performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- 19. Maintenance Data: Comply with requirements specified in Division 01 Section "OPERATION AND MAINTENANCE DATA."
- 20. 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 number.

1.7 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 01 Section "PROJECT COORDINATION" and other Sections included herein to a scale of 1/8"=1'-0" or larger detailing

BASIC ELECTRICAL REQUIREMENTS HA #23026-00 electrical room and floor plans showing major elements, components and systems of electrical equipment and materials in relationship with other systems, installations and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work including (but not limited to) the following:

- 1. Indicate the proposed locations of cable tray, conduit racks, equipment and materials. Include the following:
 - a. Clearances for installation of electrical disconnect switches at mechanical equipment.
 - b. Clearances for installation of electrical junction boxes.
 - c. Clearances for servicing and maintaining equipment including panelboards, disconnect switches, switchboards, luminaires, wiring devices, etc.
 - d. Equipment connections and support details.
 - e. Exterior wall and foundation penetrations.
 - f. Fire rated wall and ceiling and floor assembly penetrations.
 - g. Size and locations of required concrete pads and bases.
- 2. Indicate scheduling, sequencing, movement and positioning of large equipment into the building during construction.
- 3. Prepare floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.
- 4. Prepare reflected ceiling plans to coordinate and integrate installations, mechanical access to equipment, air outlets and inlets, luminaires, speakers, fire sprinklers and other ceiling mounted items.

1.8 GUARANTEE OF INSTALLATION

- A. All work under this section shall be guaranteed in writing to be free of defective work, materials, or parts for a period of one (1) year from the date of Substantial Completion.
- B. Manufacturer's specific warranties and those specified in this Section shall be included in the Contractor's Guarantee of Installation.
- C. Repair, revision or replacement of any and all defects, failure or inoperativeness shall be done by this section at no cost to the Owner.

1.9 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01 Section "CLOSEOUT PROCEDURES." In addition to the requirements specified in Division 01, indicate the following installed conditions:
 - 1. Conduit racks, size, location, and routing, for interior locations. Show all wiring device locations and connections, control locations, disconnect switch locations, and final equipment locations including actual dimensions.
 - 2. Luminaire locations and wiring connections.
 - 3. All branch circuit connections, home-run locations with panel/circuit numbers, and identify if the connections are overhead or underground.
 - 4. Update luminaire schedule to reflect actual manufacturer's components used complete with updated part numbers and lists.

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- 5. Underground ductbank locations, routings, and quantity of conduits utilized.
- 6. All approved substitutions, Contract Modifications and actual equipment and materials installed.
- 7. Contract Modifications, actual equipment and materials installed.

1.10 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 01 Section "CLOSEOUT PROCEDURES." In addition to the requirements specified in Division 01, include the following information for equipment and systems:
 - 1. Description of function, normal operating characteristics and limitations, performance and engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in and routine and normal operating instructions, regulation, control, stopping shutdown and emergency instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting, disassembly, repair and reassembly, aligning and adjusting instructions.
 - 4. Servicing instructions and schedules.
 - 5. Complete inventory list of ALL spare and loose parts delivered to Owner at completion of work. Inventory list shall include the applicable specification section, description of parts, manufacturer make/model, quantity and current list pricing.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials in a manner to prevent damage or interference with traffic conditions.
- B. Protect equipment from weather and dampness.
- C. All material stored on site shall be protected to Owner's standards. Owner may reject any or all material documented to have been improperly stored. Replacement of improperly stored material shall be solely at the contractor's expense.

1.12 TEMPORARY ELECTRICAL SERVICES

A. Temporary wiring for construction light and power for the general contractor or other subcontractors shall not be included as a part of this section of the work. Refer to Division 01 regarding payment for the electrical energy used for construction light and power and testing of the new installation.

1.13 INSTRUCTION OF OWNER'S PERSONNEL

A. The Contractor shall conduct an on-site instructional tour of the entire project. The personnel designated by the Owner shall be instructed in: operation of all electrical systems, elementary trouble-shooting procedures, preventive maintenance procedures, uses of Operation and Maintenance Manuals, relamping and cleaning of lighting fixtures and operation of all communication systems. Refer to Division 1 for additional requirements.

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1.14 PRODUCT SOURCE LIMITATIONS

A. Products specified in Division 26 Sections LOW VOLTAGE DISTRIBUTION TRANSFORMERS, SWITCHBOARDS, PANELBOARDS, ENCLOSED SWITCHES AND CIRCUIT BREAKERS, and MANUAL AND MAGNETIC MOTOR CONTROLLERS shall be obtained through one source through a single manufacturer. Source limitations in these individual sections shall not be construed to allow sourcing within these individual sections on an independent basis.

1.15 INCENTIVES AND REBATES

A. All incentives and rebates offered by outside agencies relating to Energy Efficiency or Tax Incentives offered by Governmental agencies shall be considered property of the Owner and shall not be granted to any contractor performing work on the project.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 FEES AND PERMITS

A. Arrange and pay for any fees, permits, connections charges, hook-up fees, etc. required with local governing bodies, utilities, etc.

3.2 UTILITY SERVICES

- A. Arrange with Utility Company for permanent electrical services to the facility.
- B. Install electrical service entrance in accordance with Utility Company's rules and regulations.
- C. Make arrangements with Utility Company to obtain permanent electric services to the project.
- D. Coordinate meter and metering conductors provided and installed by Utility Company.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in all other Divisions of work for rough-in requirements.

3.4 ELECTRICAL INSTALLATIONS

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- A. General: Sequence, coordinate and integrate the various elements of electrical systems, materials and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment and materials installation with other building components. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots and openings in other building components during progress of construction to allow for electrical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-inplace concrete and other structural components as they are constructed.
 - 5. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the Building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of electrical systems with exterior underground and overhead service companies and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials and equipment to conform with approved submittal data, including coordination drawings, to the greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirement, refer conflict to the Architect.
 - 9. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.
 - 10. Install electrical equipment to facilitate servicing, maintenance and repair or replacement of equipment components and as required by Code. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
 - a. All electrical items, equipment, etc. requiring access and maintenance to be provided with access panels by electrical contractor when located behind hard inaccessible finished surfaces. See Architectural ceiling plans for ceiling and wall finish types.
 - 11. Install access panel or doors where equipment is concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "ACCESS DOORS".
 - 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 - 13. Only quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.
 - 14. Provide foreman in charge of this work at all times.
 - 15. Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall at all times be kept in the job superintendent's office and shall be available to the Owner's representative.
 - 16. Where air plenums are encountered, all cabling and conductors not in raceways shall be rated, listed, and suitable for use in plenum spaces.

3.5 QUALITY ASSURANCE

A. Provide a meaningful Quality Assurance program. To assist the Contractor in this program, the specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other Quality Assurance measures to obtain a complete operating facility within the scope of this project.

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- B. The Contractor shall insure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- C. Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.6 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 01, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - 2. No joists, beams, girders, structural columns, or other structural assemblies/components shall be cut by any contractor without obtaining written permission from the Architect.
- B. Perform cutting, fitting and patching of electrical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 1. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installer's qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 01 Section "REFERENCES" for definition of "Experienced Installer."

3.7 EXCAVATION AND BACKFILL

- A. General: Perform excavation and backfilling in accordance with Division 31 Section "EARTH MOVING." In addition to the requirements specified in Division 31, the following requirements apply:
 - 1. Protection of Installed Work: During excavating and backfilling operations, protect adjacent installations.
- B. Perform excavating and backfilling for electrical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

BASIC ELECTRICAL REQUIREMENTS HA #23026-00 END OF SECTION 260100

BASIC ELECTRICAL REQUIREMENTS HA #23026-00

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. DIVISION 26 Section "SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS, CABLING" for installation requirements for sleeves, sleeve seals, non-rated penetration, and fire rated penetrations.
 - 2. DIVISION 26 Section "CONTROL-VOLTAGE ELECTRICAL POWER CABLES" for control systems communications cables and Classes 1, 2, and 3 control cables.
 - 3. DIVISION 27 for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control test and reports.

1.6 CLOSEOUT SUBMITTALS

A. Field quality-control test and reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
 - 6. Republic Wire Company.

2.3 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

- D. Conductor Insulation. Comply with NEMA WC70 for the following types:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.4 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
 - 1. Single circuit rated for use in medical applications with integral equipment grounding conductor.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation. Comply with NEMA WC70 for the following:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- G. Armor: Steel, interlocked.

2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Available Manufacturers: : Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- C. Jacketed Cable Connectors: For steel jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: Two hole with standard barrels.
 - 3. Termination: Compression.

2.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to DIVISION 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Stranded Copper.
- B. Branch Circuits: Stranded Copper.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Exposed Feeders on Roof Areas: Type XHHW-2, single conductors in raceway.
- D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspaces, Ceiling Spaces and Service Areas: Type THHN-THWN–2, single conductors in raceway.
- G. Exposed Branch Circuits on Roof Areas: Type XHHW-2, single conductors in raceway,.
- H. Branch Circuits Concealed in Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

- J. Branch Circuits for connections to devices and systems installed at storefront assemblies: Metal-clad cable, Type MC, MC shall only be permitted through storefront framing assemblies. Transition immediately to permitted conductors and raceways outside of storefront.
- K. Branch Circuits Concealed in Ceilings: Type THHN-THWN-2, single conductors in raceway.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal raceways with conductors and cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to DIVISION 26 Section "RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to DIVISION 26 Section "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS."
- G. Multi-conductor cable type MC Installation Requirements:
 - 1. Comply with NFPA 70
 - 2. Type MC shall not be used for connections to panelboards or other termination equipment.
 - 3. Type MC shall not be used in construction types prohibited by NFPA 70.
 - 4. Limited Applications: Use of Type MC shall only be permitted in the following applications:
 - a. Wiring applications through window or door framing systems where raceways are not practical.
 - b. For flexible connections to recessed luminaires. Maximum length shall not exceed 6 ft. (_m).

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in DIVISION 26 Section "SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to DIVISION 07 Section "PENETRATION FIRESTOPPING."

3.7 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections and prepare test reports.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:
 - a. Medical equipment including accelerators, CT equipment, x-ray equipment, etc.
 - b. Generator and Transfer Switch equipment connections.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

- g. Continuity test on each conductor and cable.
- h. Uniform resistance of parallel conductors.
- 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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. UTP cabling.
 - 2. RS-232 cabling.
 - 3. RS-485 cabling.
 - 4. Low-voltage control cabling.
 - 5. Control-circuit conductors.
 - 6. Identification products.

1.3 RELATED SECTIONS

- A. Division 26 Section "LIGHTING CONTROL DEVICES" for installation requirements for low-voltage lighting control devices.
- B. Division 26 Section "NETWORK LIGHTING CONTROLS" for installation requirements for low-voltage relay-based lighting control systems.
- C. Division 26 Section "INTERIOR LIGHTING" for installation requirements for low-voltage dimming drivers and ballasts.

1.4 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. IDC: Insulation displacement connector.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- E. RCDD: Registered Communications Distribution Designer.
- F. UTP: Unshielded twisted pair.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.
- C. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.1. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install control cabling and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS."
 - 1. Outlet boxes shall be no smaller than 4 inches (100 mm) wide, 4 inches (100 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) minimum or as shown on drawings. Comply with requirements for plywood backing panels in Division 06 Section "ROUGH CARPENTRY."
- 2.3 UTP CABLE
 - A. Comply with requirements of Division 27.
- 2.4 UTP CABLE HARDWARE
 - A. Comply with requirements of Division 27.

2.5 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Polypropylene insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. PVC jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Plastic insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. Plastic jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 - 6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.

- 3. Unshielded.
- 4. Fluorinated ethylene propylene jacket.
- 5. Flame Resistance: NFPA 262, Flame Test.
- 2.7 LOW-VOLTAGE CONTROL CABLE
 - A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
 - B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.9 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. HellermannTyton.
 - 3. Kroy LLC.
 - 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS" for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Comply with installation requirements of referenced and related sections of work.
- C. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

- D. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Install 110-style IDC termination hardware unless otherwise indicated.
 - 3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- E. Installation of Control-Circuit Conductors:
 - 1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS."
- F. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- G. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
 - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 - 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No 14 AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

- 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are gualified by test equipment manufacturer for channel or link test configuration.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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: Grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "OPERATION AND MAINTENANCE DATA," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with NFPA 70, Article 517, "Healthcare Facilities".

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Stranded Conductors: ASTM B 8.
 - 2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 12 inches (6.3 by 305 mm) minimum or per drawings in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Straps: Solid copper, copper lugs. Rated for 600 A.
- J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- K. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.

- b. Listed for direct burial.
- 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Stranded Copper unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors.
 - 3. Connections to Ground Rods: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
 - 5. Connections to Shielding System: Bolted connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from

panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- F. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
 - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or

sleeve to conductor at each end. Water services include both domestic and fire sprinkler water services.

- 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
- 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Welded visible connection to structural steel. Bond multiple connections together where steel structure is not continuously connected.
- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG or size shown on drawings.
 - 1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 LABELING

- A. Comply with requirements in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:

- 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- 4. Prepare dimensioned Drawings locating each ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 2. Power Distribution Units or Panelboards Serving Medical Equipment: 3 ohm(s).
 - 3. Substations and Pad-Mounted Equipment: 5 ohms.
 - 4. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems, and electrically operated and connected components required by other Divisions of work.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. GRC: Galvanized rigid steel conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code -Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "ROOF ACCESSORIES."
- C. Coordinate size, location, and installation requirements for remote mounted elevator controllers, HVAC equipment and controllers and other electrically connected components requiring support with all other Divisions of work.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

- 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "METAL FABRICATIONS" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Comply with requirements of Division 07 Section "PENETRATION FIRESTOPPING" for firestopping materials and installation for penetration through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Division 26 Section "RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- G. Conductor Supports in Vertical Conduits: Provide supports at no less than 50 feet for each vertical conduit run with feeder cables. Comply with NEC Table 319.A.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and GRC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

- 1. To Wood: Fasten with lag screws or through bolts.
- 2. To New Concrete: Bolt to concrete inserts.
- 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
- 4. To Existing Concrete: Expansion anchor fasteners.
- 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
- 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
- 7. To Light Steel: Sheet metal screws.
- 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "METAL FABRICATIONS" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 6 inches (125 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete or as shown on drawings. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "CAST-IN-PLACE CONCRETE."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529
SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Boxes, enclosures, and cabinets.
- B. Related Requirements:
 - 1. DIVISION 26 SECTION "UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS" for exterior ductbanks, manholes, handholes, and underground utility construction.
 - 2. DIVISION 27 for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. EMT: Electrical metallic tubing.
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. FMC: Flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Republic Conduit.
 - 10. Wheatland Tube Company.
- B. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Raceway Finishes:
 - a. Factory pigmented/colored raceways shall be utilized where scheduled on Drawings.
 - b. Factory pigmented/colored raceways shall be available in at least eight (8) unique colors and in Trade Sizes $\frac{1}{2}$ 4".

- c. Comply with Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- d. Factory pigmentation/color shall be organic, corrosion resistant coating.
- 3. GRC: Comply with ANSI C80.1 and UL 6.
- 4. IMC: Comply with ANSI C80.6 and UL 1242.
- 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
- 6. EMT: Comply with ANSI C80.3 and UL 797.
- 7. FMC: Comply with UL 1; zinc-coated steel.
- 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- C. Metal Fittings:
 - 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 5. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
 - 8. Bushings for Steel Connector Fittings:
 - a. For fittings 1" and smaller: Integral insulated throat bushings.
 - b. For fittings 1 ¼" and Larger: Threaded plastic bushings.
 - 9. Fittings associated with Factory pigmented/colored raceways shall match raceway finish.
- D. Joint Compound for IMC, or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.

- 10. Manhattan/CDT/Cole-Flex.
- 11. RACO; a Hubbell Company.
- 12. Thomas & Betts Corporation.
- B. Nonmetallic Conduit:
 - 1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2420 for belowground raceways.
 - RNC: Type EPC-40-PVC or Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Nonmetallic Fittings:
 - 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - 3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.

- 7. RACO; a Hubbell Company.
- 8. Robroy Industries, Inc.; Enclosure Division.
- 9. Scott Fetzer Co.; Adalet Division.
- 10. Spring City Electrical Manufacturing Company.
- 11. Thomas & Betts Corporation.
- 12. Walker Systems, Inc.; Wiremold Company (The).
- 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Semi-adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- L. Gangable boxes are prohibited. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuoushinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

- N. Cabinets:
 - 1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC or IMC.
 - 2. Concealed Conduit, Aboveground: GRC, IMC or EMT.
 - 3. Underslab Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed: EMT.
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Damp or Wet Locations: GRC or IMC.
 - 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in DIVISION 26 SECTION "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm)of enclosures to which attached.
- I. Install conduit under concrete floor slabs on grade. Raceways shall be at least 12" below vapor barrier at bottom of concrete slab.
 - 1. Change from RNC, Type EPC-40-PVC, to PVC coated rigid steel conduit, before rising above the floor. Elbows shall be PVC-Coated Rigid Steel.
- J. No conduits shall be installed in concrete slabs on steel deck above grade unless approved in writing by the Structural Engineer. If approved by Structural Engineer, install in accordance with ACI Standards; in this case conduits shall be no larger than one inch and shall not cross other conduits or pipes in slab.
- K. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat

metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- V. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 - Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

- 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Locate to require cutting of masonry unit edge only. Saw-cut opening for box, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical framing channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.
- EE. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- FF. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- GG. Locate and install boxes to allow access.
- HH. Locate and install boxes to maintain headroom and to present a neat appearance.
- II. Provide knockout closures for unused openings.
- JJ. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- KK. Position outlets to locate luminaires as shown on reflected ceiling plans.
- LL. In inaccessible ceiling areas, position outlets and junction boxes within six inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- MM. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud

bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

- NN. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- OO. For boxes installed in wood construction, use rigid support metal bar hangers or bridging between studs. Nailing boxes directly to joists or studs is not acceptable.
- PP. For boxes installed in metal construction, use rigid support metal bar hangers or metal bar fastened to two studs or with metal screws to metal studs.

3.3 INSTALLATION OF UNDERGROUND AND UNDERSLAB CONDUIT

A. Direct-Buried Conduit:

- 1. Comply with DIVISION 26 SECTION "UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS".
- 2. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in DIVISION 31 SECTION "EARTH MOVING" for pipe less than 6 inches (150 mm) in nominal diameter.
- 3. Install backfill as specified in DIVISION 31 SECTION "EARTH MOVING".
- 4. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in DIVISION 31 SECTION "EARTH MOVING."
- 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
- 6. Underground Warning Tape: Comply with requirements in DIVISION 26 SECTION "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in DIVISION 26 SECTION "SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING."
- 3.5 FIRESTOPPING
 - A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in DIVISION 07 SECTION "PENETRATION FIRESTOPPING."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

- 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

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. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Duct accessories.
 - 4. Precast concrete handholes.
 - 5. Polymer concrete handholes and boxes with polymer concrete cover.
 - 6. Utility structure accessories.

1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for, handholes, boxes, and other utility structures.
 - 4. Include underground-line warning tape.
- B. Shop Drawings:

- 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design.
 - e. Include grounding details.
 - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - g. Include joint details.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For concrete and steel used in precast concrete boxes and handholes, as required by ASTM C 858.
- B. Field quality-control reports.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Republic Conduit.
 - 10. Wheatland Tube Company.

- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems.
 - 2. ARNCO Corporation.
 - 3. Beck Manufacturing.
 - 4. Cantex, Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
 - 8. Electri-Flex Company.
 - 9. IPEX Inc.
 - 10. Lamson & Sessions; Carlon Electrical Products.
 - 11. Manhattan Wire Products; a Belden company.
- B. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems.
 - 2. ARNCO Corporation.
 - 3. Beck Manufacturing.
 - 4. Cantex, Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
 - 8. Electri-Flex Company.
 - 9. IPEX Inc.
 - 10. Lamson & Sessions; Carlon Electrical Products.
 - 11. Manhattan Wire Products; a Belden company.

- B. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- C. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

2.4 PRECAST CONCRETE BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Christy Concrete Products.
 - 2. Cretex Concrete Products West, Inc.; Riverton Division.
 - 3. Elmhurst-Chicago Stone Co.
 - 4. Oldcastle Precast Group.
 - 5. Oldcastle Precast Inc.; Utility Vault Division.
 - 6. Utility Concrete Products, LLC.
 - 7. Wausau Tile Inc.
- B. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamperresistant, captive, cover-securing bolts.
 - 1. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - 2. Cover Handle: Recessed.
- E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- F. Cover Legend: Molded lettering, as indicated for each service.
- G. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- H. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - 1. Extension shall provide increased depth of 12 inches (300 mm).
 - 2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
- I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- J. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - 1. Center window location.

- 2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
- 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
- 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
- 5. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.
- K. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - 1. Type and size shall match fittings to duct to be terminated.
 - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.

2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Polymer Concrete Handholes and Pull Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. Hubbell Power Systems; Lenoir City Division.
 - e. NewBasis.
- B. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, as indicated for each service.
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Division 31 Section "SITE CLEARING." Remove and stockpile topsoil for reapplication according to Division 31 Section "SITE CLEARING."

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- C. Underground Ducts Crossing Driveways and Roadways: Type EPC-40 PVC RNC, encased in reinforced concrete.
- D. Stub-ups: Concrete-encased PVC-coated GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 or Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 or Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 4. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "EARTH MOVING," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section "TURF AND GRASSES" and Division 32 Section "PLANTS."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Division 01 Section "EXECUTION."

3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two boxes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.
 - 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. End Bell Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch (19 mm).
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Terminator Entrances to Concrete and Polymer Concrete Handholes: Use manufactured, cast-inplace duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to terminator spacing 10 feet (3 m) from the terminator, without reducing duct line slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch (19 mm).
- H. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Division 26 Section "SLEEVES AND SEALS FOR ELECTRICAL RACEWAYS AND CABLING."
- I. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- J. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.
- K. Concrete-Encased Ducts and Duct Bank:
 - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Division 31 Section "EARTH MOVING" for pipes less than 6 inches (150 mm) in nominal diameter.
 - 2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
 - 3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
 - 4. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 - 5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure

spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

- 7. Minimum Space between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
- 8. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
- 9. Elbows: Use manufactured PVC-coated GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm)abovefinished floor and minimum 3 inches (75 mm)from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm)abovefinished floor and no less than 3 inches (75 mm)from conduit side to edge of slab.
- 10. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 11. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 12. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between duct of like services, and 4 inches (100 mm) between power and communications ducts.
- 13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
- 14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Division 03 Section "CAST-IN-PLACE CONCRETE." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
- L. Direct-Buried Duct and Duct Bank:

- 1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Division 31 Section "EARTH MOVING" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
- 2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
- 3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
- 4. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
- 5. Set elevation of bottom of duct bank below frost line.
- 6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
- 7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- 8. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.
- 9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
- 10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm)abovefinished floor and minimum 3 inches (75 mm)from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches (100 mm)abovefinished floor and no less than 3 inches (75 mm)from conduit side to edge of slab.
- 11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Division 31 Section "EARTH MOVING" for installation of backfill materials.
 - a. Place minimum 3 inches (75 mm) of sand as a bed for duct. Place sand to a minimum of 6 inches (150 mm) above top level of duct.
 - b. Place minimum 6 inches (150 mm) of engineered fill above concrete encasement of duct.

M. Underground-Line Warning Tape: Bury conducting underground line specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks and approximately 12 inches (300 mm) below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

- A. Precast Concrete Handhole Installation:
 - 1. Comply with ASTM C 891 unless otherwise indicated.
 - 2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
 - 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
 - 1. Install handholes with bottom below frost line, below grade.
 - 2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
 - 3. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- D. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
 - 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."

- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
 - 6. Fire-stopping sleeve systems for electrical applications.
- B. Related Requirements:
 - 1. Division 07 Section "PENETRATION FIRESTOPPING" for penetration firestopping installed in fireresistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.6 FIRE STOPPING SLEEVES

- A. Description: Fire rated pathway device with built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. STI Specified Technologies, Inc. EZ Path Fire Rated Pathway.
 - 2. Sealing Elements: Integral fast, self-expanding intumescence material, UL classified and FM approved in accordance with ASSTM E814 (UL1479). Sealing material shall automatically adjust to number of cables installed through sealing element and permit cables to be installed, removed, or retrofitted without the need to adjust, remove or reinstall firestop materials. Sealing materials shall provide up to 4-hour fire seals.
 - 3. Housing: Heavy-duty Specification Grade steel housing with internal and external firestopping capabilities. Housings shall be capable of being ganged together and shall

be factory finished in colors to match systems served. Include two for each sealing element.

- 4. Connecting Hardware: Steel wall plates or floor plates with manufacturer's mounting hardware and attachments; size as required for complete seal of opening(s). Transitions to conduit or other cable support systems per manufacturer's standard products. Provide transitions and wall/floor plates for each application.
- 5. Spare Parts: Provide one (1) sealing assembly for each ten (10) installed for each type and rating installed. Furnish at least one of each type.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "JOINT SEALANTS."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.4 FIRE-STOPPING SLEEVE SYSTEM INSTALLATION

- A. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING." Where indicated, install fire-stopping sleeve assemblies, arranged singly or in gangs at heights as shown or coordinated with other systems. Install fire-stopping sleeve assemblies in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations. Apply factory supplied gasketing material prior to the installation of wall/floor plates. Secure wall plates to devices per the equipment manufacturer's recommendations.
- B. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "PENETRATION FIRESTOPPING." Utilize fire-stopping sleeve assemblies where shown on drawings.

END OF SECTION 260544

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Channel support systems.
 - 3. Restraint cables.
 - 4. Hanger rod stiffeners.
 - 5. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Division 26 Section "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: See Structural Documents.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: See Structural Documents.
 - a. Component Importance Factor: See Structural Documents.
 - b. Component Response Modification Factor: See Structural Documents.
 - c. Component Amplification Factor: See Structural Documents.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural Documents
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: See Structural Documents.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage, preapproval by ICC-ES, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange 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.
 - 1. Resilient Material: Oil- and water-resistant rubber.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.

- 2. California Dynamics Corporation.
- 3. Cooper B-Line, Inc.; a division of Cooper Industries.
- 4. Hilti Inc.
- 5. Loos & Co.; Seismic Earthquake Division.
- 6. Mason Industries.
- 7. TOLCO Incorporated; a brand of NIBCO INC.
- 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

- 1. Powder coating on springs and housings.
- 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
- 3. Baked enamel or powder coat for metal components on isolators for interior use.
- 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling.

Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

- 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Tapes and stencils.
 - 4. Signs.
 - 5. Paint for identification.
 - 6. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Comply with ASME A13.1.
 - B. Comply with NFPA 70.
 - C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with Divsion 26 Section "OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - Factory pigmented/colored raceways shall be used for all associated connections related to the following systems. See Division 26 Section "RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS."
 - a. Fire Alarm: Red
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White or gray.
 - 5. Color for Equipment Grounds: Green.
- C. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
 - 3. All warning information required by NFPA 70 and NFPA 70E
- D. Equipment Identification Labels:

- 1. White letters on a black field unless otherwise noted.
 - a. Life Safety Branch Black letters on a Yellow Field.
 - b. Critical Branch White letters on an Orange Field.
 - c. Equipment Branch White letters on a Green Field.
- 2. Refer to typical details shown on Drawings for labeling layout and information required.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemicalresistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm)for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm)for equipment.
 - c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- B. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- C. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - d. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - e. Width: 3 inches (75 mm).
 - f. Overall Thickness: 5 mils (0.125 mm).

- g. Foil Core Thickness: 0.35 mil (0.00889 mm).
- h. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
- i. Tensile according to ASTM D 882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).

2.5 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with white letters on a dark gray background.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting or Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- L. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- M. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- N. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- O. Underground Line Warning Tape:

- During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
- 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- P. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification 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.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. Field-paint junction box covers according to raceway color schedule. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "FIRE ALARM."
 - 4. "LIGHTING."
 - 5. "LIGHTING CONTROLS."
 - 6. "SECURITY."
 - 7. "NETWORK."
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels or self-adhesive vinyl tape to identify the phase.
 - 1. Locate identification 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. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide selfadhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- N. Arc Flash Warning Labeling: Self-adhesive labels.
- O. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- P. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- Q. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.

- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f. Emergency system boxes and enclosures.
- g. Enclosed switches.
- h. Enclosed circuit breakers.
- i. Enclosed controllers.
- j. Variable-speed controllers.
- k. Push-button stations.
- I. Power-transfer equipment.
- m. Contactors.
- n. Lighting control switches, dimmer modules, and control devices.
- o. Battery-inverter units.
- p. Power-generating units.
- q. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Standalone daylight-harvesting dimming controls.
 - 2. Indoor occupancy and vacancy sensors.
 - 3. Switchbox-mounted occupancy sensors.
- B. Related Requirements:
 - 1. Division 26 Section "WIRING DEVICES" for wall-box dimmers, non-networkable wallswitch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's warranties.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Eaton Electrical Inc; Cutler-Hammer Products.
 - 2. Intermatic, Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Watt Stopper (The).
 - 5. Cooper/Greengate Controls
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

- 1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
- 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate power pack mounted on luminaire, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
 - 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).
- E. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 1. LED status lights to indicate load status.
 - 2. Plenum rated.

2.2 INDOOR OCCUPANCYAND VACANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Sensor Switch, Inc.
 - 5. Watt Stopper (The).
 - 6. Cooper/Greengate Controls
- B. General Requirements for Sensors:
 - 1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 - 2. Dual technology unless otherwise noted.
 - 3. Separate power pack.
 - 4. Hardwired connection to switch; and BAS and lighting control system.
 - 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 6. Operation:

- a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- 7. Sensor Output: Sensor is powered from the power pack.
- 8. Power: Line voltage.
- 9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
- 10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 12. Bypass Switch: Override the "on" function in case of sensor failure.
- 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
 - 2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
 - 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180degree pattern centered on the sensor over an area of1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.
- D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

- 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
- 6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted84 inches (2100 mm) above finished floor.
- E. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted48 inches (1200 mm) above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Sensor Switch, Inc.
 - 5. Watt Stopper (The).
 - 6. Cooper/Greengate Controls
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 - 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "CONTROL-VOLTAGE ELECTRICAL POWER CABLES."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "CONTROL-VOLTAGE ELECTRICAL POWER CABLES."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES," and "CONTROL-VOLTAGE ELECTRICAL POWER CABLES." Minimum conduit size is 3/4 inch (19 mm).
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Receptacles with integral USB charger.
 - 3. Twist-locking receptacles.
 - 4. Receptacles with integral surge protection units.
 - 5. Wall-box motion sensors.
 - 6. Hospital-grade receptacles.
 - 7. Tamper-resistant receptacles.
 - 8. Snap switches and wall-box dimmers.
 - 9. Communications outlets.
 - 10. Pendant cord-connector devices.
 - 11. Cord and plug sets.
 - 12. Poke-through assemblies.
- B. Related Sections include the following:
 - 1. Division 27 for workstation communications outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge Protective Device.
- F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
 - 2. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.
 - 3. Straight Blade Receptacles: One for every 10 but no fewer than ten.
 - 4. Receptacle Coverplates: One for every 10 but no fewer than ten for Duplex and Double Duplex type.

- 5. Straight Blade GFCI: One for every 10 but no fewer than ten.
- 6. GFCI Coverplates: One for every 10 but no fewer than ten for Duplex and Double Duplex type.
- 7. Tamper Resistant Receptacles: One for every 10 but no fewer than ten.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. All wiring devices shall be listed as "Specification" Grade minimum, no exceptions.
- B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

2.3 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. USB Charging Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596. Compatible with USB 1.1/2.0/3/0 devices, including Apple products.
- C. Hospital-Grade, Heavy Duty, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 - 1. Description: Single-piece, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 - 2. Devices required to be tamper resistant are noted with 'TP' on drawings.
- D. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

- E. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 - 1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, Tamper-Resistant Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
 - 4. Include internal "self-test" capabilities that automatically monitor GFCI functionality with integral visual and audible indication in accordance with UL 943.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
- D. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2.5 SPD RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
 - 1. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 - 2. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex SPD Convenience Receptacles:
 - 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
- C. Hospital-Grade, Duplex SPD Convenience Receptacles: Comply with UL 498 Supplement sd.
 - 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
 - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with NFPA 70.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles: Comply with NEMA WD 1, NEMA WD 6, and UL 498. Configurations as scheduled on Drawings.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description:

- 1. Matching, locking-type plug and receptacle body connector.
- 2. NEMA WD 6, heavy-duty grade, and FS W-C-596.
- 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
- 5. Configurations as scheduled on drawings.

2.8 CORD AND PLUG SETS

- A. Description:
 - 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with greeninsulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
 - 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20A, Single Pole, Double Pole, 3-Way, and 4-Way Configurations.
- C. Pilot-Light Switches, 20 A:
 - 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.10 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Schedules: Refer to Drawings for scheduled devices.

2.11 WALL-BOX MOTION SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Sensor Switch, Inc.
 - 5. Watt Stopper (The).
 - 6. Cooper/Greengate Controls.
- B. General Description: Wall- or ceiling-mounting, 120/277 V.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 - 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind Faceplate.
 - 3. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 - 4. Bypass Switch: Override the on function in case of sensor failure.
 - 5. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- C. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

- 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- 3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
- D. Ultrasonic Type: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
- E. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- F. Wall-mounted Units
 - 1. Field of View: 180-degrees minimum.

2.12 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
 - 1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

2.13 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.

- 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel,.
- 3. Material for Unfinished Spaces: Galvanized steel.
- 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, diecast aluminum with lockable cover; "EXTRA-DUTY" Rated.

2.14 POKE-THROUGH ASSEMBLIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Incorporated; Wiring Device-Kellems; products as specified and scheduled on drawings or a comparable product by one of the following:
 - 1. FSR.
 - 2. Wiremold / Legrand.
- B. Activation Type:
 - 1. Recessed Activation.
 - a. Basis-of-Design Product: Hubbell System One Recessed Activation.
 - 1) S1R4PT: 4 inch (100 mm) core with two 1/2 inch (13 mm) and one 3/4 inch (19 mm) feed conduits.
 - a) Outlets: S1R4PTQUAD: Power only, with four power outlets.
 - 2) S1R6PT: 6 inch (150 mm) with one 3/4 inch (19 mm) and one 2 inch (50 mm) feed conduits.
 - a) Subplate Configuration for S1R6: 50/50.
 - 3) Provided with appropriate subplate for device mounting and cover, finish chosen by Architect.
 - a) Cover Flange: 0.12 inch (3 mm) thick, ADA compliant.
 - b) Finish: Brushed aluminum.

C. Description:

- 1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- 2. Comply with UL 514 scrub water exclusion requirements.
- 3. Service-Outlet Assembly: Recessed type with 2 gangs populated with services indicated complying with requirements in Division 27.
- 4. Size: Selected to fit nominal 4-inch (100-mm) and 6-inch (150-mm) cored holes in floor and matched to floor thickness.
- 5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

- 6. Closure Plug: Arranged to close unused 4-inch (100-mm) or 6-inch (150-mm) cored openings and reestablish fire rating of floor.
- 7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Division 27.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. SPD Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:

- 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
- 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
- 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
- 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
 - 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: 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.
- G. Dimmers:
 - 1. Install dimmers within terms of their listing.
 - 2. Verify that dimmers used for fan speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on box-side face of coverplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

- 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
- 2. Test Instruments: Use instruments that comply with UL 1436.
- 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Enclosed controllers.
 - b. Enclosed switches.
 - 2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "CLOSEOUT PROCEDURES," include the following:

- 1. Ambient temperature adjustment information.
- 2. Current-limitation curves for fuses with current-limiting characteristics.
- 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
- 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and keycoded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK5, time delay.
 - 2. Large Motor Branch (601-4000 A): Class L, time delay.
 - 3. Other Branch Circuits: Class RK1, time delay or Class CC, fast acting.
 - 4. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).

- 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "OPERATION AND MAINTENANCE DATA," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's written permission.
 - 4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from dedicated branch circuit with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight green ON pilot light.
 - 3. Isolated neutral lug; 100 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

- 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
- 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.
3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Disconnect any/all Surge Protection Devices during acceptance testing that involves continuous test voltages that exceed SPD manufacturers' continuous voltage tolerances.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - d. Circuits to be tested shall be under full load for a minimum of one hour prior to scanning. Provide load bank when required for full load conditions.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY".

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - 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 LED luminaires as scheduled on Drawings.
- B. Related Requirements:
 - 1. Division 26 Section "LIGHTING CONTROL DEVICES" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "NETWORK LIGHTING CONTROLS" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

- 6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
 - 1. Product Data: Indicating luminaire is certified by ENERGY STAR and Design lights Consortium (DLC).
 - 2. Include Samples of luminaires and accessories involving color and finish selection.
 - 3. Include Samples of luminaires and accessories to verify finish selection.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
 - 4. Structural members to which equipment and or luminaires will be attached.
 - 5. Initial access modules for acoustical tile, including size and locations.
 - 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
 - 7. Moldings.

- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of luminaire.
- E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Minimum of Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

- 1. ENERGY STAR certified.
- 2. Design Lighting Consortium (DLC) Certified.
- 3. UL Listing: All products shall be U.L. Listed.
- 4. Recessed luminaires shall comply with NEMA LE 4.
- C. CRI: 80 minimum.
- D. CCT of 3500 K (interior) and 3000k (exterior) or as scheduled in Luminaire Schedule.
- E. Rated lamp life minimum: 50,000 hours to L70.
- F. Light Engines shall be dimmable from 100 percent to 0 percent of maximum light output.

2.3 LED DRIVERS

- A. Internal to Luminaire unless otherwise noted.
- B. Input Voltage: As scheduled in Luminaire Schedule. Multi-Tap types shall be utilized unless strict manufacture requirements indicate specific voltage connections.
- C. Dimming: 0-10V, unless otherwise specified; dimming from 100% to 0%.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Powder-coat painted finish as scheduled.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following luminaire characteristics:
 - a. "USE ONLY" and include specific mounting allowances.
 - b. CCT and CRI for all luminaires.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in Division 26 Section "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- D. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- F. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to.
- G. Suspended Luminaire Support:

- 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
- 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
- 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
- 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" for wiring connections.
- J. Comply with requirements in Division 26 Section "CONTROL-VOLTAGE ELECTRICAL POWER CABLES" for control wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Division 26 Section "NETWORK LIGHTING CONTROLS."

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

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. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Product Schedule:

- 1. For emergency lighting units. Use same designations indicated on Drawings.
- 2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
 - 4. Structural members to which equipment will be attached.
 - 5. Size and location of initial access modules for acoustical tile.
 - 6. Items penetrating finished ceiling including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Ceiling-mounted projectors.
 - e. Sprinklers.
 - f. Access panels.
 - 7. Moldings.
- B. Product Certificates: For each type of luminaire.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Provide seismic qualification certificate for each piece of equipment.
- D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
 - 2. Warranty Period for Self-Powered Exit Sign Batteries: Two years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.

- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver.
 - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1400 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet (1000 m).
 - 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 5. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - 7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
 - 1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

- 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
- 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
- 5. Charger: Fully automatic, solid-state, constant-current type.
- 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
- 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
- 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
- 10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Input Voltage: As scheduled in Luminaire Schedule Multi-Tap inputs shall be utilized where offered by manufacturer.
 - 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 - 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 MATERIALS

A. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 - 1. Smooth operating, free of light leakage under operating conditions.
 - 2. Designed to permit relamping without use of tools.
 - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Division 26 Section "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire and emergency power unit weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.

- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
 - 3. Use approved devices and support components to connect luminaire to building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:
 - 1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

END OF SECTION 265219

SECTION 268000 – ELECTRICAL DEMOLITION AND REPAIR

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. Removal of obsolete wiring and electrical apparatus.
 - 2. Relocation, reconnection, or replacement of existing wiring affected by demolition or new construction.
 - 3. Capping off concealed wiring abandoned due to demolition or new construction.

1.3 DRAWINGS AND EXISTING CONDITIONS

A. All relocations, reconnections and removals are not necessarily indicated on the drawings. As such, the Contractor shall make adequate allowance in his proposal for this work as no "extra" charges will be allowed for these items.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Refer to Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS" for raceways and boxes required by this scope of work.
- B. Refer to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" for conductor and cable installation required by this scope of work.

PART 3 - EXECUTION

3.1 TEMPORARY CONNECTIONS

A. Where existing wiring must remain in service to supply occupied areas during construction, provide temporary wiring, connections and apparatus to maintain service to such areas. All shall be performed in a neat and safe manner to prevent injury to the building or its' occupants.

3.2 EXISTING WIRING TO BE ABANDONED

- A. Concealed wiring: cap flush with existing or new building surfaces. Indicate routing, size and former function of such raceways on as-built prints.
- B. Surface Run Raceways: remove; cap where emerging from building surfaces and record as above.

3.3 EXISTING WIRING TO REMAIN IN USE

A. Where affected by demolition or new construction; relocate, replace, extend or repair raceways, conductors, outlets and apparatus to allow continued use of same. Use methods and materials as specified for new construction.

3.4 EXISTING INFRASTRUCTURE TO REMAIN

A. Existing electrical wiring, apparatus, fixtures, equipment, etc. in close proximity to altered or new work shall be upgraded, modified, and brought to current adopted code standards in accordance with NEC and local ordinances. Close proximity shall be determined by the Authority Having Jurisdiction.

3.5 MATERIALS AND APPARATUS REMOVED

- A. All obsolete raceways, conductors, apparatus, and luminaires shall become the property of the Contractor and removed from site promptly unless otherwise noted.
- B. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "PENETRATION FIRESTOPPING."

3.5 POWER OUTAGES

A. Power outages shall be held to a minimum and coordinated with the Owner. Contractor shall schedule same during normal off-duty hours, such as nights, weekends or holidays.

END OF SECTION 268000

SECTION 280100 – BASIC ELECTRONIC SAFETY AND SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this and the other sections of Division 28.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Definitions.
 - 2. Code compliance.
 - 3. Drawings and specifications.
 - 4. Submittals.
 - 5. Coordination drawings.
 - 6. Guarantee of installation.
 - 7. Record documents.
 - 8. Maintenance manuals.
 - 9. Delivery, storage and handling.
 - 10. Temporary Electrical services.
 - 11. Instruction of Owners personnel.
 - 12. Product Source Limitations
 - 13. Incentives and Rebates
- B. Furnish and install all materials and equipment and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 28 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete installation including all accessories and appurtenances required for testing the system. It is the intent of the drawings and specifications that all systems be complete, and ready for operation. All specified products shall be installed in accordance with all manufacturers' instructions and requirements.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and electrical equipment rooms.

- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 CODE COMPLIANCE

- A. All work and materials shall comply with the latest rules, codes and regulations, including, but not limited to the following:
 - 1. Occupational Safety and Health Act Standards (OSHA).
 - 2. ANSI/IEEE C-2 National Electrical Safety Code.
 - 3. ADAAG (ADA) Standards Americans With Disabilities Act.
 - 4. CABO-ANSI A117.1.
 - 5. IEEE Standards.
 - 6. Underwriter's Laboratory U.L. All products shall be U.L. Listed.
 - 7. NFPA National Fire Protection Association Codes and Standards of Installation.
 - a. NFPA 70 National Electric Code
 - b. NFPA 99 Standard for health Care Facilities
 - c. NFPA 101 Life Safety Code
 - d. NFPA 110 Emergency and Standby Power Systems
 - 8. NECA Standard of Installation.
 - 9. NEMA Standard of Installation
 - 10. International Building Code
 - 11. International Fire Code
 - 12. International Energy Conservation Code.
 - 13. Facility Guidelines Institute (FGI) Guidelines for Design and Construction of Hospitals and Outpatient Facilities
- B. Work to be executed and inspected in accordance with local codes and ordinances. Permits, fees or charges for inspection or other services shall be paid for by this Contractor. Local codes and ordinances are to be considered as minimum requirements and must be properly executed without expense to the Owner; but do not relieve the Contractor from work shown that exceeds minimum requirements.

1.5 DRAWINGS AND SPECIFICATIONS

- A. All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- B. Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduits and wiring is not assured. Exact requirements shall be governed by architectural, structural and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, supports, attachment methods, etc., necessitated by such conditions shall be included in the bid. Check all

information and report any apparent discrepancies before submitting bid.

1.6 SUBMITTALS

- A. General: Follow the procedures specified in Division 01 Section "SUBMITTALS".
- B. Substitutions and Material Submittals: By specific designation and description, standards are established for specialties and equipment.
- C. Other makes of specialties and equipment of equal quality will be considered, provided such proposed substitutions are submitted to the Architect for approval at least seven (7) calendar days prior to bid opening. A schedule showing make, type, manufacturer's name and trade designation of all materials and equipment proposed as a substitution shall be submitted together with a single copy of the manufacturer's complete specifications. A list of approved substitutions will be published as an Addendum.
- D. Within thirty (30) days after award of contract, the Contractor shall submit a schedule showing make, type, manufacturer's name and trade designation of all materials and equipment proposed for use and implementation. This schedule shall be accompanied by the manufacturer's complete specification, for each equipment item or materials used, give complete information as to listings, certifications, capacities, ratings, kind of material used, finish guarantee, etc., and such dimensions as are necessary to check space requirements. When approved, such schedule and drawing shall be in addition to these specifications and shall be in equal force in that no variation shall be permitted. The Architect is to be the sole judge as to the quality of any material offered as an equal. See General Conditions and Supplementary Conditions to the Contract.
- E. Design is based on equipment as listed in schedules on drawings and included in these specifications. All changes in foundations, bases, supports, connections, controls, space, openings, walls and ceilings and sound and vibration isolation, seismic support, and electrical and mechanical characteristics required by alternate equipment specified, submitted and approved shall be made at no additional cost to the Owner.
- F. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail; said approval does not in any way relieve the contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- G. Additional copies may be required by individual sections of these Specifications.
- H. Electronic Submittal Procedure
 - 1. Summary
 - a. Shop drawings and product data submittals shall be transmitted to Architect in electronic (PDF) format using the selected file transfer, a website service designed specifically for transmitting submittals between construction team members.
 - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.

- c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
- 2. Procedures:

a.

- Create submittal log in file transfer service by inserting required submittals listed in individual specification section.
- b. Submittal Preparation Contractor may use any or all of the following options:
 - 1. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the website.
 - 2. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via email.
 - 3. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
- c. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
- d. Contractor shall transmit each submittal to Architect using the file transfer website.
- e. Architect / Engineer review comments will receive email notice of completed review.
- f. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
- g. Submit paper copies of any reviewed submittals not submitted electronically at project closeout for record purposes in accordance with Division 01 Section "CLOSEOUT PROCEDURES."
- 3. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - a. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not a as Product Data.
 - b. Mark each copy of each submittal to show which products and options are applicable. Include the following information, as applicable.
 - 1. Manufacturer's catalog cuts.
 - 2. Manufacturer's product specification.
 - 3. Standard color charts.
 - 4. Statement of compliance with specified referenced standards.
 - 5. Testing by recognized testing agency.
 - 6. Application of testing agency labels and seals.
 - 7. Notation of coordination requirements.
 - 8. Availability and delivery time information.
 - For equipment, include the following in addition to the above, as applicable:
 - 1. Wiring diagrams showing factory-installed wiring.
 - 2. Printing performance curves.
 - 3. Operational range diagrams.
 - 4. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - d. Submit Product Data before or concurrent with Samples. Submit Product Data in the following format.
 - 1. Electronic (PDF) format using file transfer service.

C.

- 4. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions or the contract Documents or standard data.
 - a. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - 1. Identification of products.
 - 2. Schedules.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
 - 6. Relationship and attachment to adjoining construction clearly indicated.
 - 7. Seal and signature of professional engineer if specified.
 - b. Sheet Size: Except for templates , patterns, and similar full-size drawings, submit Shop Drawings on sheets a least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1067 mm)
 - c. Submit Shop Drawings in the following format:
 - 1. Electronic (PDF) format using file transfer service.
- 5. 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.
 - a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - b. Identification: Attach label on unexposed side of Samples that includes the following:
 - 1. Generic description of Sample.
 - 2. Product name and name of manufacturer.
 - 3. Sample source.

C.

- 4. Number title of application Specification Section.
- 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.
 - 1. Sample not incorporated with Work, or otherwise designated as Owner's property, are the property of Contractor.
- d. 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.
 - 1. Number of Samples: Submit three 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. Coordination Drawings: Comply with requirements specified in Division 01 Section "PROJECT MANAGEMENT AND COORDINATION."
- 7. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects names and addresses, contact information of architects and owners, and other information specified.
- 8. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

- 9. 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.
- 10. Manufacturer Certificates: Submit written statements on manufacture's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- 11. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- 12. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- 13. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indication and interpreting test results of material for compliance with requirements in the Contract Documents
- 14. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency
- 15. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "QUALITY REQUIREMENTS."
- 16. 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.
- 17. 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.
- 18. Field Test Reports: Submit reports indicating and interpreting results of field test performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- 19. Maintenance Data: Comply with requirements specified in Division 01 Section "OPERATION AND MAINTENANCE DATA."
- 20. 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 number.

1.7 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 01 Section "PROJECT COORDINATION" and other Sections included herein to a scale of 1/8"=1'-0" or larger detailing electrical room and floor plans showing major elements, components and systems of electrical equipment and materials in relationship with other systems, installations and building components. Indicated locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work including (but not limited to) the following:
 - 1. Indicate the proposed locations of cable tray, conduit racks, equipment and materials. Include the following:
 - a. Clearances for installation of electrical disconnect switches at mechanical

equipment.

- b. Clearances for installation of electrical junction boxes.
- c. Clearances for servicing and maintaining equipment including panelboards, disconnect switches, switchboards, luminaires, wiring devices, etc.
- d. Equipment connections and support details.
- e. Exterior wall and foundation penetrations.
- f. Fire rated wall and ceiling and floor assembly penetrations.
- g. Size and locations of required concrete pads and bases.
- 2. Indicate scheduling, sequencing, movement and positioning of large equipment into the building during construction.
- 3. Prepare floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.
- 4. Prepare reflected ceiling plans to coordinate and integrate installations, mechanical access to equipment, air outlets and inlets, luminaires, speakers, fire sprinklers and other ceiling mounted items.

1.8 GUARANTEE OF INSTALLATION

- A. All work under this section shall be guaranteed in writing to be free of defective work, materials, or parts for a period of one (1) year from the date of Substantial Completion.
- B. Manufacturer's specific warranties and those specified in this Section shall be included in the Contractor's Guarantee of Installation.
- C. Repair, revision or replacement of any and all defects, failure or inoperativeness shall be done by this section at no cost to the Owner.

1.9 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 01, indicate the following installed conditions:
 - 1. Conduit racks, size, location, and routing, for interior locations. Show all wiring device locations and connections, control locations, disconnect switch locations, and final equipment locations including actual dimensions.
 - 2. Luminaire locations and wiring connections.
 - 3. Update luminaire schedule to reflect actual manufacturer's components used complete with updated part numbers and lists.
 - 4. Underground ductbank locations, routings, and quantity of conduits utilized.
 - 5. All approved substitutions, Contract Modifications and actual equipment and materials installed.
 - 6. Contract Modifications, actual equipment and materials installed.

1.10 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 01, include the following information for equipment

and systems:

- 1. Description of function, normal operating characteristics and limitations, performance and engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
- 2. Manufacturer's printed operating procedures to include start-up, break-in and routine and normal operating instructions, regulation, control, stopping shutdown and emergency instructions.
- 3. Maintenance procedures for routine preventative maintenance and troubleshooting, disassembly, repair and reassembly, aligning and adjusting instructions.
- 4. Servicing instructions and schedules.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials in a manner to prevent damage or interference with traffic conditions.
- B. Protect equipment from weather and dampness.
- C. All material stored on site shall be protected to Owner's standards. Owner may reject any or all material documented to have been improperly stored. Replacement of improperly stored material shall be solely at the contractor's expense.

1.12 TEMPORARY ELECTRICAL SERVICES

A. Temporary wiring for construction light and power for the general contractor or other subcontractors shall not be included as a part of this section of the work. Refer to Division 01 regarding payment for the electrical energy used for construction light and power and testing of the new installation.

1.13 INSTRUCTION OF OWNER'S PERSONNEL

A. The Contractor shall conduct an on-site instructional tour of the entire project. The personnel designated by the Owner shall be instructed in: operation of all electrical systems, elementary trouble-shooting procedures, preventive maintenance procedures, uses of Operation and Maintenance Manuals, relamping and cleaning of lighting fixtures and operation of all communication systems.

1.14 INCENTIVES AND REBATES

A. All incentives and rebates offered by outside agencies relating to Energy Efficiency or Tax Incentives offered by Governmental agencies shall be considered property of the Owner and shall not be granted to any contractor performing work on the project.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in all other Divisions of work for rough-in requirements.

3.2 ELECTRONIC SAFETY AND SECURITY INSTALLATIONS

- A. General: Sequence, coordinate and integrate the various elements of electrical systems, materials and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment and materials installation with other building components. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots and openings in other building components during progress of construction to allow for electrical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-inplace concrete and other structural components as they are constructed.
 - 5. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the Building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of electrical systems with exterior underground and overhead service companies and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials and equipment to conform with approved submittal data, including coordination drawings, to the greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirement, refer conflict to the Architect.
 - 9. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.
 - 10. Install electrical equipment to facilitate servicing, maintenance and repair or replacement of equipment components and as required by Code. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
 - a. All electrical items, equipment, etc. requiring access and maintenance to be provided with access panels by electrical contractor when located behind hard inaccessible finished surfaces. See Architectural ceiling plans for ceiling and wall finish types.
 - 11. Install access panel or doors where equipment is concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "ACCESS DOORS".
 - 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 - 13. Only quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.
 - 14. Provide foreman in charge of this work at all times.
 - 15. Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall at all times be kept in the job

superintendent's office and shall be available to the Owner's representative.

3.3 QUALITY ASSURANCE

- A. Provide a meaningful Quality Assurance program. To assist the Contractor in this program, the specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other Quality Assurance measures to obtain a complete operating facility within the scope of this project.
- B. The Contractor shall insure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- C. Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.4 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 01, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - 2. No joists, beams, girders or structural columns shall be cut by any contractor without obtaining written permission from the Architect.
- B. Perform cutting, fitting and patching of electrical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 1. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installer's qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 01 Section "DEFINITIONS AND STANDARDS" for definition of "Experienced Installer."

3.7 EXCAVATION AND BACKFILL

- A. General: Perform excavation and backfilling in accordance with Division 31 Section "EARTH MOVING." In addition to the requirements specified in Division 31, the following requirements apply:
 - 1. Protection of Installed Work: During excavating and backfilling operations, protect adjacent installations.

- B. Perform excavating and backfilling for electrical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

END OF SECTION 280100

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. UTP cabling.
 - 2. RS-232 cabling.
 - 3. RS-485 cabling.
 - 4. Low-voltage control cabling.
 - 5. Control-circuit conductors.
 - 6. Fire alarm wire and cable.
 - 7. Identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remotecontrol and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. RCDD: Registered Communications Distribution Designer.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Pathways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Submit conductors and cables in their respective applicable system sections.
- B. Seismic Qualification Certificates: For pathways, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For wire and cable to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "OPERATION AND MAINTENANCE DATA," include the following:
 - 1. Allowable pulling tension of cable.
 - 2. Cable connectors and terminations recommended by the manufacturer.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.1. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

- 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Cable Trays: See Division 26 Section "CABLE TRAY SYSTEMS"
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS."
- D. Outlet boxes shall be no smaller than 4 inches (100 mm) wide, 4 inches (100 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) minimum or as indicated. Comply with requirements for plywood backing panels in Division 06 Section "ROUGH CARPENTRY".

2.3 UTP CABLE

A. Comply with Division 27 requirements.

2.4 UTP CABLE HARDWARE

A. Comply with Division 27 requirements.

2.5 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Polypropylene insulation.

- 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
- 4. PVC jacket.
- 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
- 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Plastic insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. Plastic jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with NFPA 262.
- 2.6 RS-485 CABLE
 - A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
 - B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.7 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.9 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Comtran Corporation.
 - 2. Draka Cableteq USA.
 - 3. Genesis Cable Products; Honeywell International, Inc.
 - 4. Rockbestos-Suprenant Cable Corp.
 - 5. West Penn Wire; a brand of Belden Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.10 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. HellermannTyton.
 - 3. Kroy LLC.
 - 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS." for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- D. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Division 26 Section "HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS." for installation of supports for pathways, conductors and cables.

3.3 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Install 110-style IDC termination hardware unless otherwise indicated.
 - 3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

- 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- 3.5 FIRE ALARM WIRING INSTALLATION
 - A. Comply with NECA 1 and NFPA 72.
 - B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS."
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
 - C. Wiring Method:
 - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
 - D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
 - E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
 - F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-

code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.7 CONNECTIONS

- A. Comply with requirements in Division 28 Section "DIGITAL ADDRESSABLE FIRE-ALARM SYSTEM" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "DIGITAL ELEVATOR RESCUE ASSISTANCE SIGNAL AND CALL SYSTEM" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "EMERGENCY RESPONDER RADIO COVERAGE SYSTEMS" for connecting, terminating, and identifying wires and cables.

3.8 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.9 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "GROUNDING, BONDING, AND ELECTRICAL PROTECTION" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS."

3.10 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Remote annunciator.
 - 7. Addressable interface device.
 - 8. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

A. General Submittal Requirements:

- 1. Submittals shall be approved by Architect prior to submitting them to authorities having jurisdiction.
- 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level IV minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- 3. Do not begin installation until submittal documents have been approved by the Building Official.
- 4. Submission of reproducing contract drawings shall not qualify as a system layout drawing.
- 5. Use of Consultants electronic (CAD) files for aid in preparation of submittals by project suppliers may be obtained on a per sheet basis upon approval by the project's Engineer. CAD files will include project base and approximate device locations on electronic media. Connections of devices are the contractor's responsibility and will not be included. Contact Engineer for per sheet costs.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Qualification Data: For qualified Installer.
- E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "OPERATION AND MAINTENANCE DATA" include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

- 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
- 3. Record copy of site-specific software.
- 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
- 5. Manufacturer's required maintenance related to system warranty requirements.
- 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- 7. Copy of NFPA 25.
- H. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer..
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide SimplexGrinnell LP; a Tyco International company, 4100 Series addressable alarm system.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
 - 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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 8. Recall elevators to primary or alternate recall floors.
 - 9. Record events in the system memory.
- C. 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.
- D. 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. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions:
 - 1. Initiate notification appliances.
 - 2. Annunciate at fire-alarm control unit and remote annunciators.

3. Switch heating, ventilating and air-conditioning systems equipment controls to fire-alarm mode.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 40 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: Style B.
 - b. Notification Appliance Circuits: Style Y.
 - c. Signaling Line Circuits: Style 3.5.
 - d. Install no more than 50 addressable devices on each signaling line circuit.
 - 2. Serial Interfaces: Two RS-232 ports for printers.
- D. Notification Appliance Circuit: Operation shall sound in a temporal pattern.
- E. Elevator Recall:
 - 1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarminitiating devices, except those listed, shall not start elevator recall.

- a. Elevator lobby detectors except the lobby detector on the designated floor.
- b. Smoke detector in elevator machine room.
- c. Smoke detectors in elevator hoistway.
- 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
- 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the powersupply module rating.
- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.

3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be analog-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.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.

- c. Present average value.
- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).
- 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
- 4. Each sensor shall have multiple levels of detection sensitivity.
- 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a singlemounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. Specific candela rating as shown on drawings.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.

2.8 REMOTE ANNUNCIATOR

- A. Description: 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 control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER (CELLULAR)

- A. 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.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from firealarm control unit and automatically transmit signal directly to a monitoring station receiver via 3G cellular network. When contact is made with central station(s), signals shall be transmitted.
- C. Local functions at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that cellular network is available.
 - 2. Manual test report function and manual transmission clear indication.
 - 3. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- G. Basis of Design: DSC #3G4010cf Series

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS."
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- F. Audible Visual Alarm-Indicating Devices: Install not less than 82 inches above finished floor (wall mounts). Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "DOOR HARDWARE." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an

addressable confirmation connection when such feedback is available at the device or system being controlled.

- 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
- 2. Alarm-initiating connection to elevator recall system and components.
- 3. Supervisory connections at valve supervisory switches.
- 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
- 5. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "IDENTIFICATION FOR ELECTRICAL SYSTEMS."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Install laminated map of entire fire alarm system at location visible from fire-alarm control panel. Laminate each floor map separately. Locate and additional floor map at each respective floor equipment.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

- 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
- 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
- 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.7 WARRANTY

- A. The contractor shall warrant the fire alarm system wiring and equipment to be free from mechanical and electrical defects for a period of one year from the date of the completed and certified test.
- B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two inspections and tests per year in compliance with NFPA-72.

END OF SECTION 283111