

CONSTRUCTION DOCUMENTS  
AUGUST 9, 2018

# NAC REC CENTER



## PROJECT MANUAL VOLUME 1 OF 2

1000 ABILITY WAY  
PARK CITY, UTAH 84060

PROJECT NO: 18065



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VOLUME 1

# TABLE OF CONTENTS

## DIVISION 01 — GENERAL REQUIREMENTS

- 011000 - SUMMARY
- 012500 - SUBSTITUTION PROCEDURES
- 012600 - CONTRACT MODIFICATION PROCEDURES
- 012900 - PAYMENT PROCEDURES
- 013100 - PROJECT MANAGEMENT AND COORDINATION
- 013200 - CONSTRUCTION PROGRESS DOCUMENTATION
- 013300 - SUBMITTAL PROCEDURES
- 014000 - QUALITY REQUIREMENTS
- 015000 - TEMPORARY FACILITIES AND CONTROLS
- 015639 - TEMPORARY TREE AND PLANT PROTECTION
- 016000 - PRODUCT REQUIREMENTS
- 017300 - EXECUTION
- 017700 - CLOSEOUT PROCEDURES
- 017823 - OPERATION AND MAINTENANCE DATA
- 017839 - PROJECT RECORD DOCUMENTS
- 017900 - DEMONSTRATION AND TRAINING

## DIVISION 03 — CONCRETE

- 033000 - CAST-IN-PLACE CONCRETE
- 034500 - PRECAST ARCHITECTURAL CONCRETE

## DIVISION 04 — MASONRY

- 042200 - CONCRETE UNIT MASONRY
- 044313.16 - ADHERED STONE MASONRY VENEER

## DIVISION 05 — METALS

- 051200 - STRUCTURAL STEEL FRAMING
- 055000 - METAL FABRICATIONS

## DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

- 061000 - ROUGH CARPENTRY
- 061516 - WOOD FLOOR AND ROOF DECKING
- 061600 - SHEATHING
- 061753 - SHOP-FABRICATED WOOD TRUSSES
- 061800 - GLUED-LAMINATED CONSTRUCTION
- 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

## DIVISION 07 — THERMAL AND MOISTURE PROTECTION

- 072100 - THERMAL INSULATION
- 074113 - CORRUGATED METAL ROOF AND WALL PANELS
- 074213 - METAL PANELS
- 074646 - FIBER-CEMENT SIDING
- 076200 - SHEET METAL FLASHING AND TRIM
- 077253 - SNOW GUARDS
- 079200 - JOINT SEALANTS

## DIVISION 08 — OPENINGS

- 081113 - HOLLOW METAL DOORS AND FRAMES
- 081416 - FLUSH WOOD DOORS
- 083113 - ACCESS DOORS AND FRAMES
- 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
- 087100.01 - DOOR HARDWARE
- 088000 - GLAZING

## DIVISION 09 — FINISHES

- 092900 - GYPSUM BOARD
- 093013 - CERAMIC TILING
- 095113 - ACOUSTICAL PANEL CEILINGS
- 096513 - RESILIENT BASE AND ACCESSORIES
- 096566 - RESILIENT ATHLETIC FLOORING
- 096813 - TILE CARPETING
- 099113 - EXTERIOR PAINTING
- 099123 - INTERIOR PAINTING
- 099300 - STAINING AND TRANSPARENT FINISHING

## DIVISION 10 — SPECIALTIES

- 101423.16 - ROOM-IDENTIFICATION & PANEL SIGNAGE
- 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS
- 102226 - OPERABLE PARTITIONS
- 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES
- 104413 - FIRE PROTECTION CABINETS
- 104416 - FIRE EXTINGUISHERS

## VOLUME 2

## DIVISION 21 — FIRE SUPPRESSION

- 211000 - FIRE PROTECTION

## DIVISION 22 — PLUMBING

- 221410 - PLUMBING PIPING
- 221411 - DISINFECTING WATER SUPPLY SYSTEM
- 221430 - PLUMBING SPECIALTIES
- 224440 - PLUMBING FIXTURES
- 224450 - PLUMBING EQUIPMENT

## DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

- 230500 - BASIC MECHANICAL REQUIREMENTS
- 230529 - BASIC MECHANICAL MATERIALS AND METHODS
- 230540 - MECHANICAL SOUND AND VIBRATION CONTROL
- 230548 - MECHANICAL SEISMIC CONTROL
- 230593 - TESTING, ADJUSTING AND BALANCING
- 230700 - MECHANICAL INSULATION
- 230810 - VARIABLE FREQUENCY DRIVE
- 230900 - ELECTRONIC CONTROLS
- 231123 - NATURAL GAS SYSTEM
- 233300 - DUCTWORK AND ACCESSORIES
- 233400 - AIR HANDLING FANS



233713 - AIR INLETS AND OUTLETS  
234100 - AIR CLEANING  
235100 - BREECHINGS, CHIMNEYS, STACKS, AND FLUES  
235700 - HEAT TRANSFER  
236400 - REFRIGERATION  
237400 - AIR HANDLING SYSTEMS  
237410 - AIR HANDLING UNIT WITH COILS

## DIVISION 26 — ELECTRICAL

260500 - ELECTRICAL GENERAL PROVISIONS  
260501 - MECHANICAL AND ELECTRICAL COORDINATION  
260507 - ELECTRICAL CONNECTIONS FOR EQUIPMENT  
260519 - CONDUCTORS AND CABLES (600V AND BELOW)  
260526 - GROUNDING  
260529 - SUPPORTING DEVICES  
260532 - CONDUIT RACEWAY  
260533 - ELECTRICAL BOXES AND FITTINGS  
260548 - ELECTRICAL SEISMIC CONTROL  
260553 - ELECTRICAL IDENTIFICATION  
260573 - PROTECTIVE DEVICE STUDY  
260923 - OCCUPANCY SENSORS  
260943 - LIGHTING CONTROL EQUIPMENT  
262413 - SWITCHGEAR AND SWITCHBOARDS  
262416 - PANELBOARDS  
262713 - SERVICE ENTRANCE  
262726 - WIRING DEVICES  
262815 - OVERCURRENT PROTECTIVE DEVICES  
262816 - MOTOR AND CIRCUIT DISCONNECTS  
264313 - SURGE PROTECTIVE DEVICES (SPD)  
265100 - INTERIOR AND EXTERIOR BUILDING LIGHTING

## DIVISION 27 — COMMUNICATIONS

271501 - TELEPHONE SYSTEM (RACEWAYS)  
274100 - AUDIOVISUAL SYSTEM

## DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

282205 - ACCESS CONTROL SYSTEM  
283111 - FIRE ALARM AND DETECTION SYSTEM  
283112 - FIRE SPRINKLER MONITORING SYSTEM

## DIVISION 32 — EXTERIOR IMPROVEMENTS

328400 - PLANTING IRRIGATION  
329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)  
329200 - TURF AND GRASSES  
329300 - PLANTS

## DIVISION 33 — UTILITIES

330000 - CIVIL SPECS

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**SECTION 011000 - SUMMARY****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and Drawing conventions.

**B. Related Requirements:**

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

**1.2 PROJECT INFORMATION**

- A. Project Identification: The National Ability Center Recreation Center.
- B. Project Location: National Ability Center Main Campus, 1000 Ability Way, Park City, UT 84060.
- C. Owner: The National Ability Center.
- D. Architect: Architectural Nexus.
- E. Construction Manager / General Contractor: Big-D Construction.

**1.3 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  1. New recreation center, meeting space, restrooms and associated site improvements.
- B. Type of Contract:
  1. Project will be constructed under a single prime contract.

**1.4 ACCESS TO SITE**

- A. General: Contractor shall have use of Project site for construction operations during construction period. Construction will take place while the campus is operational and must be coordinated with the Owner.

## 1.5 WORK RESTRICTIONS

- A. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

## 1.6 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 011000**

**SECTION 012500 - SUBSTITUTION PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

**1.2 DEFINITIONS**

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

**1.3 ACTION SUBMITTALS**

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

- g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. 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.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 PROCEDURES

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

#### 1.6 SUBSTITUTIONS

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



1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
  1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.
    - i. Requested substitution provides specified warranty.
    - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

AUGUST 9, 2018

CONSTRUCTION  
DOCUMENTS

NAC REC CENTER

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 012500**

**SECTION 012600 - CONTRACT MODIFICATION PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 MINOR CHANGES IN THE WORK**

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

**1.3 PROPOSAL REQUESTS**

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

4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

#### 1.4 CHANGE ORDER PROCEDURES

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

#### 1.5 CONSTRUCTION CHANGE DIRECTIVE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 012600**

**SECTION 012900 - PAYMENT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Arrange schedule of values consistent with format of AIA Document G703.
  - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 3. 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.
  - 4. 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.
  - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
  - 6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
  - 8. 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.

## 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt OR submit electronic copy of the original.. 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.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Contractor's construction schedule (preliminary if not final).
  - 4. Products list (preliminary if not final).
  - 5. Sustainable design action plans, including preliminary project materials cost data.
  - 6. Schedule of unit prices.
  - 7. Submittal schedule (preliminary if not final).



8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Initial progress report.
  13. Report of preconstruction conference.
  14. Certificates of insurance and insurance policies.
  15. Performance and payment bonds.
  16. Data needed to acquire Owner's insurance.
- H. 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.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. 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. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706.
  5. AIA Document G706A.
  6. AIA Document G707.
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 012900**

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**SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

**1.3 DEFINITIONS**

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.

**1.5 GENERAL COORDINATION PROCEDURES**

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate

construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

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

## 1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

#### 1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
  1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.

- c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project software. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

## 1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.



- d. Critical work sequencing and long lead items.
  - e. Designation of key personnel and their duties.
  - f. Lines of communications.
  - g. Use of web-based Project software.
  - h. Procedures for processing field decisions and Change Orders.
  - i. Procedures for RFIs.
  - j. Procedures for testing and inspecting.
  - k. Procedures for processing Applications for Payment.
  - l. Distribution of the Contract Documents.
  - m. Submittal procedures.
  - n. Sustainable design requirements.
  - o. Preparation of Record Documents.
  - p. Use of the premises.
  - q. Work restrictions.
  - r. Working hours.
  - s. Owner's occupancy requirements.
  - t. Responsibility for temporary facilities and controls.
  - u. Procedures for moisture and mold control.
  - v. Procedures for disruptions and shutdowns.
  - w. Construction waste management and recycling.
  - x. Parking availability.
  - y. Office, work, and storage areas.
  - z. Equipment deliveries and priorities.
  - aa. First aid.
  - bb. Security.
  - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Sustainable design requirements.
    - i. Review of mockups.
    - j. Possible conflicts.
    - k. Compatibility requirements.
    - l. Time schedules.
    - m. Weather limitations.
    - n. Manufacturer's written instructions.

- o. Warranty requirements.
  - p. Compatibility of materials.
  - q. Acceptability of substrates.
  - r. Temporary facilities and controls.
  - s. Space and access limitations.
  - t. Regulations of authorities having jurisdiction.
  - u. Testing and inspecting requirements.
  - v. Installation procedures.
  - w. Coordination with other work.
  - x. Required performance results.
  - y. Protection of adjacent work.
  - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.
      - 4) Status of submittals.
      - 5) Status of sustainable design documentation.
      - 6) Deliveries.
      - 7) Off-site fabrication.
      - 8) Access.

- 9) Site use.
  - 10) Temporary facilities and controls.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) Status of RFIs.
  - 16) Status of Proposal Requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 013100**

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**SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Site condition reports.

**1.2 DEFINITIONS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file, where indicated.
  - 2. PDF file.

- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, 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.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

#### 1.4 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.

#### 1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of 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.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:



1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  5. Commissioning Time: Include no fewer than 15 days for commissioning.
  6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
  2. 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.
  3. 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.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities.
- H. Recovery Schedule: When periodic update indicates the Work is seven or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to

working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- I. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

## 1.6 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
  1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
  1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.

- h. Work by Owner that may affect or be affected by Contractor's activities.
  - i. Testing and inspection.
  - j. Commissioning.
  - k. Punch list and final completion.
  - l. Activities occurring following final completion.
- 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
- 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
- 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
  - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- 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.

## 1.7 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. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Emergency procedures.
  13. Orders and requests of authorities having jurisdiction.
  14. Change Orders received and implemented.
  15. Construction Change Directives received and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial completions and occupancies.
  19. Substantial Completions authorized.
- B. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 013200**

**SECTION 013300 - SUBMITTAL PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

**1.2 DEFINITIONS**

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

**1.3 SUBMITTAL SCHEDULE**

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

**1.4 SUBMITTAL FORMATS****A. Submittal Information: Include the following information in each submittal:**

1. Project name.
2. Date.
3. Name of Architect.
4. Name of 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. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

## 1.5 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.
  2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- 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.
- 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. Resubmittal Review: Allow 10 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

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

## 1.6 SUBMITTAL REQUIREMENTS

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

- C. Samples: Submit Samples for review of kind, 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. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.



- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- 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 Welding Procedure Specification and Procedure Qualification Record 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 primers and substrate preparation needed for adhesion.
  2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed

before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED-DESIGN SERVICES

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

#### 1.8 CONTRACTOR'S REVIEW

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

## 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
  - 2. Submittals by Web-Based Project Software: Architect will indicate, on Project software website, the appropriate 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**

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**SECTION 014000 - QUALITY REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

**1.2 DEFINITIONS**

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  - 1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.

2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
  3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

### 1.4 CONFLICTING REQUIREMENTS

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

## 1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
  2. Statement that products at Project site comply with requirements.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
  2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  3. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.



- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - d. When testing is complete, remove test specimens and test assemblies. Do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups of size indicated.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 8. Demolish and remove mockups when directed unless otherwise indicated.
- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  - 1. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

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

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

## 3.1 TEST AND INSPECTION LOG

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

## 3.2 REPAIR AND PROTECTION

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

**END OF SECTION 014000**

**SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

**1.2 USE CHARGES**

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.

## 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.5 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

## 2.1 TEMPORARY FACILITIES

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

## 2.2 EQUIPMENT

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

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

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

### 3.2 INSTALLATION, GENERAL

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

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed

construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  1. Install electric power service underground unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.
- J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
  1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
  2. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds at each computer.
  3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
  4. Backup: External hard drive, , with automated backup software providing daily backups.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.



1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
  1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard and replace stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

**3.7 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

**END OF SECTION 015000**

**SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related requirements:
  - 1. Section 311000 "Site Clearing" for removing existing trees and shrubs.

**1.2 DEFINITIONS**

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- E. Vegetation: Trees, shrubs, groundcovers, grass and other plants.

**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 each type of the following:
  - 1. Organic Mulch: Sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
  - 2. Protection-Zone Fencing: Assembled Samples.
  - 3. Protection-Zone Signage: Full-size Samples.

- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

## 1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA.

## 1.7 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Moving or parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
  - 1. Planting Soil: Planting soil as specified in Section 329115 "Soil Preparation (Performance Specification)."
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
  - 1. Type: Ground or shredded bark.

- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements:
1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top rails and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
    - a. Height: 72 inches.
  2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart. High-visibility orange color.
    - a. Height: 48 inches.
  3. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

#### 3.2 PREPARATION

- A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- B. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
1. Apply 3-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

#### 3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected areas except by entrance gates.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
  2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
  3. Access Gates: Install one access gate for each tree or grouping of trees to be protected..
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

### 3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Do not allow exposed roots to dry out before placing permanent backfill.

### 3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  3. Cover exposed roots with burlap and water regularly.
  4. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.



## 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
  - 1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
  - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
  - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
- B. Cut branches with sharp pruning instruments; do not break or chop.
- C. Do not paint or apply sealants to wounds.
- D. Chip removed branches and dispose of off-site.

## 3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- C. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil in a single uncompacted layer and hand grade to required finish elevations.

## 3.8 FIELD QUALITY CONTROL

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

## 3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
  - 2. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.

## 3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

AUGUST 9, 2018

CONSTRUCTION  
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**END OF SECTION 015639**

**SECTION 016000 - PRODUCT REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

**1.2 DEFINITIONS**

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

**1.3 ACTION SUBMITTALS**

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable

product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

- 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
- 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
- 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

- C. Storage:

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

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## PART 2 - PRODUCTS

## 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

- B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
  - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
  - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
  - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
  - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

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

## PART 3 - EXECUTION (Not Used)

## END OF SECTION 016000

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**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. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. 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.

**1.2 INFORMATIONAL SUBMITTALS**

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit three copies signed by land surveyor or professional engineer.
- D. Final Property Survey: Submit three copies showing the Work performed and record survey data.

**1.3 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut

- and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. 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 and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

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

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- 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 or 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 or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  1. 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. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, 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.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
  - 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.
  - 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 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

**3.8 STARTING AND ADJUSTING**

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

**3.9 PROTECTION OF INSTALLED CONSTRUCTION**

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

**END OF SECTION 017300**



**SECTION 017700 - CLOSEOUT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

- B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

**1.2 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.

**1.3 CLOSEOUT SUBMITTALS**

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

**1.4 SUBSTANTIAL COMPLETION PROCEDURES**

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

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
  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 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 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

## 1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

#### 1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Submit list of incomplete items in the following format:
    - a. MS Excel electronic file. Architect will return annotated file.
    - b. PDF electronic file. Architect will return annotated file.
    - c. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

#### 1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit on digital media acceptable to Architect or by uploading to web-based project software site.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

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

## PART 3 - EXECUTION

## 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - d. Sweep concrete floors broom clean in unoccupied spaces.
    - e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - f. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - g. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
    - i. 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."

**3.2 REPAIR OF THE WORK**

- A. Complete repair and restoration operations, before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

**END OF SECTION 017700**

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**SECTION 017823 - OPERATION AND MAINTENANCE DATA****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 CLOSEOUT SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit on digital media acceptable to Architect or by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

**1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

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

#### 1.4 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.
- 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."



## 1.5 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.

## 1.6 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.
- 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.

## 1.7 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.
- 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. 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.
- D. 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.
- E. 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.
- F. 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.
- 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.
- H. 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.

## 1.8 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. 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.
- D. 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.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. 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 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.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.2 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit to Architect one paper-copy set(s) of marked-up record prints OR PDF electronic files of scanned record prints OR record digital data files.
- B. Record Specifications: Submit one paper copy OR annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy OR annotated PDF electronic files and directories of each submittal.

**PART 2 - PRODUCTS****2.1 RECORD DRAWINGS**

- A. Record Drawings General: Maintain record drawings during the construction phase in the form of either Record Prints OR Record Digital Data Files.
- B. 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.
    - a. Record data as soon as possible after obtaining it.
    - b. Record and check the markup before enclosing concealed installations.
  2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- C. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
  1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. 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.
  3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.2 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.
  1. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file OR paper copy.

## 2.3 RECORD PRODUCT DATA

- A. 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.
- B. Format: Submit record Product Data as annotated PDF electronic file OR paper copy.

## 2.4 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 OR paper copy.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

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

**END OF SECTION 017839**

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**SECTION 017900 - DEMONSTRATION AND TRAINING****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

**1.3 CLOSEOUT SUBMITTALS**

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

**1.4 QUALITY ASSURANCE**

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

## 1.5 COORDINATION

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

## 1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

- 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.

- 2. Documentation: Review the following items in detail:

- a. Emergency manuals.
- b. Systems and equipment operation manuals.
- c. Systems and equipment maintenance manuals.
- d. Product maintenance manuals.
- e. Project Record Documents.
- f. Identification systems.
- g. Warranties and bonds.
- h. Maintenance service agreements and similar continuing commitments.

- 3. Emergencies: Include the following, as applicable:

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.

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

## 1.7 PREPARATION

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

## 1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

## 1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD modewith vibration reduction technology.
  - 1. Submit video recordings on CD-ROM or thumb drive or by uploading to web-based Project software site.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
- E. 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**

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**SECTION 033000 - CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Material certificates.
- B. Material test reports.
- C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

**1.5 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

## 1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
  - 1. 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).

## PART 2 - PRODUCTS

## 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301 (ACI 301M).
  - 2. ACI 117 (ACI 117M).

## 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."



## 2.4 CONCRETE MATERIALS

## A. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type II, gray.
2. Fly Ash: ASTM C 618, Class F or C.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, Portland blast-furnace slag cement.

## B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

## C. Air-Entraining Admixture: ASTM C 260/C 260M.

## D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## E. Water: ASTM C 94/C 94M and potable.

## 2.5 VAPOR RETARDERS

## A. Sheet Vapor Retarder: ASTM E 1745, Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

1. Basis-of-Design Product: Provide Stego Wrap 15 mil. Vapor Barrier or approved equal.

## 2.6 CURING MATERIALS

## A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF Corp. - Construction Chemicals.
  - b. Sika Corporation.
  - c. Or approved equal.

- 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 C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corp. - Construction Chemicals.
    - b. W. R. Meadows, Inc.
    - c. Or approved equal.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corp. - Construction Chemicals.
    - b. L&M Construction Chemicals, Inc.
    - c. SpecChem, LLC.
    - d. Or approved equal.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corp. - Construction Chemicals.
    - b. W. R. Meadows, Inc.
    - c. Or approved equal.

## 2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

## 2.8 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, according to ACI 301 (ACI 301M).

- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use 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, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

## 2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

### A. Normal-Weight Concrete:

- 1. Minimum Compressive Strength: As indicated at 28 days.
- 2. Maximum W/C Ratio: 0.45.
- 3. Slump Limit: 5 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
- 4. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25- mm) nominal maximum aggregate size.

## 2.10 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).

- C. Chamfer exterior corners and edges of permanently exposed concrete.

### 3.2 EMBEDDED ITEM INSTALLATION

- 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. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.3 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

### 3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

- B. 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. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

- 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

### 3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

- 1. Apply to concrete surfaces not exposed to public view.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

- 1. 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.

- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

- 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces indicated
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish and measure surface, so gap at any point between concrete surface and an unveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for 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. Cure for not less

than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

#### 3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

#### 3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

**END OF SECTION 033000**

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**SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes architectural precast concrete cladding units.

**1.2 DEFINITIONS**

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

**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. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings:
  - 1. Detail fabrication and installation of architectural precast concrete units.
  - 2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
  - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
  - 4. Indicate details at building corners.
- D. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Material certificates.
- C. Material Test Reports: For aggregates.
- D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

## 1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design architectural precast concrete units.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

## 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.
- B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## 2.3 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, , uncoated, seven-wire, low-relaxation strand.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
  1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
  2. Metakaolin: ASTM C 618, Class N.
  3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
  4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
  1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Gradation: Uniformly graded To match design reference sample.
  2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.
- D. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## 2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

## 2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.

- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi minimum.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- F. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

- H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.
- M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

## 2.9 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

## 2.10 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:
  - 1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
  - 2. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
  - 3. Textured-Surface Finish: Impart by form liners or inserts.
  - 4. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.

5. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
  6. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
  7. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
  8. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
  9. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
  10. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.
- B. Finish exposed top and back surfaces of architectural precast concrete units to match face-surface finish.
- C. Finish exposed back surfaces of architectural precast concrete units with smooth, steel-trowel finish.
- D. Finish unexposed surfaces of architectural precast concrete units with as cast finish.

## 2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712.
- B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  2. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

### 3.2 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections and prepare reports:
  - 1. Erection of loadbearing precast concrete members.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

### 3.4 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

### 3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**END OF SECTION 034500**



**SECTION 042200 - CONCRETE UNIT MASONRY****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Steel reinforcing bars.

**1.2 DEFINITIONS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
- D. Samples: For each type and color of the following:
  - 1. Exposed CMUs.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
  - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

**1.5 FIELD CONDITIONS**

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost

or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

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

## PART 2 - PRODUCTS

### 2.1 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
- C. CMUs: ASTM C 90.

### 2.2 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

### 2.3 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
  - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

### 2.4 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim.

### 2.5 MASONRY-CELL FILL

- A. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

## 2.6 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime or masonry cement mortar.
  - 3. For reinforced masonry, use portland cement-lime or masonry cement mortar.
  - 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

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

## 3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.

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

### 3.3 LAYING MASONRY WALLS

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

### 3.4 MORTAR BEDDING AND JOINTING

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

### 3.5 MASONRY-CELL FILL

- A. Pour loose-fill insulation into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

- B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

### 3.6 MASONRY-JOINT REINFORCEMENT

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

### 3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

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

### 3.8 FLASHING

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

- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

### 3.9 REINFORCED UNIT MASONRY INSTALLATION

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

### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- H. Prism Test: For each type of construction provided, according to ASTM C 1314 at seven days and at 28 days.

### 3.11 PARGING

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

### 3.12 REPAIRING, POINTING, AND CLEANING

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

### 3.13 MASONRY WASTE DISPOSAL

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

**END OF SECTION 042200**

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**SECTION 044313.16 - ADHERED STONE MASONRY VENEER****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Adhered Veneer Stone System: Stone masonry adhered to glass mat sheathing.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each variety of stone, stone accessory, and manufactured product.**B. Samples:**

1. For each stone type indicated.
2. For each color of mortar required.

**1.3 MOCKUP****A. Provide twenty (20) square-foot mockup of adhered stone veneer system for approval of stone layout and installation.**

1. For each stone type indicated.
2. For each color of mortar required.

**1.4 FIELD CONDITIONS****A. Protection of Stone Masonry:** During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.**B. Cold-Weather Requirements:** Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried.

**C. Hot-Weather Requirements:** Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.**PART 2 - PRODUCTS****2.1 QUARTZ-BASED STONE**

- A. Material Standard: Comply with ASTM C 616/C 616M, Classification II Quartzitic Sandstone.

1. Basis-of-Design Material: As indicated in the Drawings.
2. Color: As indicated in the Drawings.
3. Pattern: Squares and rectangles; natural cleft or guillotined builder or mix.

## 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.

- B. Hydrated Lime: ASTM C 207, Type S.

- C. Masonry Cement: ASTM C 91/C 91M.

- D. Aggregate: ASTM C 144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

- E. Latex Additive: Manufacturer's standard acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

- F. Water: Potable.

## 2.3 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual," Specifications Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.4 mm) thick.

- B. Flexible Flashing: For flashing unexposed to the exterior, use the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive, rubberized-asphalt compound, bonded to a high-density, cross-laminated, polyethylene film to produce an overall thickness of not less than 0.040 inch (1.0 mm).

## 2.4 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

## 2.5 FABRICATION

- A. Select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.
- B. Thickness of Stone: Provide thickness indicated, but not less than the following:
  - 1. Thickness: 1 inch (25 mm) plus or minus 1/4 inch (6 mm).

## 2.6 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride.
  - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
  - 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Mortar for Stone Masonry: Comply with ASTM C 270, Proportion Specification.
- C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.
- D. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.
  - 1. For latex-modified portland cement, setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.

## PART 3 - EXECUTION

## 3.1 SETTING STONE MASONRY

- A. Perform necessary field cutting and trimming as stone is set.
  - 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.

2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
  3. Pitch face at field-split edges as needed to match stones that are not field split.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones in range ashlar pattern with course heights as indicated, random lengths, and uniform joint widths, with offset between vertical joints as indicated.
- D. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.
- E. Arrange stones in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.
- F. Arrange stones in polygonal (mosaic) pattern with uniform joint widths.
- G. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- H. Maintain uniform joint widths, except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 3/8 inch (10 mm) at narrowest points or more than 1 inch (25 mm) at widest points.
- I. Provide sealant joints of widths and at locations indicated.
1. Keep sealant joints free of mortar and other rigid materials.
  2. Sealant joints are specified in Section 079200 "Joint Sealants."
- J. Install embedded flashing at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least 12 inches (300 mm), and behind weather barrier.
  2. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches (150 mm) into masonry at each end.
  3. At sills, extend flashing not less than 4 inches (100 mm) at ends.
  4. At ends of head and sill flashing, turn up not less than 2 inches (50 mm) to form end dams.
  5. Extend sheet metal flashing 1/2 inch (13 mm) beyond masonry face at exterior, and turn flashing down to form a drip.
  1. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face, and adhere flexible flashing to top of metal drip edge.
  2. Install metal flashing termination beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face, and adhere flexible flashing to top of metal flashing termination.
  3. Cut flexible flashing flush with wall face after completing masonry wall construction.

### 3.2 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

### 3.3 INSTALLATION OF ADHERED STONE MASONRY VENEER

- A. Install flashing over sheathing and behind building paper or wrap by fastening through sheathing into framing.
- B. Install lath over building paper or wrap by fastening through sheathing into framing to comply with ASTM C 1063.
- C. Install lath over unit masonry and concrete to comply with ASTM C 1063.
- D. Install scratch coat over metal lath 3/8 inch (10 mm) thick to comply with ASTM C 926.
- E. Coat backs of stone units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar, so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat.
- F. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm) before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

### 3.4 POINTING

- A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.
- B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly, and allow it to become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

### 3.5 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.

### 3.6 EXCESS MATERIALS AND WASTE

- A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

**END OF SECTION 044313.16**

**SECTION 051200 - STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural steel.
2. Grout.

**1.2 DEFINITIONS**

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

**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. Shop Drawings: Show fabrication of structural-steel components.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, fabricator and testing agency.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.
- E. Field quality-control and special inspection reports.

**1.6 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36, ASTM F 1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Finish: Plain.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36, ASTM F 1554, Grade 55, weldable, straight.
  - 1. Finish: Plain.



- E. Threaded Rods: ASTM A 36/A 36M, ASTM A 193/A 193M, Grade B7.

- 1. Finish: Plain.

## 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
- B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.

1. Surfaces of high-strength bolted, slip-critical connections.
  2. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  3. Galvanized surfaces.
  4. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
  3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

## 3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

## 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.

- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.

**END OF SECTION 051200**

**SECTION 055000 - METAL FABRICATIONS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Miscellaneous steel framing and supports; typically galvanized.
2. Metal ladders.
3. Miscellaneous steel trim.
4. Loose bearing and leveling plates.
5. Galvanize the steel in lintels wind girt and head - within exterior walls, steel primed

**B. Products furnished, but not installed, under this Section include the following:**

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

**1.2 ACTION SUBMITTALS****A. Product Data: For the following:**

1. Grout.

**B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.****C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.****PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS****A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.****B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.**

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; nominal thickness.
  - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; minimum thickness; unfinished.
- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- B. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.
- C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

## 2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

## 2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

## 2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.10 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Galvanize all steel that is exposed to the weather or part of the exterior wall system. Otherwise prime all steel in preparation for field painting.

## 2.11 PRIMER

- A. Primer: Provide fabricator's standard lead- and chromate- free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.



## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 1. Obtain fusion without undercut or overlap.
  - 2. Remove welding flux immediately.
  - 3. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

## 3.2 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.3 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 055000**

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**SECTION 061000 - ROUGH CARPENTRY****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Framing with engineered wood products.
2. Shear wall panels. No, see sheathing
3. Wood blocking, cants, and nailers.
4. Wood furring.
5. Plywood backing panels.

**B. See Section 061600 "Sheathing" for structural sheathing.****1.2 ACTION SUBMITTALS****A. Product Data:** For each type of process and factory-fabricated product.**1.3 INFORMATIONAL SUBMITTALS****A. Material Certificates:** For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.**B. Evaluation Reports:** For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Post-installed anchors.
6. Metal framing anchors.

**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, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
  3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

## 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
  5. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
1. As indicated on the structural drawings.
- B. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to

flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Flange material is determined by performance rating. See the Evaluations in Section 061600 "Sheathing" for information about durability classifications of plywood and OSB.
2. Web Material: Plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.
3. Structural Properties: Depths and design values not less than those indicated.
4. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA-EWS standard.
5. Comply with APA PRR-401, rim board grade. Factory mark rim boards with APA-EWS trademark indicating thickness, grade, and compliance with APA-EWS standard.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
  3. Rooftop equipment bases and support curbs.
  4. Cants.
  5. Furring.
  6. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
  2. Eastern softwoods; No. 2 Common grade; NeLMA.
  3. Northern species; No. 2 Common grade; NLGA.
  4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

## 2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

## 2.5 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on **ICC-ES AC193** or **ICC-ES AC308** as appropriate for the substrate.

## 2.6 METAL FRAMING ANCHORS

- A. As indicated by Structural Engineer on the drawings.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
  - 1. Use for wood-preserved-treated lumber and where indicated.

## 2.7 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

## 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. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking and similar supports to comply with requirements for attaching other construction.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- H. Securely attach rough 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 (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.

### 3.2 PROTECTION

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

**END OF SECTION 061000**

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**SECTION 061516 - WOOD ROOF DECKING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes solid-sawn wood floor and roof decking – just roof and it's plywood

**1.2 ACTION SUBMITTALS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Research/Evaluation Reports: For glued-laminated roof decking indicated to be of diaphragm design and construction, from ICC-ES.

**PART 2 - PRODUCTS****2.1 WOOD DECKING, GENERAL**

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

**2.2 SOLID-SAWN WOOD DECKING**

- A. Standard for Solid-Sawn Wood Decking: Comply with AITC 112.
- B. Wood Decking Species: Douglas fir-larch or Douglas fir-larch (North).
- C. Wood Decking Nominal Size: 2 by 6.
- D. Wood Decking Grade: Commercial Decking or Commercial Dex.
- E. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- F. Moisture Content: Provide wood decking with 19 percent maximum moisture content at time of dressing.
- G. Face Surface: Smooth.
- H. Edge Pattern: As indicated in the drawings.

- I. Finish: Per Section 099300 Staining and Transparent Finishing.

### 1.3 ACCESSORY MATERIALS

- A. Fastener Material: Hot-dip galvanized steel.
- B. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install solid-sawn wood decking to comply with AITC 112.
  - 1. Locate end joints for two-span continuous lay-up.
- B. Anchor wood decking, where supported on walls, with bolts as indicated.
- C. Apply joint sealant to seal wood decking at exterior walls at the following locations:
  - 1. Between wood decking and supports located at exterior walls.
  - 2. Between wood decking and exterior walls that butt against underside of decking.
  - 3. Between tongues and grooves of wood decking over exterior walls and supports at exterior walls.

### 3.2 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

**END OF SECTION 061516**

**SECTION 061600 - SHEATHING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Wall sheathing.
  - 2. Sheathing joint and penetration treatment.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preserved-treated plywood.

**PART 2 - PRODUCTS****2.1 PRESERVATIVE-TREATED PLYWOOD**

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with concrete or used with roofing, flashing, vapor barriers, and waterproofing.

**2.2 WALL SHEATHING**

- A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior, Exposure 1 sheathing.
  - 1. Thickness: As indicated on the Drawings.
- B. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation.
  - b. Georgia-Pacific Gypsum LLC.
  - c. Temple-Inland Building Products by Georgia-Pacific.
  - d. USG Corporation.
  - e. Or approved equal.
2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick as indicated on the Drawings.

## 2.3 ROOF SHEATHING

- A. Plywood Sheathing: Exterior, Exposure 1 sheathing.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

## 2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- A. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- B. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall Sheathing:
    - a. Nail to wood framing.
    - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

### 3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing as indicated on the Drawings.
  - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION 061600**

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**SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wood roof trusses.
2. Wood floor trusses.
3. Wood girder trusses.

**1.2 ACTION SUBMITTALS****A. Product Data:** For metal-plate connectors, metal truss accessories, and fasteners.**B. Shop Drawings:** Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

**C. Delegated-Design Submittal:** For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.**1.3 INFORMATIONAL SUBMITTALS****A. Product Certificates:** For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.**B. Evaluation Reports:** For the following, from ICC-ES:

1. Metal-plate connectors.
2. Metal truss accessories.

**1.4 QUALITY ASSURANCE****A. Metal Connector-Plate Manufacturer Qualifications:** A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
  2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

### 2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."



### 1.3 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
  2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
  3. CompuTrus, Inc.
  4. Eagle Metal Products.
  5. Jager Building Systems, Inc.
  6. MiTek Industries, Inc.
  7. Robbins Engineering, Inc.
  8. Truswal Systems Corporation.
  9. Or approved equal.
- B. General: Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

### 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
  2. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

### 2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cleveland Steel Specialty Co.
  2. KC Metals Products, Inc.
  3. Phoenix Metal Products, Inc.
  4. Simpson Strong-Tie Co., Inc.
  5. USP Structural Connectors.
  6. Or approved equal.

- B. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

## 2.6 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1.
  - 1. Position members to produce design camber indicated.
  - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- F. Securely connect each truss ply required for forming built-up girder trusses.
- G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
  - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- H. Install wood trusses within installation tolerances in TPI 1.
- I. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

- J. Replace wood trusses that are damaged or do not comply with requirements.

**END OF SECTION 061753**

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**SECTION 061800 - GLUED-LAMINATED CONSTRUCTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes framing using structural glued-laminated timber.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

**1.3 INFORMATIONAL SUBMITTALS**

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

**1.5 WARRANTY**

- A. Manufacturer and Installer shall provide warranties for the interior and exterior glulam beams and columns according to the following. Warranty shall include a minimum of one annual on-site inspection by both parties to thoroughly inspect all glulam products and associated systems to determine the state of the products and create and implement a plan to mitigate any damage or wear.
- B. Installer's Warranty: Installer agrees to repair or replace exterior glulam beams and columns within specified warranty period. Installer agrees to repair or replace interior glulam beams within specified warranty period.
  - 1. Warranty Period Exterior Glulam Beams and Columns: Four (4) years from date of Substantial Completion.
  - 2. Warranty Period Interior Glulam Beams: Twenty (20) years from date of Substantial Completion.

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace exterior glulam beams and columns within specified warranty period. Manufacturer agrees to repair or replace interior glulam beams within specified warranty period.
  - 1. Warranty Period Exterior Glulam Beams: Four (4) years from date of Substantial Completion.
  - 2. Warranty Period Interior Glulam Beams: Twenty (20) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
  - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
  - 2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
- B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that complies with combination symbols indicated.
- C. Species and Grades for Beams and Purlins:
  - 1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E.
  - 2. Lay-up: Either balanced or unbalanced.
- D. Species and Grades for Columns:
  - 1. Species and Combination Symbol: Douglas fir-larch, 3.
- E. Appearance Grade: Architectural, complying with AITC 110.
- F. Finish: Per Section 099300 Staining and Transparent Finishing.

### 2.2 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Simpson Strong-Tie Co., Inc.
  - 2. USP Structural Connectors.
  - 3. Or approved equal.

- A. Materials: Unless otherwise indicated, fabricate from the following materials:
  - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
  - 2. Round steel bars complying with ASTM A 575, Grade M 1020.
  - 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- B. Interior and Exterior Fasteners: Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

## 2.3 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

## 2.4 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

- C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.
  - 1. Predrill for fasteners using timber connectors as templates.
  - 2. Finish exposed surfaces to remove planing or surfacing marks.
  - 3. Coat cross cuts with end sealer.

### 3.2 ADJUSTING

- A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### 3.3 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
  - 1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

**END OF SECTION 061800**



**SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

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

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.**B. Shop Drawings:**

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

**C. Samples:**

1. Plastic laminates, for each color, pattern, and surface finish.
2. Thermoset decorative panels, for each color, pattern, and surface finish.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For manufacturer and Installer.**1.4 CLOSEOUT SUBMITTALS****A. Quality Standard Compliance Certificates:** AWI Quality Certification Program certificates.**1.5 QUALITY ASSURANCE****A. Manufacturer's Qualifications:** Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

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

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

## 1.6 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

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

1. Basis-of-Design Products: Finish materials as indicated in the Finish Legend on Drawing AI601.

2. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.

3. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.

2. Postformed Surfaces: Grade HGP.

3. Vertical Surfaces: Grade HGS.

4. Edges: Grade HGS.

5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels or as indicated.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
  1. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  2. Drawer Bottoms: Thermoset decorative panels.
- B. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- C. 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.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated in the Finish Legend on Drawing AI601.

## 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 and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  2. Particleboard: ANSI A208.1, Grade M-2.
  3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- B. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm), 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- C. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

- D. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
- F. Drawer Slides: BHMA A156.9.
  - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
  - 3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
  - 4. For 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 Grade 1HD-100.
  - 5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
- G. Slides for Sliding Glass Doors: BHMA A156.9, B07063; aluminum.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.
- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Color: As selected by architect from full manufacturer specifications.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Stainless Steel: BHMA 630.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous- metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive, General: Do not use adhesives that contain Urea formaldehyde.

**2.5 FABRICATION**

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- A. 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 INSTALLATION**

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (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.

**END OF SECTION 064116**

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**SECTION 072100 - THERMAL INSULATION****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Extruded polystyrene foam-plastic board (at foundations).
2. Closed-cell spray polyurethane foam (limited conditions at exterior walls).
3. Glass-fiber blanket (at miscellaneous locations and walls indicated to receive sound attenuation batt).
4. Rigid foam board insulation thermal, water and air resistance barrier wall system (Basis-of-design is DOW Thermax Wall System including insulation and girts, typical at exterior walls).

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

- A. Product test reports.
- B. Research reports.

**PART 2 - PRODUCTS****2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD**

- A. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Kingspan Insulation.
    - d. Owens Corning.

**2.2 CLOSED-CELL SPRAY POLYURETHANE FOAM**

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (25 mm of 43 K x sq. m/W at 24 deg C).
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. BASF Corporation
    - b. Dow Chemical Company (The).
  2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

**2.3 GLASS-FIBER BLANKET**

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Guardian Building, Products, Inc.
    - c. Johns Manville; a Berkshire Hathaway company.
    - d. Knauf Insulation.

**2.4 RIGID FOAM BOARD INSULATION (Thermal, Water and Air Resistance Barrier Wall System)****A. Basis of Design Product: DOW Thermax Wall System.**

- A. Continuous Exterior Insulation: Glass-fiber reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4 mil embossed dark grey acrylic-coated aluminum on one side and 1.25 mil embossed aluminum on the other side, complying with ASTM C1289.
- B. Fasteners: Provide insulated sheathing manufacturer's recommended polymer or other corrosion protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.



- C. Liquid Spray Flashing: Provide insulation manufacturer's recommended board joint commercial liquid spray flashing and sealant for sealing joints, seams, window openings, door openings, counter-flashing and penetrations through the insulation layer.
- E. Penetration Filler: Provide insulated sheathing manufacturer's recommended polyurethane foam for sealing penetrations of insulated sheathing.
- F. Gap Air Infiltration Filler: Two Component, Quick Cure Polyurethane Foam.
- G. Stud Veneer Attachment: Provide stud framed wall attachment through the rigid foam sheathing to the substrate to structural stud. Verify anchor size and installation pattern with manufacturer.
- H. Provide flexible polyethylene foam gasket strip to reduce air infiltration between a concrete foundation and sill plate.

## 2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
  - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 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.

**3.2 INSTALLATION OF SLAB INSULATION**

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) in from exterior walls.

**3.3 INSTALLATION OF FOUNDATION WALL INSULATION**

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

**3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION**

- A. Closed-Cell Spray Polyurethane Insulation:
  - 1. Comply with insulation manufacturer's written instructions applicable to products and applications.
  - 2. Spray insulation to envelop entire area to be insulated and fill voids.
  - 3. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- 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).
  - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

**END OF SECTION 072100**

**SECTION 074113 - CORRUGATED METAL ROOF AND WALL PANELS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes corrugated metal roof panels.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- D. Samples: For each type of metal panel indicated.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product test reports.
- B. Warranties: Sample of special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: As indicated on the drawings.

- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 CORRUGATED METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping corrugations and mechanically attaching panels to supports. Include accessories required for weathertight installation. Provide material for roof panels from same manufacturing run. All panels to be of the same color, finish, thickness, grade, and fabrication.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Corrugated Metal Roof Panels – Type 1 - Formed with corrugated ridges and valleys designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ABC Metal Roofing.
      - 1) Basis of Design: Rustic Trail.
    - b. Metal Sales.
    - c. Or approved equal.
  2. Material: Uncoated Steel Sheet:
    - a. Nominal Thickness: 22 gauge steel.
    - b. Exterior Finish: Unpainted and unfinished, cold rolled steel.
    - c. Color: N/A.
  3. Attachment: Exposed direct fastened panel.
  4. Panel Coverage: 29.33 inches.
  5. Panel Height: 7/8".
- C. Corrugated Metal Roof Panels – Type 2 - Formed with corrugated ridges and valleys designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Metal Sales.
      - 1) Basis of Design: IC72 Panel – Roof.
    - b. ABC Metal Roofing.
    - c. Or approved equal.

2. Material: Aluminum-zinc alloy-coated steel sheet, ASTM A 792, AZ50 or zinc-coated steel sheet, ASTM A 653 G90 coating designation, structural quality, Grade 50, 0.0236- inch (0.60-mm) minimum thickness.
  - a. Nominal Thickness: 22 gauge
  - b. Exterior Finish: PVDF (Kynar 500).
  - c. Color: As selected by Architect from manufacturer's full range of colors.
2. Attachment: Exposed direct fastened panel.
3. Panel Coverage: 36 inches (914.4 mm).
4. Panel Height: 1-1/2 inches (38.1 mm).

### 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
  3. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. GCP Applied Technologies Inc. (formerly Grace Construction Products).
    - b. Or approved equal.
- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

### 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- A. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- B. Roof Curbs: Fabricated from same material as roof panels, 24 gauge nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
  2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.6 FINISHES

### A. Panels and Accessories:

1. 25 year Galvalume Finish or approved equal.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

### 3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
- B. Felt Underlayment: Apply at locations indicated on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
1. Apply over the entire roof surface.
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

### 3.3 METAL PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  5. Watertight Installation:



- a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
  - a. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  - b. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

#### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

**END OF SECTION 074113**

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**SECTION 074213 - METAL PANELS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes metal wall panels and related work as shown and specified.
  - 1. Weathering Steel Plate.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Fabrication and installation details.
- C. Samples: Submit 2 minimum 6 x 6-inch samples for each material.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: Minimum of 3 years of experience on similar work; knowledge and understanding of standards referenced herein; skill necessary to perform in compliance with this specification. Installers failing to demonstrate the required experience, knowledge, or skill shall be removed from the project.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  - 1. Deflection Limits: For wind loads, no greater than 1/240 of the span.
  - 2. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference: 6.24 lbf/sq. ft. (300 Pa).
  - 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 4. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**1.4 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Provide in required form for a period of 2 years from Date of Substantial Completion.

## PART 2 – PRODUCTS

## 2.1 METAL PANELS

## A. A606-4 Weathering Steel Plate Panel System:

1. Bases-of-Design: RustWall Panel; 18 gage; 18 inches wide; unless noted otherwise.
2. Quality Standard: Meeting ASTM A588 and ASTM A606 Type 4.

## PART 3 – EXECUTION

## 3.1 EXAMINATION

- A. Examine conditions of work in place before beginning work; report defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Protect panels from contact with lime, cement or chemicals. Do not allow traffic or material storage on completed surface.

## 3.3 INSTALLATION

- A. Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.
- B. Install metal wall panels plumb, straight, square and level; at proper elevations, locations and in alignment with adjacent work. Attach panels as shown. Lap and seal all joints. Tightly close interlocking seam between panels. Finish panels clean and weathertight. Work showing dents, creases, deformations, weathering or other defects affecting use or appearance will not be accepted.
- C. Allow for expansion and contraction over an ambient temperature range up to 150 degrees F; distortions resulting from fastening or expansion and contraction stresses not acceptable.
- D. Apply sealant at all joints and lap per manufacturer's recommendation.

## 3.4 CLEANING

- A. At completion clean exposed surfaces in a manner that will not damage finish.

**END OF SECTION 074213**

**SECTION 074646 - FIBER-CEMENT SIDING**

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes fiber-cement siding.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For fiber-cement siding including related accessories.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Research/evaluation reports.
- D. Sample warranty.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area, approximately twenty (20) square feet.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 FIBER-CEMENT BOARD

## A. Basis-of-Design Product: HardiePanel® Vertical Siding - Smooth

1. Substitutions: In accordance with Division 1.
2. Profile: As indicated on the Drawings.
3. Finish: Painted finish per Section 099113 Exterior Painting.

## 2.2 FIBER-CEMENT BATTEN

## A. Basis-of-Design Product: HardieTrim® Boards - Smooth Batten Boards

1. Substitutions: In accordance with Division 1.
2. Profile: As indicated on the Drawings.
3. Finish: Painted finish per Section 099113 Exterior Painting.

## 2.3 ACCESSORIES

- A. Siding Accessories, General: Provide trim in accordance with Manufacturer's instructions.
- B. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

## A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Install fasteners in compliance with the manufacturer's requirements and recommendations, and in compliance with structural design.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

## 3.2 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- A. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

**END OF SECTION 074646**

**SECTION 076200 - SHEET METAL FLASHING AND TRIM****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Manufactured reglets and counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

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

- B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product certificates.

- B. Product test reports.

- C. Sample warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved. All roof, wall and edge copings and flashings should be provided by the Metal Roof Manufacturer to the greatest extent possible. Where not possible, use pre-finished metal provided by the Metal Roof Manufacturer in the same color and finish as provided for the roof.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Where exposed and a part of the roof assembly, the sheet metal flashing and trim shall be fabricated from the same material as used on the Corrugated Metal Roof system. Obtain metal goods from Roofing Manufacturer in shape and configuration desired or break form these items on site from Roofing Manufacturer supplied materials.
- D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- E. 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 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
  - 1. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 3. Color: As selected by Architect from manufacturer's full range.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; 2D (dull, cold rolled) finish.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Surface: Manufacturer's standard clear acrylic coating on both sides.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 3. Color: As selected by Architect from manufacturer's full range.

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand

high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
1. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
1. For Stainless Steel: ASTM B 32, with acid flux of type recommended by stainless-steel sheet manufacturer.
  2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.5 MANUFACTURED REGLETS

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
  - 1. Material: Aluminum, 0.024 inch (0.61 mm) thick or galvanized steel, 0.022 inch (0.56 mm) thick.

## 2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 1. Obtain field measurements for accurate fit before shop fabrication.
  - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
  - 1. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen, wire-ball downspout strainer, valley baffles.
- B. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
  - 1. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen, wire-ball downspout strainer.
  - 2. Fabricate from the Following Materials:
    - a. Stainless Steel: 0.016 inch (0.40 mm) thick.
- C. Downspouts: Fabricate downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
  - 1. Hanger Style: As indicated in the Drawings.
  - 2. Fabricate from the following materials:
    - a. Aluminum: 0.024 inch (0.61 mm) thick.
    - b. Stainless Steel: 0.016 inch (0.40 mm) thick.
    - c. Galvanized Steel: 0.022 inch (0.56 mm) thick.
    - d. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.
- D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
  - 1. Aluminum: 0.032 inch (0.81 mm) thick.

- E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Galvanized Steel: 0.028 inch (0.71 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

## 2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing and Fascia Cap: Fabricate in minimum 96 inch long but not exceeding 12 foot long sections. Furnish with 6inch wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Aluminum .050 inch thick
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Galvanized Steel: 0.028 inch (0.71 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick

- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, fasten and seal solder or weld watertight. Shop fabricate interior and exterior corners. Fabricate from the Following Materials:

1. Aluminum .050 inch thick
2. Stainless Steel: 0.025 inch (0.64 mm) thick.
3. Galvanized Steel: 0.040 inch (1.02 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch (1.02 mm) thick.
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Galvanized Steel: 0.028 inch (0.71 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

- D. Counterflashing and Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Galvanized Steel: 0.022 inch (0.56 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

- E. Roof-Penetration Flashing: Fabricate from the following materials:

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## 2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Galvanized Steel: 0.022 inch (0.56 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

B. Valley Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.
2. Galvanized Steel: 0.028 inch (0.71 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

C. Drip Edges: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Galvanized Steel: 0.022 inch (0.56 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Galvanized Steel: 0.022 inch (0.56 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

## 2.10 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

### PART 3 - EXECUTION

#### 3.1 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

#### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
  2. Do not use torches for soldering.
  3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
  2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.



- C. Built-in Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.
  - 1. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing. Lap sides minimum of 2 inches (50 mm) over underlying course. Lap ends minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with roofing nails. Install slip sheet over underlayment.
  - 2. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
- E. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.
- F. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- G. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below scupper or gutter discharge.
- H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm).

- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 044313.16 "Adhered Stone Masonry Veneer."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

### 3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

**END OF SECTION 076200**

**SECTION 077253 - SNOW GUARDS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Rail-type, flat-mounted snow guards (for corrugated metal roof profile).

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product.**B. Shop Drawings:** Include roof plans showing layouts and attachment details of snow guards.

1. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.

**C. Samples:**

1. Rail-Type Snow Guards: Bracket and 12-inch- (300-mm-) long rail.

**1.3 INFORMATIONAL SUBMITTALS****A. Product Test Reports:** For each type of snow guard, for tests performed by a qualified testing agency, indicating point of failure of attachment to roof system identical as that used on this Project.**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS****A. Performance Requirements:** Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**B. Structural Performance:**

1. Snow Loads: As indicated on Drawings.

## 2.2 RAIL-TYPE SNOW GUARDS

### A. Flat-Mounted, Rail-Type Snow Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
  - b. Berger Building Products, Inc.
  - c. Metal Roof Innovations, Ltd.
  - d. PMC Industries, Ltd.
  - e. Rocky Mountain Snow Guards, Inc.
  - f. TRA SNOW AND SUN, INC.
  - g. Or approved equal.
2. Description: Units fabricated from metal baseplate anchored to bracket and equipped with two bars, rails, or pipes.
3. Brackets and Baseplate: Aluminum; mill finished or Type 304 stainless steel; mill finished.
4. Bars: Aluminum; mill finished or Type 304 stainless steel; mill finished.
  - a. Profile: Round.
5. Seam clamps: ASTM B 221 (ASTM B 221M) aluminum extrusion or ASTM B 85/B 85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

### 3.2 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.
- B. Attachment for Exposed Fastened Metal Roofing:
  1. Do not use fasteners that will void metal roofing finish warranty.
  2. Flat-Mounted, Rail-Type Snow Guards:
    - a. Install brackets in straight rows.
    - b. Mechanically fasten to metal roofing, using sealant and mechanical fasteners identical to those used to secure metal roofing to substrate.

- c. Install cross members to brackets.

**END OF SECTION 077253**

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**SECTION 079200 - JOINT SEALANTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

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

**1.4 INFORMATIONAL SUBMITTALS**

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

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 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 C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - MANUFACTURERS

## 2.1 JOINT SEALANTS

- A. Provide Joint Sealants from the following manufacturers:
  - 1. Laticrete International, Inc.
  - 2. 3M.
  - 1. Rust-Oleum.
  - 2. ICP Adhesives and Sealants Inc.
  - 3. Acoustiblock.
  - 4. PABCO.
  - 5. DuraSeal.



6. GCP.
1. Dow Corning.
2. Gorilla.
3. Or approved equal.

### PART 3 - PRODUCTS

#### 3.1 JOINT SEALANTS, GENERAL

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

#### 3.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

#### 3.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

#### 3.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

#### 3.5 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C 1247, tested in deionized water unless otherwise indicated
- B. Urethane, Immersible, S, NS, 100/50, NT, I: Immersible, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses NT, and I.

#### 3.6 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

### 3.7 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, 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.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

### 3.8 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 4 - EXECUTION

### 4.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

#### 4.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- A. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- B. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- C. 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.
- D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

#### 4.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

#### 4.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:

- a. Control and expansion joints in brick pavers.
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between plant-precast architectural concrete paving units.
    - c. Joints in stone paving units, including steps.
    - d. Tile control and expansion joints.
    - e. Joints between different materials listed above.
    - f. Other joints as indicated on Drawings.
  2. Joint Sealant: Urethane, M, P, 50, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
  1. Joint Locations:
    - a. Joints in pedestrian plazas.
    - b. Joints in swimming pool decks.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
  2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in stone flooring.
    - c. Control and expansion joints in brick flooring.
    - d. Control and expansion joints in tile flooring.
    - e. Other joints as indicated on Drawings.
  2. Joint Sealant: Urethane, S, P, 25, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of concrete walls and partitions.

- d. Other joints as indicated on Drawings.
  - 1. Joint Sealant: Urethane, S, NS, 25, NT.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
- 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
  - 2. Joint Sealant: Acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
  - 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.
- H. Joint-Sealant Application: Concealed mastics.
- 1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
  - 2. Joint Sealant: Butyl-rubber based.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

**END OF SECTION 079200**

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**SECTION 081113 - HOLLOW METAL DOORS AND FRAMES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes:
  - 1. Interior standard steel doors and frames (factory primed for paint per Specification Section 199123 Interior Painting).
  - 2. Exterior standard steel doors and frames (factory galvanized for paint per Specification Section 099113 Exterior Painting).

**1.3 ACTION SUBMITTALS**

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product test reports.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; ASSA ABLOY.

2. Curries Company; ASSA ABLOY.
1. Gensteel Doors, Inc.
2. Steelcraft; an Allegion brand.
3. VT Industries.
4. Weyerhaeuser.
5. Or approved equal.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. (2.84 W/K x sq. m) when tested according to ASTM C 518.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B.
- a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
  - b. Frames: Fabricated from same thickness material as adjacent door frame.
  - c. Construction: Full profile welded.

## 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B.
1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - f. 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 weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    - g. Core: Manufacturer's standard; insulated.



## 2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
- b. Construction: Full profile welded.

## 2.5 FRAME ANCHORS

## A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

## B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

## C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

## D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 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. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

## E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## F. Mineral-Fiber Insulation: ASTM 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.

## 2.7 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. 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. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 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.

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

### 3.2 INSTALLATION

#### A. Hollow-Metal Frames: Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
  - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
  - b. Install frames with removable stops located on secure side of opening.
2. Floor Anchors: Secure with postinstalled expansion anchors.
  - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Solidly pack mineral-fiber insulation inside frames.
4. .
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

#### B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

#### C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 081113**

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**SECTION 081416 - FLUSH WOOD DOORS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.

**B. Related Requirements:**

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of door. 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. Undercuts.
5. Doors to be factory finished and finish requirements.

**C. Samples:** For factory-finished doors.**1.3 INFORMATIONAL SUBMITTALS****A. Quality Standard Compliance Certificates:** AWI Quality Certification Program certificates.**PART 2 - PRODUCTS****2.1 MANUFACTURERS****A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Marshfield DoorSystems, Inc.
  - 1) Basis-of-Design.
2. Algoma Hardwoods, Inc.

3. Oshkosh Door Company.
1. Or approved equal.

## 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
  1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
- B. WDMA I.S.1-A Performance Grade:
  1. Heavy Duty.
- C. Particleboard-Core Doors:
  1. Particleboard: ANSI A208.1, Grade LD-1, made with binder containing no urea-formaldehyde.
  2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

## 2.3 FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
  1. Grade: Premium, with Grade A faces.
  2. Species: Select White Birch.
  3. Cut: Plain sliced.
  4. Match between Veneer Leaves: Slip match.
  5. Assembly of Veneer Leaves on Door Faces: Balance match.
  6. Core: Particleboard.
  7. Construction: Five plies. Stiles and rails are bonded to core; then entire unit is abrasive planed before veneering.

## 2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
1. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

## 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Transparent Finish:
  1. Grade: Premium.
  2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
  3. Staining: As selected by Architect from manufacturer's full range.
  4. Effect: Filled finish.
  5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 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.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### END OF SECTION 081416

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**SECTION 083113 - ACCESS DOORS AND FRAMES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Access doors and frames for walls and ceilings.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
  - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
  - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

**2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS**

- A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- B. Flush Access Doors with Exposed Flanges (where not exposed to tenant view):
  - 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
  - 2. Locations: Wall and ceiling.
  - 3. Door Size: As required.
  - 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
    - a. Finish: Factory finish.
  - 5. Metallic-Coated Steel Sheet for Door (at damp locations): Nominal 0.064 inch, 16 gage.

- a. Finish: Factory finish.
- 6. Frame Material: Same material, thickness, and finish as door.
- 7. Hinges: Manufacturer's standard.
- 8. Hardware: Latch.
- C. Flush Access Doors with Concealed Flanges (where exposed to tenant view):
  - 1. Locations: Wall and ceiling.
  - 2. Door Size: As required.
  - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
    - a. Finish: Factory finish.
  - 4. Metallic-Coated Steel Sheet for Door (at damp locations): Nominal 0.064 inch, 16 gage.
    - a. Finish: Factory finish.
  - 5. Frame Material: Same material and thickness as door.
  - 6. Hinges: Manufacturer's standard.
  - 7. Hardware: Latch.
- D. Fire-Rated, Access Doors (profiles to match above access doors depending on location):
  - 1. Assembly Description: Fabricate door with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board beads at concealed flange installations.
  - 2. Locations: Wall and ceiling.
  - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 4. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage.
    - a. Finish: Factory finish.
  - 5. Metallic-Coated Steel Sheet for Door (at damp locations): Nominal 0.040 inch, 20 gage.
    - a. Finish: Factory finish.
  - 6. Frame Material: Same material, thickness, and finish as door.
  - 7. Hinges: Manufacturer's standard.
  - 8. Hardware: Latch.
- E. Hardware:
  - 1. Latch: Cam latch operated by screwdriver.

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same type as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
  - 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## 2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
  - 1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

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

**END OF SECTION 083113**

**SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Storefront framing.
2. Manual-swing entrance doors.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS FOR ENTRANCES AND STOREFRONTS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed finish required.
- C. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- D. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
    - f. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- F. Qualification Data: For qualified Installer and testing agency.
- G. Product test reports.

- H. Field quality-control reports.
- A. Maintenance data.
- B. Warranties: Sample of special warranties.
- C. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- D. Product test reports.
- E. Source quality-control reports.

## 1.2 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units and systems required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ICAC mutual recognition arrangement as complying with ISO/IEC 17025. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.4 WARRANTY

- A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of aluminum-framed entrances, storefronts and curtain wall systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 – PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS FOR ALUMINUM FRAMED ENTRANCES AND STOREFRONT SYSTEMS:

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller, and an amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
  - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  1. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- B. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
  2. Entrance Doors:
    - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- D. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.45 as determined according to NFRC 200.
  3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 PRODUCTS AND MANUFACTURERS

- A. Basis of Design Product: Kawneer VG451T Front Set Storefront System.
1. Subject to compliance with requirements, Basis of Design product, available manufacturers offering products that may be incorporated into the work including, but are not limited to the following:
    - a. EFCO.



- b. Manko Window Systems, Inc.
- a. Tubelite.

## 2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Front.
  - 4. Finish: T
  - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
  - a. Provide 10-inch bottom stile.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products or products equivalent in function and comparable in quality to named products. Comply with BHMA standard referenced.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

## 2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES:

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: As selected by Architect from full range of industry colors and color densities – in light/medium/dark bronze color spectrum.

## 2.9 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.10 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
3. Profiles that are sharp, straight, and free of defects or deformations.
  4. Accurately fitted joints with ends coped or mitered.
  5. Physical and thermal isolation of glazing from framing members.
  6. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

- 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

**END OF SECTION 084113**

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**SECTION 08 7100 - DOOR HARDWARE****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Door hardware for swinging doors and other doors to the extent indicated.
- B. Cylinders and hardware for special doors as scheduled in hardware sets.
- C. Electro-mechanical devices and access control components as specified herein.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 1113 - Hollow Metal Doors and Frames.
- B. Section 08 1416 - Flush Wood Doors.
- C. Section 08 4313 - Aluminum-Framed Storefronts and Entrances.

**1.3 REFERENCED STANDARDS**

- A. American National Standards Institute (ANSI):
  - 1. International Code Council (ICC): ANSI/ICC A117.1: Accessible and Usable Buildings and Facilities, edition as adopted by local Authority Having Jurisdiction (AHJ).
  - 2. Builders Hardware Manufacturer's Association (BHMA)
    - a. ANSI/BHMA A156.1; Butts & Hinges; 2013 edition
    - b. ANSI/BHMA A156.2; Bored and Preamsembled Locks and Latches; 2011 edition
    - c. ANSI/BHMA A156.16; Auxiliary Hardware; 2013 edition
    - d. ANSI/BHMA A156.18; Materials and Finishes; 2012 edition
    - e. ANSI/BHMA A156.36; Auxiliary Locks; 2010 edition
- B. Door and Hardware Institute (DHI)
  - 1. Keying Systems and Nomenclature, 2003 edition
  - 2. Sequence and Format for the Hardware Schedule, 2001 edition

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate layout, templating, and installation of work with other sections as required. Provide templates, product information, schedules, and diagrams required to fully coordinate the work.
  - 1. Coordinate blocking for wall stops and other wall mounted hardware with Section 06 1053 - Miscellaneous Rough Carpentry.
  - 2. Coordinate hardware locations and templating with the appropriate Division 08 door and frame sections.

3. Coordinate conduit, raceways, wiring, and connection as required for electrical and pneumatic hardware items with the appropriate electrical, access control, intrusion detection, and fire alarm sections.
- B. Pre-installation Meeting: Upon approval of hardware schedule and wiring diagram submittals and before hardware installation, conduct a pre-installation meeting to discuss special installation requirements, coordinate electrical rough-in and other preparatory work performed by other trades, review sequence of operation for each electrified door opening, and review required testing, inspecting, and certifying procedures.
- C. Keying Conference: Prior to ordering hardware, conduct meeting to coordinate key system requirements and layout of keying with owner, contractor, and supplier.

## 1.5 SUBMITTALS

- A. General:
  1. Provide submittals in accordance with Section 01 6000 - Product Requirements.
  2. Advise architect within the submittal package of incompatibility or issues which may detrimentally affect the work of this section.
  3. Submittals shall be prepared by or under the supervision of Architectural Hardware Consultant. Stamp submittals with the DHI certification seal and signature of the supervising Architectural Hardware Consultant.
  4. Submittal sequence: Submit product data, hardware schedule, samples, and qualification data concurrently. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in project construction schedule. Upon approval of first submittal package, submit wiring diagrams and key schedule.
- B. Product Data: Submit manufacturer's technical product data for each item of door hardware. Highlight relevant product information such as model, function, trim, finish, options, electrical requirements, and accessories.
- C. Hardware Schedule:
  1. Submit hardware schedule detailing fabrication and assembly of door hardware as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  2. Format schedule complying with the vertical format in DHI's "Sequence and Format for the Hardware Schedule" publication.
    - a. Use same door numbers as found in contract documents and group doors with like hardware under a single heading.
    - b. Identify each heading with the submitted heading number and Architect's specified hardware set number.
    - c. Each heading shall include a list of applicable openings with information as follows: Architect's specified door number, to/from location, maximum door swing, handing information, door and frame sizes and materials, applicable ratings, and other information that may impact the door hardware.
    - d. Each heading shall also include complete designations of every item including: quantity per opening, manufacturer, description of item, and complete model number designating type, style, function, size, finish, fasteners, and other options required for the provision of hardware. Indicate non-standard installation requirements or mounting heights, operational narratives of electrified openings, and list related door devices specified in other sections.



- D. Keying Schedule: Submit keying schedule detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations complying with DHI's "Keying Systems and Nomenclature" publication.
- E. Shop Drawings:
  - 1. Elevation Diagrams: For each electrified application, provide an elevation diagram depicting the locked side of the door. In title block of diagram, reference the applicable opening number and/or hardware set number as specified by the architect. Depict visible hardware items using solid lines and hidden hardware items using dashed lines and identify each electrified hardware item. Depict required electrical wiring and identify the required quantity and gage of wires for each component. Include narrative of opening operation.
  - 2. Point to Point Diagrams: For each electrified application, provide a point to point schematic diagram that depicts each wiring connection point on each component. Depict the required wiring from component to component and indicate each wire's start point, termination point, color, and requirements for each conductor's gage, twist type, shielding, maximum length, and plenum rating as required by hardware manufacturer and/or applicable codes.
- F. Samples: Submit a sample of each type of hardware requested by the architect. Provide samples of same finish, style, and function as specified herein and tag with location and full description for coordination with the schedule. Samples will be returned to supplier in like-new condition. Items that are acceptable to the architect may, after final check of operations, be incorporated into the work, within the limitations of the keying requirements.
- G. Manufacturer's Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to ensure that adequate provisions are made for locating and installing door hardware to comply with indicated requirements. Provide additional templates, template lists, hardware schedules, and product information to other trades upon request.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, provide reports for locks, latches, delayed egress locks, electro-mechanical hardware, and door closers. Certify that products are approved for use on each type and size of labeled fire door and meet the requirements specified herein for fire rated openings.

## 1.6 CLOSE OUT SUBMITTALS

- A. General: Upon substantial completion, provide two (2) copies of the closeout submittals complying with Section 01 7800 - Closeout Submittals.
- B. Operation And Maintenance Data: Provide operation and maintenance manuals that include the following for each hardware item:
  - 1. Project information including contact information for architect, contractor, supplier, installer, Architectural Hardware Consultant, and local representative of each hardware manufacturer
  - 2. Copies of approved product data, hardware schedule, keying schedule, shop drawings, and manufacturer's templates submittals. Submittals shall be updated to reflect as-built conditions.
  - 3. Complete information on care, maintenance, adjustment, repair and replacement of parts, and preservation of finishes

## 1.7 QUALITY ASSURANCE

- A. Qualifications

1. Supplier Qualifications:
  - a. Supplier shall have documented experience in the supply of door hardware for five (5) years or for three (3) prior projects similar in scope, size, and quality. Supplier shall be a certified direct distributor and be a full sales and service organization for the manufacturer(s) listed. Supplier shall have warehousing facilities within 75 miles of the project site.
  - b. During the course of the work, supplier shall make available an Architectural Hardware Consultant (AHC) or Architectural Openings Consultant (AOC), as certified by DHI and enrolled in the DHI Continuing Education Program, to consult with contractor, architect, and owner about door hardware and keying.
2. Installer Qualifications: Installer shall have documented experience in the installation of door hardware for five (5) years or for three (3) prior projects similar in scope, size, and quality. Installer shall be employee of the supplying company.
3. Manufacturer Sourcing Qualifications:
  - a. Obtain each type of door hardware (hinges, latch and locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Marking and Packaging: Package hardware items manufacturer's standard packaging, clearly marked with hardware set number correlating to door hardware schedule and architect's door number.
- B. Delivery and Acceptance: Coordinate with construction schedule and deliver packaged hardware items to place of installation (e.g. project site, fabrication shop). Upon delivery, inspect and inventory door hardware. Immediately notify supplier of defective or missing items.
  1. Deliver keys and cores to owner by registered mail or overnight package service. Ship keys separately from cores.
- C. Storage and Handling:
  1. Provide secure, dry storage area for door hardware delivered to the project site, but not yet installed. Store items on shelves or pallets to prevent damage.
  2. Control handling and installation of hardware items that are not immediately replaceable so that completion of work will not be delayed by hardware losses both before and after installation.

#### 1.9 WARRANTY

- A. General Warranty: Warrant door hardware against defects in material and workmanship as set forth in Section 01 7000 - Execution and Closeout Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Approved Manufacturer's: Products by manufacturers listed under acceptable substitutions may be incorporated into the work contingent upon the provided product complying with all requirements indicated within this section.

Basis of Design Acceptable Substitutions

1. Hinges:	Ives (IVE)	Any BHMA Equivalent.
2. Locks & Latches:	Falcon (FAL)	Sargent (SAR), Best (BES).
3. Cylinders & Keying:	Schlage (SCH)	Sargent (SAR), Best (BES).
4. Exit Devices:	Falcon (FAL)	Sargent (SAR), Precision (PRE).
5. Mechanical Closers:	Falcon (FAL)	Sargent (SAR), Stanley (STA).
6. Automatic Operators	LCN (LCN)	Besam (BES), Stanley (STA).
7. Door Stops & Holders:	Ives (IVE)	Any BHMA Equivalent.
8. Thresholds & Gasketing:	Zero (ZER)	Any BHMA Equivalent.

## 2.2 GENERAL MATERIALS

- A. Fasteners: Provide fasteners for each hardware item and application as recommended by the hardware manufacturer. Finish of fasteners shall match adjacent hardware and shall be concealed wherever possible. Where sets indicate hardware is to be supplied with security screws, provide manufacturer's recommended fastener with a torx-drive head.

## 2.3 HINGES

- A. Provide knuckle hinges for exterior doors to be constructed of either stainless steel or brass with stainless steel pins. Hinges for interior doors shall be constructed of either steel or stainless steel. Provide hinge with grade, number of knuckles, and type (e.g. full mortise) as scheduled. Provide hinge with non-removable pin (NRP) at reverse-handed doors scheduled with locking hardware.
- B. Provide hinges meeting ANSI/BHMA A156 grade 2 or 3 as scheduled. Provide minimal hinge width required to allow hinge barrel to clear jamb and trim and allow door to swing 180 degrees. Provide hinge height and grade as follows except where hardware schedules specifically call out sizing or hinge grade:
- |  |                           |
|--|---------------------------|
| 1. Residence Unit Interior Doors:        | 3-1/2 inch hinge, Grade 3 |
| 2. Interior Doors, up to 36 inches wide: | 4-1/2 inch hinge, Grade 2 |
| 3. Interior Doors, over 36 inches wide:  | 5 inch hinge, Grade 1     |
| 4. Exterior Doors, up to 36 inches wide: | 4-1/2 inch hinge, Grade 1 |
| 5. Exterior Doors, over 36 inches wide:  | 5 inch hinge, Grade 1     |
- C. Provide a minimum of 2 hinges per door leaf. For door leaves exceeding 60 inches in height, provide a minimum of 1 hinge for every 30 inches or portion thereof.
- D. Basis of Design Products:
- |                          |
|--------------------------|
| 1. Grade 1: Ives 5BB1HW. |
| 2. Grade 2: Ives 5BB1.   |
| 3. Grade 3: Ives 5PB1.   |

## 2.4 LOCKS & LATCHES

### A. General:

1. Provide locks and latches at fire rated doors with a minimum listing by UL or other testing agency as matches the required opening rating.
2. Locks and latches shall all comply with accessibility requirements and shall not require tight grasping, pinching, or turning of the wrist.
3. Provide keyed locks with cylinder preparations that are compatible with the cylinder / core types specified within this section.
4. Provide locks with standard ANSI strike plates with curved lips (extended as appropriate to extend just beyond face of frame/trim).
5. Provide Mortise locks and latches that meet ANSI/BHMA A156.13, Series 1000, and Grade 1.
6. Provide cylindrical/tubular locks and latches that meet the indicated ANSI/BHMA A156.2, Series 4000 grade.

### B. Basis of Design Products:

1. Mortise Locks: Falcon MA Series w/ Occupancy Indicator.
2. Grade 1 Cylindrical Locks: Falcon T Series.

## 2.5 EXIT DEVICES & ACCESSORIES

- A. Provide conventional push pad type exit device complying with ANSI A156.3 Grade 1. Where scheduled at doors exceeding 36 inches in width, provide device designed for wide doors. Where scheduled at fire rated doors, provide device labeled as "Fire Exit Hardware". Where required by the stile-width, provide narrow-stile type device.

### B. Basis of Design Products

1. Falcon 25 Series (24 Series where required for narrow/medium stile doors).

## 2.6 CYLINDERS & KEYING

- A. Construction Key System: Provide temporary, keyed-alike, construction cores at exterior doors for the duration of the construction period. Provide sufficient keys that access to site for necessary construction activity and personnel will not be impeded. Construction cores will remain property of the contractor and will be returned upon installation of permanent key system at substantial completion.
- B. Permanent Key System: Provide a new key system utilizing lock manufacturer's restricted 6-pin, interchangeable core type cylinder housings of type and tailpiece/cam required for compatibility with locking hardware. Provide permanent cores that are factory keyed with utility patented and factory restricted keyway requiring authorized signature for key duplication. Provide cores with concealed permanent markings designating the appropriate key symbol. Provide 2 cut keys for every core provided. Keys shall all be stamped with appropriate key symbol and master keys shall also be stamped with the key system registry number. Design key system as directed by owner's representative in keying meeting. Keys and cores shall be shipped directly from the factory to the owner's representative in separate shipments.
1. Installation of Permanent Key System: Upon substantial completion, contractor shall assist owner in removal of construction cores and installation of permanent key system.

## C. Basis of Design Products:

1. Schlage Everest 29T Series FSIC.

## 2.7 SURFACE DOOR CLOSERS

- A. Provide surface closers certified to ANSI/BHMA A156.4 Grade 1, with body constructed of cast iron or cast aluminum. Closers shall not use Pressure Relief Valves. Provide closer with universal screw packs that include through-bolts, wood screws, and template machine screws.

## B. Basis of Design Products:

1. Falcon SC70 Series.

## 2.8 AUTOMATIC OPERATORS &amp; ACCESSORIES

- A. Electro-Mechanical Operators: Provide low-energy electro-mechanical type automatic operator complying with ANSI/BHMA A156.19. Operator shall operate via DC motor through reduction gears. Manual, hydraulic, or chain drive operators are not permitted. Provide operator that can be manually operated without damage to the unit. Operator shall have variable adjustments for opening and closing speed.

1. Provide units with manual on/off/hold open switch, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, logic terminal to interface with accessories and sensors.
2. Unit shall have power boost feature to compensate for high stack pressures or high wind pressure.
3. Provide brackets, adapters, or any other required installation accessories for compatibility with mounting details.
4. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf.

- B. Actuators & Switches: Provide pressure plate type, hardwired actuator switches. Where actuator mounts on bollard or wall, provide 4-1/2 inch square actuator. Where actuator switch mounts to mullions or door frames, provide narrow actuator. At exterior locations, provide actuator with weather ring.

## C. Basis of Design Products:

1. Automatic Operator: LCN Senior Swing 9500 Series.
2. Actuator Switches: LCN 8310 Series.

## 2.9 DOOR STOPS &amp; HOLDERS

- A. Wall Stop: Where door swings against wall that is reinforced with blocking for stop, provide wall-mounted stop.

1. Exception: Do not provide wall stops where stop would mount to an exterior facing wall.
2. Provide wall stops with convex rubber bumper at locksets with push and/or turn buttons within the lever. Otherwise, provide concave rubber bumpers.

- B. Floor Stop: Provide floor stop where conditions do not comply with requirements for wall stop, and floor stop can be mounted such that a tripping hazard is not created while door is closed.

1. Exception: Do not provide floor stops in locations where flooring is tile or rubber resilient flooring or where floor stop would mount in areas exposed to snowy or icy weather.
  2. Where floor stop requires riser at threshold locations, provide floor stop with appropriate riser.
- C. Overhead Stops: Where conditions are not appropriate for wall stops or floor stops, provide overhead stops.
1. Unless otherwise scheduled, provide surface mounted overhead stops at hollow metal, wood, and fiberglass type doors and concealed overhead stops at storefront type doors.
  2. Where door is to have both surface overhead stops and push-side mounted door closers, compression stop type closer arm may be provided in lieu of surface overhead stop except in doors with frames manufactured of aluminum.
- D. Basis of Design Products:
1. Interior Wall Stops: Ives WS406/407 Series.
  2. Exterior Floor Stops: Ives FS444 Series.
  3. Interior Floor Stops: Ives FS439 Series.
  4. Exterior Concealed Overhead Stops: Glynn Johnson 100 ADJ Series.
  5. Exterior Surface Overhead Stops: Glynn Johnson 90 Series.
  6. Interior Concealed Overhead Stops: Glynn Johnson 410 Series.
  7. Interior Surface Overhead Stops: Glynn Johnson 450 Series.

## 2.10 THRESHOLDS & GASKETING

- A. Where scheduled, provide the indicated gasketing with length sufficient to provide a continuous seal around the opening. Where doors and frames are provided as a pre-hung assembly, provide assembly manufacturer's standard gasketing.
- B. Provide thresholds and gasketing as scheduled or any BHMA equivalent product.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Install door hardware as detailed in the approved hardware schedule using only approved fasteners and in accordance with manufacturer's recommended procedures and methods.
- B. Install hardware and signage at fire rated openings in accordance with NFPA 80 requirements.
- C. Maximum Gap Clearance: Install doors and frames such that gap clearances do not exceed the measurements listed below for any application. These clearances comply with NFPA requirements for smoke and fire rated openings:
1. Between Door and Frame Head and Jambs: 1/8 inch for wood doors, 3/16 inch for metallic doors.
  2. Between Paired Door Meeting Stiles: 1/8 inch.
  3. Door Undercut: 3/4 inch.
- D. Hardware Mounting Heights: Mount door hardware units at hollow metal door manufacturer's standard heights.

- E. Surface Mounted Door Closers: Install surface mounted door closers on room side of openings, except where prohibited by scheduled hardware. Use appropriate arms, spacers, brackets, and accessories to properly install surface mounted door closers. Adjust spring power to the appropriate setting to ensure the doors reliably close under normal operating conditions. Utilize the following installation methods to install closers:
  - 1. Metallic doors: Drill and tap holes and install closers using template machine screws. Self-drilling and tapping screws are prohibited.
  - 2. Reinforced wood doors and wood frames: Drill pilot holes and install closers using threaded to the head wood screws. Self-piloting screws are prohibited.
  - 3. Non-Reinforced wood doors: Drill holes and install closers using through bolt fasteners.
- F. Protection Plates: Where plates greater than 16 inches in height are to be installed on fire rated openings, install using plate manufacturer's recommended adhesive in lieu of mechanical fasteners.
- G. Wall Mounted Door Stops And Holders
  - 1. Locate wall mounted door stops at the appropriate height and location to properly contact protruding door trim.
  - 2. Where indicated in the HW Sets, mount floor stops at exterior doors as a wall stop.
- H. Gasketing: Install gasketing to provide a continuous seal around the perimeter of the opening. Install soffit mounted hardware using the proper brackets, spacers, and accessories to allow proper installation without cutting or notching gasketing material or mounting channels.
- I. Overlapping Astragals
  - 1. Install astragals at exterior doors using thru-bolts.
  - 2. Where overlapping astragals are scheduled on out-swinging doors, provide for mounting on the pull-side of the active leaf. Otherwise, provide for mounting on the push-side of the inactive leaf.
  - 3. Notching astragal is not acceptable. Where strike lip conflicts with astragal, provide strike as specified in "Locks and Latches" article of this section.
- J. Thresholds and Saddles: Trim, cut, and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Thresholds and saddles shall be set in full bed of butyl-rubber or polyisobutylene mastic sealant.

### 3.2 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Architect will engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
- B. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.3 ADJUSTING

- A. After building HVAC system is balanced and adjusted, conduct final adjustment of door closers. Verify spring power of the surface mounted door closer is properly adjusted to close and latch the door and to comply with the opening force requirements of ANSI A117.1 as follows:
  - 1. Doors with Closers shall take five (5) seconds to close from 90 degrees to 12 degrees.

2. Interior, non-fire rated swinging doors shall open with a maximum of 5 lbs of pressure.
3. Exterior doors and fire rated doors shall open with the minimum amount of pressure required to positively close and latch the door.

#### 3.4 CLEANING AND PROTECTION

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



**HARDWARE SCHEDULE****Hardware Group No. 100**

1 SET	EXTERIOR HINGE(S)	5BB1HW SERIES	630	IVE
1 EA	KEY PAD LOCK	CO-100-CY-70-KP-RHO-JD	626	SCE
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	OVERHEAD STOP	90S	630	GLY
1 EA	SURFACE CLOSER	SC71A DS	689	FAL
1 SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	GASKETING	429 SERIES	719	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
1 EA	THRESHOLD	656 SERIES	719	ZER
1 EA	RAIN DRIP	142 SERIES	719	ZER

**Hardware Group No. 101**

1 SET	EXTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	630	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC81A SS	689	FAL
1 EA	GASKETING	429 SERIES	719	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
1 EA	THRESHOLD	656 SERIES	719	ZER

**Hardware Group No. 102**

1 SET	EXTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	630	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC81A RW/PA	689	FAL
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	429 SERIES	719	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
1 EA	THRESHOLD	656 SERIES	719	ZER

**Hardware Group No. 103**

1 SET	EXTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	630	IVE
1 EA	ENTRY / OFFICE LOCK	T511J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A SSHO	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	GASKETING	429 SERIES	719	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
1 EA	THRESHOLD	656 SERIES	719	ZER

**Hardware Group No. 104**

1 SET	EXTERIOR HINGE(S)	5BB1HW SERIES	630	IVE
1 EA	PANIC HARDWARE	CD-25-R-NL	626	FAL
1 SET	FSIC CYLINDER HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A SS	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
EA	GASKETING	429 SERIES	719	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
EA	THRESHOLD	656 SERIES	719	ZER

**Hardware Group No. 201**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PUSH PLATE	8200 6" X 16"	630	IVE
1 EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1 EA	AUTOMATIC OPERATOR	9542 MS	<input type="checkbox"/> 628	LCN
1 EA	TOUCHLESS ACTUATOR	8310-813	<input type="checkbox"/> 630	LCN
1 EA	INTERIOR ACTUATOR	8310-853T	<input type="checkbox"/> 630	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	SILENCER SET	SR60 SERIES	GRY	IVE
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING & CONNECTIONS	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) BOTH ACTUATORS ALWAYS ENABLED.

**Hardware Group No. 202**

1 SET	INTERIOR HINGE(S)	5BB1HW SERIES	652	IVE
1 EA	PANIC HARDWARE	CD-25-R-L-DANE	626	FAL
1 EA	T-TURN DOGGING CYL.	09-900 NH XB11-720	626	SCH
1 SET	FSIC CYLINDER HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A HW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. 203**

2 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	MANUAL FLUSH BOLT	FB458 / FB358	626	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
2 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 SET	REMAINING HARDWARE	BY DOOR/FRAME MANUFACTURER		B/O

**Hardware Group No. 204**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A RW/PA	689	FAL
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 SET	REMAINING HARDWARE	BY DOOR/FRAME MANUFACTURER		B/O

**Hardware Group No. 205**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A RW/PA	689	FAL
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. 206**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	SILENCER SET	SR60 SERIES	GRY	IVE

**Hardware Group No. 207**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	ENTRY / OFFICE LOCK	T511J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	OH STOP	450S	630	GLY
1 EA	SURFACE CLOSER	SC71A RW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	SILENCER SET	SR60 SERIES	GRY	IVE

**Hardware Group No. 208**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	ENTRY / OFFICE LOCK	T511J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A RW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	SILENCER SET	SR60 SERIES	GRY	IVE

**Hardware Group No. 209**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	ENTRY / OFFICE LOCK	T511J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	SURFACE CLOSER	SC71A HW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. 210**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PRIVACY LOCK	MA321 OCCUPIED/VACANT DGM	626	FAL
1 EA	SURFACE CLOSER	SC81A RW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. 211**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PASSAGE SET	T101S DANE	626	FAL
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. 212**

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PASSAGE SET	T101S DANE	626	FAL
1 EA	SURFACE CLOSER	SC81A RW/PA	689	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	DOOR STOP	WS407 SERIES / FS439	630	IVE
1 EA	GASKETING	488S SERIES	BK	ZER

**Hardware Group No. AS-101**

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	CONTINUOUS HINGE	112HD TWP	<input type="checkbox"/> 628	IVE
1 EA	PANIC HARDWARE	CD-24-C-EO	626	FAL
1 EA	PANIC HARDWARE	LM-CD-24-C-C-718	<input type="checkbox"/> 626	FAL
2 EA	T-TURN DOGGING CYL.	09-900 NH XB11-720	626	SCH
1 SET	FSIC CYLINDER HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
2 EA	OFFSET PULL	8190HD 10" STD	630	IVE
1 EA	AUTOMATIC OPERATOR	9553 REG2 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE ACTUATOR	8310-818T	<input type="checkbox"/> 630	LCN
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 SET	MEETING EDGE GASKET	STOREFRONT MFR STD	TBD	B/O
2 EA	DOOR SWEEP	8192 SERIES	628	ZER
1 EA	THRESHOLD	654 SERIES	719	ZER
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING & CONNECTIONS	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) LM SWITCH IN PANIC HARDWARE DISABLES BOTH ACTUATORS WHEN DOOR IS LATCHED.

**Hardware Group No. AS-102**

2 EA	CONTINUOUS HINGE	112HD	628	IVE
2 EA	MORTISE CYLINDER	250	626	FAL
2 EA	OFFSET PULL	8190HD 10" STD	630	IVE
1 EA	AUTOMATIC OPERATOR	9553 REG2 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE	8310-818T	<input type="checkbox"/> 630	LCN
	ACTUATOR			
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 SET	MEETING EDGE GASKET	STOREFRONT MFR STD	TBD	B/O
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING &	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
	CONNECTIONS			
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) BOTH ACTUATORS ARE ALWAYS ENABLED.

**Hardware Group No. AS-103**

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	PANIC HARDWARE	CD-24-R-NL-OP	626	FAL
1 EA	MONITOR STRIKE	4263 SERIES	<input type="checkbox"/> 626	VON
1 EA	T-TURN DOGGING CYL.	09-900 NH XB11-720	626	SCH
1 SET	FSIC CYLINDER	AS REQUIRED BY LOCKING	626	SCH
	HOUSING(S)	HARDWARE		
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION	23-030-ICX	626	SCH
	CORE(S)			
1 EA	OFFSET PULL	8190HD 10" STD	630	IVE
1 EA	AUTOMATIC OPERATOR	9542 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE	8310-818T	<input type="checkbox"/> 630	LCN
	ACTUATOR			
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 EA	DOOR SWEEP	8192 SERIES	628	ZER
1 EA	THRESHOLD	654 SERIES	719	ZER
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING &	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
	CONNECTIONS			
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) LM SWITCH IN PANIC HARDWARE DISABLES BOTH ACTUATORS WHEN DOOR IS LATCHED.

**Hardware Group No. AS-104**

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	DUMMY PUSH BAR	250DT	626	FAL
1 EA	OFFSET PULL	8190HD 10" STD	630	IVE
1 EA	AUTOMATIC OPERATOR	9542 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE	8310-818T	<input type="checkbox"/> 630	LCN
	ACTUATOR			
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING &	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
	CONNECTIONS			
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) BOTH ACTUATORS ARE ALWAYS ENABLED.

**Hardware Group No. AS-105**

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	CLASSROOM LOCK	8845 SERIES X SCHLAGE 06A TRIM	626	ACC
1 SET	FSIC CYLINDER	AS REQUIRED BY LOCKING	626	SCH
	HOUSING(S)	HARDWARE		
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION	23-030-ICX	626	SCH
	CORE(S)			
1 EA	ELECTRIC STRIKE	6211 FSE 24VDC	<input type="checkbox"/> 630	VON
1 EA	AUTOMATIC OPERATOR	9542 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE	8310-818T	<input type="checkbox"/> 630	LCN
	ACTUATOR			
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 EA	DOOR SWEEP	8192 SERIES	628	ZER
1 EA	THRESHOLD	654 SERIES	719	ZER
1 EA	KEY SWITCH	653-04 L2	630	SCE
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING &	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
	CONNECTIONS			
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) ELECTRIC STRIKE POWERED BY POWER TRANSFORMER ON BOARD AUTOMATIC OPERATOR.

B) KEYSWITCH ENABLES/DISABLES BOTH ACTUATORS.



**Hardware Group No. AS-106**

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	CLASSROOM LOCK	8845 SERIES X SCHLAGE 06A TRIM	626	ACC
1 SET	FSIC CYLINDER HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 EA	ELECTRIC STRIKE	6211 FSE 24VDC	<input type="checkbox"/> 630	VON
1 EA	AUTOMATIC OPERATOR	9542 MS	<input type="checkbox"/> 628	LCN
2 EA	NARROW STILE ACTUATOR	8310-818T	<input type="checkbox"/> 630	LCN
1 SET	HEAD & JAMB GASKET	STOREFRONT MFR STD	TBD	B/O
1 EA	KEY SWITCH	653-04 L2	630	SCE
1 EA	120VAC POWER	BY DIVISION 26	<input type="checkbox"/>	B/O
1 SET	CONDUIT & RACEWAY	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING & CONNECTIONS	BY DIVISION 26 / DIVISION 28	<input type="checkbox"/>	B/O
1 SET	WIRING DIAGRAMS	RISER/ELEVATION & SCHEMATIC	<input type="checkbox"/>	DLR

A) ELECTRIC STRIKE POWERED BY POWER TRANSFORMER ON BOARD AUTOMATIC OPERATOR.

B) KEYSWITCH ENABLES/DISABLES BOTH ACTUATORS.

**Hardware Group No. FLD-200**

1 SET	ALL HARDWARE B/O	DOOR MFR STD
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**Hardware Group No. OHD-100**

1 SET	FSIC CYLINDER HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	CONSTRUCTION CORE(S)	23-030-ICX	626	SCH
1 SET	REMAINING HARDWARE	BY DOOR/FRAME MANUFACTURER		B/O

**END OF SECTION 087100**

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**SECTION 088000 - GLAZING****PART 1 - GENERAL****1.1 SUMMARY****A. Section includes:**

1. Glass for doors, glazed aluminum storefront systems, aluminum entrances and curtain wall systems.
2. Glazing sealants and accessories.

**1.2 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Preconstruction adhesion and compatibility test report.

**1.5 QUALITY ASSURANCE**

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

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Snow Loads: As indicated on Drawings.
  - 3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.

4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. AAMA Publications: AAMA GD5G-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- E. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- F. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.3 GLASS PRODUCTS

1. **G1-Insulated Glass:** 1" Insulated Glazing system with (2) two layers of 1/4" glass. ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
2. **G2-Tempered Insulated Glass:** 1" Tempered Insulated Glazing system with (2) two layers of 1/4" glass. Tempered: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
3. **G3-Insulated Glass:** 1" Insulated Glazing system with (2) two layers of 1/4" glass. ASTM C 1048, Kind HS (heat strengthened), One-way mirrored glass system.
4. **G4-Tempered Insulated Glass:** 1" Tempered Insulated Glazing system with (2) two layers of 1/4" glass. Tempered: ASTM C 1048, Kind FT (fully tempered), One-way mirrored glass system.
5. **G5- Clear Annealed Float Glass:** ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
6. **G6-Clear Float Glass, Tempered:** ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

## 2.4 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seals.
  2. Spacer: Manufacturer's standard spacer material and construction.

## 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.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

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

## 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## PART 3 - EXECUTION

### 3.1 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.
- A. 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.
- B. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- C. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- D. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 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. Apply heel bead of elastomeric sealant.
- 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.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

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



developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.6 MONOLITHIC GLASS SCHEDULE

- A. Clear Heat-Strengthened Float Glass: **Glass G4**
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.
- B. Clear Fully Tempered Float Glass: **Glass G5**
  - 1. Minimum Thickness: 6 mm.

2. Safety glazing required.

### 3.7 INSULATING GLASS SCHEDULE

#### A. Low-E-Coated, Clear Insulating Glass: **Glass G1**

1. Basis-of-Design Product: PPG Solarban 70 XL Solar Control Low-E Glass Clear + Clear.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Air.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Sputter coated.
8. Winter Nighttime U-Factor: 0.28.
9. Summer Daytime U-Factor: 0.26.
10. Visible Light Transmittance: 64 %.
11. Solar Heat Gain Coefficient: 0.24.
12. Safety glazing required.

#### B. Low-E-Coated, Clear Tempered Insulating Glass: **Glass G2**

1. Basis-of-Design Product: PPG Solarban 70 XL Solar Control Low-E Glass Clear + Clear.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Sputter coated.
8. Winter Nighttime U-Factor: 0.28.
9. Summer Daytime U-Factor: 0.26.
10. Visible Light Transmittance: 64 %.
11. Solar Heat Gain Coefficient: 0.24.
12. Safety glazing required.

#### C. Low-E-Coated, Clear Tempered Insulating Glass with Translucent Film: **Glass G3**

1. Similar to Glass G2 but with translucent window film, to be selected by Architect from manufacturer's full range.

#### D. Spandrel Glass: **Glass G6**

1. Spandrel glass manufactured by PPG (basis-of-design manufacturer) or manufacturer of insulating glass, color to be selected by Architect from manufacturer's full range.

#### E. Double Strength Low-E-Coated, Clear Tempered Insulating Glass: **Glass G7**

1. Similar to Glass G2 but with 1/2 inch lites for added strength.

**END OF SECTION 088000**

**SECTION 092900 - GYPSUM BOARD****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

**PART 2 - PRODUCTS****2.2 PERFORMANCE REQUIREMENTS**

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

**2.3 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.

**2.4 INTERIOR GYPSUM BOARD**

- A. Manufacturers: Subject to compliance with requirements, manufacturers with products that may be incorporated into the work include, but are not limited to:
  - 1. American Gypsum.
  - 2. CertainTeed Corporation.
  - 3. Georgia-Pacific Gypsum.
  - 4. National Gypsum Company.

5. USG Corporation.
  - A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
    1. Thickness: 5/8 inch (15.9 mm).
    2. Long Edges: Tapered.
  - B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
    1. Thickness: 1/2 inch (12.7 mm).
    2. Long Edges: Tapered.
  - C. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
    1. Core: 5/8 inch (15.9 mm), Type X.
    2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
    3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
    4. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
    5. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
    6. Long Edges: Tapered.
    7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  1. At walls to receive tile other than at showers.
  2. Core: 5/8 inch (15.9 mm), Type X.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
  1. At shower walls.
  2. Thickness: 5/8 inch (15.9 mm).
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.

- d. L-Bead: L-shaped; exposed long flange receives joint compound.
- a. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- b. Expansion (control) joint.
- c. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

- 1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
- 2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

## 2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

- 1. Interior Gypsum Board: Paper.
- 2. Exterior Gypsum Soffit Board: Paper.
- 3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
- 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
- 4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
- 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

- 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

E. Joint Compound for Tile Backing Panels:

- 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. 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.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C 840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- A. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- B. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- C. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.2 PROTECTION

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

### END OF SECTION 092900

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**SECTION 093013 - CERAMIC TILING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Porcelain tile at walls and floors.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product.**B. Samples:**

1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For Installer.**1.4 MAINTENANCE MATERIAL SUBMITTALS****A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.**

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

**1.5 QUALITY ASSURANCE****A. Installer Qualifications:**

1. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

## PART 2 - PRODUCTS

## 2.1 PRODUCTS, GENERAL

- A. Basis-of-Design Products: Provide products indicated in the Finish Legend on Drawing A1601 or equal to be approved by Architect.
- B. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- C. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

## 2.2 TILE BACKING PANELS (Specified in Section 092000 "Gypsum Board")

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  - 1. At walls to receive tile other than at showers.
  - 2. Core: 5/8 inch (15.9 mm), Type X.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.3 SETTING MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bostik, Inc.
  - 2. Custom Building Products.
  - 3. Laticrete International, Inc.
  - 4. MAPEI Corporation.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
  - 1. For wall applications, provide nonsagging mortar.
- C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
  - 1. For wall applications, provide nonsagging mortar.

## 2.4 GROUT MATERIALS

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

2. Custom Building Products.
  1. Laticrete International, Inc.
  2. MAPEI Corporation.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
- D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

## 2.5 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. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

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

### 3.2 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods appropriate for the project conditions. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, and apply to types of setting and grouting materials used.
- 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.
- A. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- B. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- C. 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.
- D. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- E. Install tile backing 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.

**END OF SECTION 093013**

**SECTION 095113 - ACOUSTICAL PANEL CEILINGS****PART 1 - GENERAL****1.1 SUMMARY**

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

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.
- D. Field quality-control reports.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**PART 2 - PRODUCTS****2.1 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 E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A according to ASTM E 1264.
  - 2. Smoke-Developed Index: 50 or less.

## 2.2 ACOUSTICAL PANELS

### A. Basis of Design Products:

1. As indicated in the Finish Legend on Drawing AI601.

## 2.3 METAL SUSPENSION SYSTEM

### A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M.

### B. Capped, Double-Web, Steel Suspension System: Face dimension as indicated in the Finish Legend on Drawings AI601 and AI602; main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush, size as indicated in the Drawings.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Painted white.

## 2.4 ACCESSORIES

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

### B. Hold-Down Clips: Manufacturer's standard hold-down.

### C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

### D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

## 2.5 METAL EDGE MOLDINGS AND TRIM

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

**PART 3 - EXECUTION****3.1 PREPARATION**

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

**3.2 INSTALLATION**

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  - 3. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
    - b. Install panels with pattern running in one direction parallel to short axis of space.
    - c. Install panels in a basket-weave pattern.
  - 4. Install hold-down and seismic clips in areas required; space according to panel manufacturer's written instructions unless otherwise indicated.

**3.3 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform inspections.
  - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

**END OF SECTION 095113**

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**SECTION 096513 - RESILIENT BASE AND ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Thermoset-rubber base.
2. Rubber molding accessories.
3. Rubber stair accessories. - none

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product.**B. Samples:** For each exposed product and for each color and texture specified, not less than 1 1/2 inches (300 mm) long.**1.3 PERFORMANCE REQUIREMENTS****A. Fire-Test-Response Characteristics:** As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.**PART 2 - PRODUCTS****2.1 THERMOSET-RUBBER BASE:****A. Basis of Design Product: (BS1)**

1. Rubber base by Johnsonite.
2. Profile: Traditional toeless.
3. Color: To be selected from manufacturer's full range.
4. Gauge: As indicated by basis-of-design product.
5. Height: 6".
6. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
7. Outside Corners: Job formed.
8. Inside Corners: Job formed.

**B. Basis of Design Product: (BS2)**

1. Rubber base by Johnsonite Millwork.
2. Profile: Mandalay.
3. Color: To be selected from manufacturer's full range.

4. Gauge: As indicated by basis-of-design product.
1. Height: 6".
2. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
3. Outside Corners: Job formed.
4. Inside Corners: Job formed.

## 2.2 RUBBER MOLDING ACCESSORY

- A. Description: Rubber transition strip between carpet tile and sealed concrete floor.
- B. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.3 RUBBER STAIR ACCESSORIES

- A. Basis of Design Product: (RB2)
  1. Roppe Raised Design Rubber Tread.
  2. Type: TS (rubber, vulcanized thermoset).
  3. Profile: #40 abrasive strip design.
  4. Color: To be selected from manufacturer's full range.
  5. Gauge: As indicated by basis-of-design product.
  6. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  7. Size: Lengths and depths to fit each stair tread in one piece.
  8. Integral Risers: Smooth, flat; in height that fully covers substrate.
- B. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  1. Style: Toeless, by length matching treads.
  2. Thickness: Manufacturer's standard.
- C. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

## 2.4 INSTALLATION MATERIALS

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

## PART 3 - EXECUTION

## 3.1 PREPARATION

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

## 3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches (152 mm) in length.
    - a. BS1 – Form without producing discoloration (whitening) at bends.
    - b. BS2 – Miter corners.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches (152 mm) in length.
    - a. BS1 and BS2 – Miter corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

**END OF SECTION 096513**

**SECTION 096566 - RESILIENT ATHLETIC FLOORING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Rubber sheet flooring.

**1.2 COORDINATION**

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

**1.3 ACTION SUBMITTALS**

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

- B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.

- C. Samples: For each exposed product and for each type, color, and pattern specified.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.5 QUALITY ASSURANCE**

- A. Rubber Flooring Installer Qualifications: An experienced installer who has completed rubber flooring installations similar in material, design, installation and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

**PART 2 – PRODUCTS****2.1 RUBBER FLOOR TILE AND RUBBER SHEET FLOOR****A. Basis-of-Design Product:**

1. As indicated in the Finish Legend on Sheet AI601 or approved equal.

- B. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.

## 2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- A. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5 or as required by flooring manufacturer.
  - 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- A. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

### 3.3 FLOOR TILE INSTALLATION

- A. Lay out 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 square with room axis.
- B. Discard broken, cracked, chipped, or deformed tiles.
- C. Tile Matching: Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.
  - 1. Lay tiles with grain running in one direction.
- D. Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
  - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- E. Free-Lay Tile: Place flooring at locations indicated with units securely interconnected and fully seated on substrate to form a smooth, level surface.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing flooring installation:
  - 1. Remove adhesive and other blemishes from flooring surfaces.
  - 2. Sweep and vacuum flooring thoroughly.
  - 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
  - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

**END OF SECTION 096566**

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**SECTION 096813 - TILE CARPETING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes modular carpet tile.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  - 2. Carpet tile type, color, and dye lot.
  - 3. Type of subfloor.
  - 4. Type of installation.
  - 5. Pattern of installation.
  - 6. Pattern type, location, and direction.
  - 7. Pile direction.
  - 8. Type, color, and location of insets and borders.
  - 9. Type, color, and location of edge, transition, and other accessory strips.
  - 10. Transition details to other flooring materials.
- C. Samples: For each exposed product and for each color and texture required.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product test reports.
- B. Sample warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.5 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 Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 CARPET TILE

- A. Basis of Design Product: As indicated in the Finish Legend on Drawing AI601.

## 2.2 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. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours OR AS REQUIRED BY MANUFACTURER.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement OR AS REQUIRED BY MANUFACTURER.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

## 3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- A. 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.
- B. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down as recommended in writing by carpet tile manufacturer; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION 096813**

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**SECTION 099113 - EXTERIOR PAINTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Fiber-cement board.
  - 2. Structural steel and metal fabrications.
  - 3. Galvanized metal doors and frames.

**1.2 DEFINITIONS**

- A. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and each color and gloss of topcoat.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to:
  - 1. Benjamin Moore.
  - 2. Sherwin Williams.
  - 3. PPG Paints.

## 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- 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 the Finish Legend on Drawings AI601 and AI602 or as selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

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

## 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

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

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

#### A. Cement Board Substrates:

##### 1. Latex System MPI EXT 3.3A:

- a. Prime Coat: Latex, exterior, matching topcoat.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

#### B. Steel and Iron Substrates:

##### 1. Water-Based Light Industrial Coating System MPI EXT 5.1M:

- a. Prime Coat: Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

#### C. Galvanized-Metal Substrates:

##### 1. Latex System MPI EXT 5.3H:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

**END OF SECTION 099113**

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**SECTION 099123 - INTERIOR PAINTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Gypsum board.
  - 2. Abuse-resistant gypsum board.

**1.2 DEFINITIONS**

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to:
  - 1. Benjamin Moore.
  - 2. Sherwin Williams.
  - 3. PPG Paints.

## 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- 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 the Finish Legend on Drawing A1601.

## 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. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

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

**3.3 APPLICATION**

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- A. 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 INTERIOR PAINTING SCHEDULE**

- A. Gypsum Board Substrates:
  - 1. Latex over Latex Sealer System MPI INT 9.2A:
    - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat (Ceilings): Latex, interior, flat (MPI Gloss Level 1), MPI #53.
    - d. Topcoat (Public Areas): Latex, interior (MPI Gloss Level 3), MPI #52.
    - e. Topcoat (Restrooms and Locker Rooms): Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
    - f. See gloss levels in the Drawings.
  - 2. Whiteboard Paint: (As indicated in the Drawings)
    - a. Prime Coat: Primer sealer
    - b. Intermediate Coat: interior, matching topcoat.
    - c. Topcoat: interior (MPI Gloss Level 5)

**END OF SECTION 099123**

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**SECTION 099300 - STAINING AND TRANSPARENT FINISHING****PART 1 - GENERAL****1.1 SUMMARY**

1. Interior Substrates: All interior exposed wood including, but not limited to:

- a. Exposed laminated veneer lumber.
- b. Interior wood roof decks.

**1.2 DEFINITIONS**

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of finish system and in each color and gloss of finish required. As applied to a sample of the lumber it will be used on in the field.

**1.4 QUALITY ASSURANCE**

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.
  - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Behr Process Corporation.
  2. Sherwin Williams.
  3. Benjamin Moore & Co.
  4. Dunn-Edwards Corporation.
  5. Duron, Inc.
  6. Glidden Professional.
  7. Kelly-Moore Paint Company Inc.
  8. Lenmar Lacquers; Benjamin Moore & Co.
  9. Or approved equal.

### 2.2 MATERIALS, GENERAL

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

## 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 Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

- C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

## 3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

- A. Wood Substrates: Glued-laminated construction, panel products, interior wood floor and roof decks.
  - 1. Basis-of-Design Product: SuperDeck Exterior Oil-Based Transparent Stain, by Sherwin Williams in color as selected by Architect from manufacturer's full range.
    - a. Install per manufacturer's instructions and recommendations. Prepare wood surface prior to beginning application according to Manufacturer's recommendations for surface, exposure and use. Apply number of coats as recommended by manufacturer.

**END OF SECTION 099300**



**SECTION 101423.16 - ROOM-IDENTIFICATION & PANEL SIGNAGE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes room-identification signs that are directly attached to the building.
  - a. Frameless aluminum panel signs.
  - b. Code-required signage at restrooms, shower rooms, electrical rooms, mechanical rooms, communication rooms, custodial rooms, stairs, exiting within stairs, and any other signs required by authorities having jurisdiction.
  - c. Meet requirements for Braille, font, text size, universal symbols, contrast, and any other accessibility requirement.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - a. Include fabrication and installation details and attachments to other work.
  - b. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - c. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size
  - d. Show locations of electrical service connections.
  - e. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Sample warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.5 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - a. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

## 2.2 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - a. Solid-Sheet Sign: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:
    - a. Surface-Applied, Flat Graphics: Manufacturer's standard applied vinyl film, paint, or photo image.
    - b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
    - c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
  - b. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of manufacturer's standard core sheet. Manufacturer's standard edge finish.
    - a. Surface-Applied, Flat Graphics: Manufacturer's standard applied vinyl film, paint, or photo image.
    - b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

## 2.3 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign or Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - a. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic or phenolic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: As indicated on Drawings.
    - b. Surface-Applied Graphics: Applied vinyl film, paint or photo image.
    - c. Color(s): As selected by Architect from manufacturer's full range.
  - b. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition: As indicated on Drawings.
    - b. Corner Condition in Elevation: As indicated on Drawings.
  - c. Mounting: Surface mounted to wall with concealed anchors.

## 2.4 BASIS OF DESIGN

- A. Panel Sign: Contractor and Architect to work with signage manufacturer to provide affordable and simple code signage and room identification signage.

## 2.5 SIGN MATERIALS

- A. As indicated on the drawings. May include the following:
  - a. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
  - b. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

## 2.6 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - a. Use concealed fasteners and anchors unless indicated to be exposed.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

## 2.7 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - a. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - a. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - b. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - c. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

**B. Mounting Methods:**

- a. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
- b. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
- c. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

**END OF SECTION 101423.16**

**SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of**B. product.** Sustainable Design**C. Submittals:**

Attachment details.

**D. Samples** for each type of toilet compartment material indicated.**1.3 INFORMATIONAL SUBMITTALS****A. Product certificates.****1.4 CLOSEOUT SUBMITTALS****A. Maintenance data.****PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS****A. Surface-Burning Characteristics:** Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 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 for toilet compartments designated as accessible.

## 2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corp.; ASI Group.
  2. American Sanitary Partition Corporation.
  3. Ampco Products, LLC.
  4. Bobrick Washroom Equipment, Inc.
  5. Bradley Corporation.
  6. Flush Metal Partition, LLC.
  7. General Partitions Mfg. Corp.
  8. Global Partitions; ASI Group.
  9. Knickerbocker Partition Corporation.
  10. Metpar Corp.
- B. Toilet-Enclosure Style: Overhead braced, floor anchored.
- C. Urinal-Screen Style: Wall hung
- D. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- E. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, stainless steel
- G. Phenolic-Panel Finish:
1. Facing Sheet Finish: One color and pattern in each room.
  2. Color and Pattern: As selected by Architect from manufacturer's full range with manufacturer's standard through-color core matching face sheet.
  3. Edge Color: Through-color matching facing sheet color.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
1. Material: Stainless steel
  2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- B. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.

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

## 2.4 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch (13 mm).
    - b. Panels and Walls: 1 inch (25 mm).
  2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
  3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full- height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

**3.2 ADJUSTING**

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

**END OF SECTION 102113.17**



**SECTION 102226 – OPERABLE PARTITIONS****PART 1: GENERAL****1.2 SUMMARY**

A. This Section includes the following:

1. Manually operated, paired panel operable partitions.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 "Standard Practice for Architectural Application and Installation of Operable Partitions."

**1.4 SUBMITTALS**

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

### 1.6 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Partition Warranty period: Three (3) years from date of Substantial Completion.
- C. Suspension System Warranty: Five (5) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Modernfold, Inc.
  - 2. Manufacturer of equal product approved by Architect.

### 2.2 MANUFACTURERS, PRODUCTS, AND OPERATIONS

- A. Basis-of-Design Product: Subject to compliance with the requirements, provide the following product or approved equal:
  - 1. Acousti-Seal Encore - Paired Panel: Manually operated paired panel operable partition.

### 2.3 OPERATION

- A. Acousti-Seal Encore - Paired Panel: Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals and automatic top seals.
- B. Final Closure:
  - 1. Horizontally expanding panel edge with removable crank.

## 2.4 PANEL CONSTRUCTION

- A. Nominal 4.25-inch (108mm) thick panels in manufacturer's standard 51-inch (1295mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- B. Panel skin shall be:
  - 1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
    - a. 52 STC.
- C. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
  - 1. SOSS invisible laminated hinge with antifriction segments mounted between each heat treated link. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Concealed hinges or hinges mounted into panel edge or vertical astragal are not acceptable. Exposed hinge barrels are not acceptable.
- D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at all panel joints.
- E. Panel Weights:
  - 1. 52 STC - 8.2 lbs./square foot.

## 2.5 PANEL FINISH

- A. Panel finish shall be factory applied, Class "A" rated material. Finish shall be:
  - 1. Acoustical, non-woven needle punch carpet, with fused fibers to prevent unraveling or fray of material.
- B. Panel Trim: Exposed panel trim of one consistent color:
  - 1. As selected by architect from manufacturer's full range.

## 2.6 SOUND SEALS

- A. Vertical Interlocking Sound Seals between panels: Aluminum astragals, with tongue and groove configuration in each panel edge. Rigid plastic astragals are not acceptable.
- B. Horizontal Top Seals shall be Modernfold SureSet™ automatic operable top seals, manually operated top seals not required or permitted.

C. Horizontal bottom floor seals shall be Modernfold Sureset™ bottom seal:

1. Modernfold SM2 Bottom Seal. Manually activated seals providing nominal 2" (51mm) operating clearance with an operating range of + 0.50" (13mm) to -1.50" (38mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds (265 kg) downward force to the floor throughout operating range.

2.7 SUSPENSION SYSTEM

A. Suspension System

1. Suspension Tracks: Minimum 11-gauge, 0.12-inch (3.04mm) roll-formed steel track, suitable for either direct mounting to a wood header or supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38-inch (10mm) diameter threaded rods. Aluminum track is not acceptable.
  - a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
2. Carriers: One all-steel trolley with steel tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.

PART 3: EXECUTION

3.1 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that insure operable partitions are without damage or deterioration at time of Substantial Completion.

**3.3 ADJUSTING**

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

**3.4 EXAMINATION**

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.5 DEMONSTRATION**

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

**END OF SECTION 102226**

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**SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Public-use washroom accessories.
2. Childcare accessories.
3. Underlavatory guards.
4. Custodial accessories.

**B. Owner (Vendor) Furnished Items: As indicated on Drawing AI601.****1.2 ACTION SUBMITTALS****A. Product Data: For each type of product indicated.****B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.**

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

**1.3 INFORMATIONAL SUBMITTALS****A. Warranty: Sample of special warranty.****1.4 CLOSEOUT SUBMITTALS****A. Maintenance data.****1.5 WARRANTY****A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.**

1. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PUBLIC-USE WASHROOM ACCESSORIES

## A. Basis-of-Design Products: As indicated on Drawing AI601.

1. Provide products by manufacturer of basis-of-design items or approved equal. Subject to compliance with requirements, manufacturers of items that may be installed include, but are not limited to:
  - a. Bobrick.
  - b. Bradley.
  - c. ASI.

## 2.2 CHILDCARE ACCESSORIES

## A. Basis-of-Design Products: As indicated on Drawing AI601.

## 2.3 UNDERLAVATORY GUARDS

## A. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

## 2.4 CUSTODIAL ACCESSORIES

## A. Basis-of-Design Products: As indicated on Drawing AI601.

1. Provide products by manufacturer of basis-of-design items or approved equal. Subject to compliance with requirements, manufacturers of items that may be installed include, but are not limited to:
  - a. Bobrick.
  - b. Bradley.
  - c. ASI.

## 2.5 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.



**PART 3 – EXECUTION**

**3.1        INSTALLATION**

- A.    Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B.    Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

**END OF SECTION 102800**

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**SECTION 104413 - FIRE PROTECTION CABINETS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes fire-protection cabinets for portable fire extinguishers.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

**1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.4 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 FIRE-PROTECTION CABINET**

- 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:
  - a. American Specialties, Inc.; ASI Group.
  - b. Guardian Fire Equipment, Inc.
  - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - d. Kidde Residential and Commercial Division.
  - e. Larsens Manufacturing Company.
  - f. Modern Metal Products, Division of Technico Inc.
  - g. MOON American.
  - h. Potter Roemer LLC.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Construction: Nonrated.

- D. Cabinet Material: Cold-rolled steel sheet.
- A. Semi-Recessed Cabinet:
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- B. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- C. Cabinet Trim Material: Steel sheet.
- D. Door Material: Steel sheet.
- E. Door Style: Center glass panel with frame.
- F. Door Glazing: Tempered float glass (clear).
- G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- H. Accessories:
  - 1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
  - 2. 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: Decals.
      - 3) Lettering Color: Black.
      - 4) Orientation: Vertical.
- I. Materials:
  - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
    - a. Finish: Baked enamel or powder coat.
    - b. Color: As selected by Architect from full range of industry colors and color densities.
  - 2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

**2.2 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.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

**END OF SECTION 104413**

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**SECTION 104416 - FIRE EXTINGUISHERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

**1.2 ACTION SUBMITTALS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Warranty: Sample of special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**1.5 COORDINATION**

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

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

- 1. 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.

## 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International.
    - c. Badger Fire Protection.
    - d. Buckeye Fire Equipment Company.
    - e. Guardian Fire Equipment, Inc.
    - f. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - g. Kidde Residential and Commercial Division.
    - h. Larsens Manufacturing Company.
    - i. Pem All Fire Extinguisher Corp.; Pem Systems, Inc.
    - j. Pyro-Chem; Tyco Fire Suppression & Building Products.
  - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: UL-rated 4A-80B-C nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

## 2.3 MOUNTING BRACKETS

- C. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
- D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.



PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

**END OF SECTION 104416**

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CONSTRUCTION DOCUMENTS  
AUGUST 9, 2018

# NAC REC CENTER



## PROJECT MANUAL VOLUME 2 OF 2

1000 ABILITY WAY  
PARK CITY, UTAH 84060

PROJECT NO: 18065



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VOLUME 1

# TABLE OF CONTENTS

## DIVISION 01 — GENERAL REQUIREMENTS

- 011000 - SUMMARY
- 012500 - SUBSTITUTION PROCEDURES
- 012600 - CONTRACT MODIFICATION PROCEDURES
- 012900 - PAYMENT PROCEDURES
- 013100 - PROJECT MANAGEMENT AND COORDINATION
- 013200 - CONSTRUCTION PROGRESS DOCUMENTATION
- 013300 - SUBMITTAL PROCEDURES
- 014000 - QUALITY REQUIREMENTS
- 015000 - TEMPORARY FACILITIES AND CONTROLS
- 015639 - TEMPORARY TREE AND PLANT PROTECTION
- 016000 - PRODUCT REQUIREMENTS
- 017300 - EXECUTION
- 017700 - CLOSEOUT PROCEDURES
- 017823 - OPERATION AND MAINTENANCE DATA
- 017839 - PROJECT RECORD DOCUMENTS
- 017900 - DEMONSTRATION AND TRAINING

## DIVISION 03 — CONCRETE

- 033000 - CAST-IN-PLACE CONCRETE
- 034500 - PRECAST ARCHITECTURAL CONCRETE

## DIVISION 04 — MASONRY

- 042200 - CONCRETE UNIT MASONRY
- 044313.16 - ADHERED STONE MASONRY VENEER

## DIVISION 05 — METALS

- 051200 - STRUCTURAL STEEL FRAMING
- 055000 - METAL FABRICATIONS

## DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

- 061000 - ROUGH CARPENTRY
- 061516 - WOOD FLOOR AND ROOF DECKING
- 061600 - SHEATHING
- 061753 - SHOP-FABRICATED WOOD TRUSSES
- 061800 - GLUED-LAMINATED CONSTRUCTION
- 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

## DIVISION 07 — THERMAL AND MOISTURE PROTECTION

- 072100 - THERMAL INSULATION
- 074113 - CORRUGATED METAL ROOF AND WALL PANELS
- 074213 - METAL PANELS
- 074646 - FIBER-CEMENT SIDING
- 076200 - SHEET METAL FLASHING AND TRIM
- 077253 - SNOW GUARDS
- 079200 - JOINT SEALANTS

## DIVISION 08 — OPENINGS

- 081113 - HOLLOW METAL DOORS AND FRAMES
- 081416 - FLUSH WOOD DOORS
- 083113 - ACCESS DOORS AND FRAMES
- 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
- 087100.01 - DOOR HARDWARE
- 088000 - GLAZING

## DIVISION 09 — FINISHES

- 092900 - GYPSUM BOARD
- 093013 - CERAMIC TILING
- 095113 - ACOUSTICAL PANEL CEILINGS
- 096513 - RESILIENT BASE AND ACCESSORIES
- 096566 - RESILIENT ATHLETIC FLOORING
- 096813 - TILE CARPETING
- 099113 - EXTERIOR PAINTING
- 099123 - INTERIOR PAINTING
- 099300 - STAINING AND TRANSPARENT FINISHING

## DIVISION 10 — SPECIALTIES

- 101423.16 - ROOM-IDENTIFICATION & PANEL SIGNAGE
- 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS
- 102226 - OPERABLE PARTITIONS
- 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES
- 104413 - FIRE PROTECTION CABINETS
- 104416 - FIRE EXTINGUISHERS

## VOLUME 2

## DIVISION 21 — FIRE SUPPRESSION

- 211000 - FIRE PROTECTION

## DIVISION 22 — PLUMBING

- 221410 - PLUMBING PIPING
- 221411 - DISINFECTING WATER SUPPLY SYSTEM
- 221430 - PLUMBING SPECIALTIES
- 224440 - PLUMBING FIXTURES
- 224450 - PLUMBING EQUIPMENT

## DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

- 230500 - BASIC MECHANICAL REQUIREMENTS
- 230529 - BASIC MECHANICAL MATERIALS AND METHODS
- 230540 - MECHANICAL SOUND AND VIBRATION CONTROL
- 230548 - MECHANICAL SEISMIC CONTROL
- 230593 - TESTING, ADJUSTING AND BALANCING
- 230700 - MECHANICAL INSULATION
- 230810 - VARIABLE FREQUENCY DRIVE
- 230900 - ELECTRONIC CONTROLS
- 231123 - NATURAL GAS SYSTEM
- 233300 - DUCTWORK AND ACCESSORIES
- 233400 - AIR HANDLING FANS

233713 - AIR INLETS AND OUTLETS  
234100 - AIR CLEANING  
235100 - BREECHINGS, CHIMNEYS, STACKS, AND FLUES  
235700 - HEAT TRANSFER  
236400 - REFRIGERATION  
237400 - AIR HANDLING SYSTEMS  
237410 - AIR HANDLING UNIT WITH COILS

## DIVISION 26 — ELECTRICAL

260500 - ELECTRICAL GENERAL PROVISIONS  
260501 - MECHANICAL AND ELECTRICAL COORDINATION  
260507 - ELECTRICAL CONNECTIONS FOR EQUIPMENT  
260519 - CONDUCTORS AND CABLES (600V AND BELOW)  
260526 - GROUNDING  
260529 - SUPPORTING DEVICES  
260532 - CONDUIT RACEWAY  
260533 - ELECTRICAL BOXES AND FITTINGS  
260548 - ELECTRICAL SEISMIC CONTROL  
260553 - ELECTRICAL IDENTIFICATION  
260573 - PROTECTIVE DEVICE STUDY  
260923 - OCCUPANCY SENSORS  
260943 - LIGHTING CONTROL EQUIPMENT  
262413 - SWITCHGEAR AND SWITCHBOARDS  
262416 - PANELBOARDS  
262713 - SERVICE ENTRANCE  
262726 - WIRING DEVICES  
262815 - OVERCURRENT PROTECTIVE DEVICES  
262816 - MOTOR AND CIRCUIT DISCONNECTS  
264313 - SURGE PROTECTIVE DEVICES (SPD)  
265100 - INTERIOR AND EXTERIOR BUILDING LIGHTING

## DIVISION 27 — COMMUNICATIONS

271501 - TELEPHONE SYSTEM (RACEWAYS)  
274100 - AUDIOVISUAL SYSTEM

## DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

282205 - ACCESS CONTROL SYSTEM  
283111 - FIRE ALARM AND DETECTION SYSTEM  
283112 - FIRE SPRINKLER MONITORING SYSTEM

## DIVISION 32 — EXTERIOR IMPROVEMENTS

328400 - PLANTING IRRIGATION  
329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)  
329200 - TURF AND GRASSES  
329300 - PLANTS

## DIVISION 33 — UTILITIES

330000 - CIVIL SPECS

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## SECTION 211000 - FIRE PROTECTION

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Connections and Fees.
- B. Firelines, Extensions as shown on Drawings.
- C. System Design Requirements per Jurisdictional Authorities.
- D. Underground Exterior Piping as shown on Drawings.
- E. Interior and Exterior above Ground Piping.
- F. Sprinkler System.
- G. Standpipe System.
- H. Fire Department Connections.
- I. All Alarms, Switches and Required Wiring.

## 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500 - Basic Mechanical Requirements.
- C. The 211000 Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete sprinkler system ready for operation in accordance with the requirements of the authority having jurisdiction. The purpose of the furnished specifications and associated drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust and make operable. The Contractor shall visit the site before submitting the bid, and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of discrepancy or lack of clarity shall be promptly identified to the Owner's Representative and Engineer for clarification.

## 1.3 RELATED SECTIONS

- A. Section 012300 - Alternates.

- B. Section 230529 - Basic Mechanical Materials and Methods.
- C. Section 230540 - Mechanical Sound and Vibration Control.
- D. Section 212200 - FM-200 Extinguishing System.
- E. Section 221410 - Plumbing Piping: Copper water piping.
- F. Section 221411 - Disinfecting Water Supply System.
- G. Section 221430 - Plumbing Specialties: Pressure gauges, air gap fittings, pressure relief valves.

#### 1.4 FIRE LINES

- A. The work of this section shall include extension of service mains from the on-site mains to the building, as shown on drawings.

#### 1.5 CONNECTIONS AND FEES

- A. System development charges and or similar charges, that in principle allow the right to obtain the services from the utility will be arranged and paid for by the Site Utilities Contractor.
- B. Tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.
- C. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Site Utilities Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the 211000 Contractor.
- D. Be responsible for all pads, vaults, manholes, manhole covers, valve enclosures, valves, services boxes, and required material, all in conformance with requirements of the serving utility company.
- E. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
- F. Permit fees shall be provided in the base bid. The 211000 Contractor shall furnish the Owner with a copy of all official documents and written correspondence associated with permits.

## 1.6 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. – FM Global or Factory Mutual Research.
3. IRI - Industrial Risk Insurors (aka: F.I.A. Factory Insurance Association.)
4. NFPA - National Fire Protection Association.
5. Jurisdictional Agencies:
  - a. Building Department.
  - b. Fire Department or Fire Prevention Bureau or Marshal.
  - c. Insurance Agency, Carrier, and/or Underwriter as defined in Section 1.7.
6. Engineer refers to the consulting Mechanical Engineer of record.
7. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
8. Other definitions for fire protection systems are listed in NFPA 13.
9. Working Plans as used in this Section mean those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.
10. Review and Approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

## 1.7 SYSTEM DESIGN REQUIREMENTS

A. Sprinkler System Requirements:

1. Provide a dry-pipe sprinkler system to protect the entry canopy, dock, generator room, and similar areas subject to freezing.
2. Provide a freeze-protected sprinkler system using dry sprinkler heads or charged with U.S.P. glycerin or propylene glycol to protect walk-in freezers, vestibules, and similar areas subject to freezing.
3. Provide a wet pipe sprinkler system to protect all other areas of the building,. Include protection of elevator shafts, kitchen exhaust ducts, boiler rooms, and similar areas as required by code.
4. Sprinkler heads shall be centered in ceiling tiles in all finished areas.
5. Provide inspector test valve and piped drain at each riser.

## B. Standpipe System Requirements:

1. Provide Class I standpipe system of the manual wet type as required by code and as approved by the jurisdictional authority.

Locate Class I hose connections at each intermediate landing in every required stairway, at opening of horizontal exits, at entrance of exit passageways, at entrance of covered mall buildings, and on the roof at the top of each standpipe riser. Locate Class II hose connections to be accessible and so that all portions of the building are within 30 feet of a nozzle attached to 100 feet of hose.

- C. Occupancy hazard classifications shall be determined in accordance with NFPA 13 unless higher hazard classifications are indicated on the drawings or required by insurance underwriter or jurisdictional authority.
- D. Fire protection shall be designed and installed per NFPA 13, FM Global current published standards and local Jurisdictional Agency requirements. Where a conflict occurs the more stringent standard shall apply.
- E. Verify requirements with Jurisdictional authorities, i.e.: Insurance Co. or Underwriter (when specified above), Fire Department or Marshal, or Building Department. Provide system complete, functional and acceptable to Jurisdictions without penalty of any type to the insurance premium rate. Division 211000 Contractor shall coordinate his work with all other sections of these specifications and drawings. No change order will be issued for lack of coordination or lack of verification of requirements of Jurisdictional Authorities.
- F. System shall be hydraulically calculated per Jurisdictional Agency Standards.
- G. All calculations shall include flow test results. Flow tests shall be performed by this Contractor and submitted to the Fire Department. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.
- H. The system shall be designed to account for seasonal changes and for future degradation of the water supply system, using previous seasonal flow tests from the water utility to determine the expected range of pressure fluctuation at the project site.
- I. Be responsible for accurate measurements, coordination with other trades, required offsets, scheduling, timely submittals, material delivery, job manning, and conformance to construction schedules.

- J. Provide backflow protection in accordance with jurisdictional requirements. Provide back flow preventers of required types, and installed in an approved manner above or below grade as applicable. Backflow devices in pits or vaults below ground will not be acceptable unless the pit or vault is free draining, provided with a floor drain piped to atmosphere without the aid of mechanical pumps or devices. Outfall for drain must be installed in non flood and non submersible positions. Backflow devices above grade shall be protected with self regulating thermostat controlled heat cable, approved for fire service by the jurisdictional authority, and shall not be less than 15 watts/lineal foot installed with required pitch. Insulate with 2" fiber glass with all service jacket and cover with weatherproof aluminum protective jacket. Heat cable shall be as manufactured by Raychem "Auto Trace". Backflow preventer shall be as manufactured by "FEBCO" or "BEECO". Refer to Sections 230529 and 221430 for specifications for Heat Trace and Backflow Preventers. Verification as to acceptance by jurisdictional authority and fire insurance underwriter shall be the responsibility of this Contractor.
- K. All areas shall be classified in accordance with NFPA 13 with respect to hazard classification and shall have automatic sprinkler systems designed for the appropriate classification.
- L. Fire Protection Contractor shall furnish and install all alarm and supervisory switches or devices required for the automatic sprinkler system, jockey pump, installed so as to provide an electrically supervised system.
- M. The number and location of fire department connections shall be coordinated with the Architect and local Fire Department. The fire department connections shall be piped directly into the building fire protection loop or standpipe system.
- N. Each sprinkler riser control valve shall be equipped with a valve supervisory switch and a waterflow switch on piping down stream of the last control valve. Drain piping for each fire protection riser shall be sized and located to accommodate full flow from the main drain under normal system pressure.
- O. This project is located within a seismic zone which is subject to earthquakes. Sprinkler systems shall be protected per NFPA 13 to prevent breakage.

#### 1.8 QUALITY ASSURANCE

- A. The firm, company, corporation, or partnership producing and providing the material and labor of this Section shall have at least 3 years experience performing scope of work described and required by these Contract Documents.
- B. Acceptable Fire Protection Contractors meeting the above requirements are as follows:
  - 1. Delta Fire Protection, Salt Lake City, UT
  - 2. Alta Fire Protection, Salt Lake City, UT
  - 3. Fire Engineering Company, Salt Lake City, UT
  - 4. Chaparral Fire Protection, Salt Lake City, UT
  - 5. Firetrol Protection Systems, Salt Lake City, UT

6. Grinnell Fire Protection, Salt Lake City, UT
  7. Western Automatic Sprinkler, Salt Lake City, UT
  8. Preferred Fire Protection Company, Salt Lake City, UT
  9. Aurora Fire Protection, Salt Lake City, UT
  10. Shilo Automatic Fire Sprinkler, ID
- C. Contractors not listed must submit for acceptance 10 calendar days prior to bid date. Proof of prior experience for Contractors not listed shall be submitted to the Engineer in writing, giving total and complete information of dates, name, address of owner, and location of all projects completed during past 3 years with specific references as to Engineers, and prime contractors involved. List names of companies, phone numbers and project manager's name.
- D. Codes and Standards:
1. All work shall conform to the requirements of the currently adopted editions of the following NFPA Standards and Recommended Practices as appropriate for the type of service except as specifically noted in each Section:
    - a. "Installation of Sprinkler Systems", NFPA 13.
    - b. "Installation of Standpipe and Hose Systems", NFPA 14.
    - c. "Installation of Fire Pumps", NFPA 20.
    - d. "National Electrical Code", NFPA 70.
    - e. "National Fire Alarm Code", NFPA 72.
    - f. "Inspection, Maintenance and Testing of Water- Based Suppression Systems", NFPA 25.
  2. All building construction work shall conform to the currently adopted edition of the International Building Code and International Fire Code.
  3. All work shall conform to the federal, state and local regulations governing this installation.
  4. Should any conflicts occur between any code or standard, the most stringent requirement(s) shall apply.
  5. The Fire Protection Contractor shall be subject to the interpretation of statutory requirements by the local Fire Department. Acceptance of the completed systems by the local Fire Department is required.

#### 1.9 TECHNICAL SUBMITTALS

- A. Timely submittals are essential to on-time completion of the project. The Owner will incur no obligation to extend the contract completion date, or to reduce or waive any liquidated damages due, as a result of the Fire Protection Contractor's failure to provide the specified submittals in a timely and acceptable fashion.
- B. The information shown on each technical submittal shall be complete with respect to quantities, dimensions, specified performance and design criteria, products, materials, and similar data to enable the Owner, Engineer and Architect to review the information as required. Only complete submittals will be reviewed. Incomplete submittals will be rejected and returned to the Fire Protection Contractor without being reviewed.

- C. Each technical submittal shall include a cover letter providing a description of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Fire Protection Contractor shall provide specific notation on each Working Plan, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
- D. No construction or installation will be authorized until the required submittals are received and reviewed by the Owner, Engineer, and Architect. Any construction or installation performed without written authorization from the Owner shall be entirely at the Fire Protection Contractor's own risk.
- E. The required Technical Submittals for all systems and equipment installed in accordance with these specifications include:
  - 1. Working Plans, per NFPA 13.
  - 2. Water Supply Information, per NFPA 13.
  - 3. Hydraulic Calculations, per NFPA 13.
  - 4. Operation and Maintenance Manual.
  - 5. Test Protocols.
  - 6. Fire Protection Contractor's Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.
  - 7. Record Drawings.
  - 8. FM Global
- F. Provide six copies of each required Working Plan, manufacturer's data sheet, water supply information, hydraulic calculations, and test protocol submittal within 60 days of award of contract.
- G. Provide two copies of each required Operation and Maintenance Manual, Material & Test Certificates, and Record Drawing submittal a minimum of 10 working days prior to final acceptance testing.
- H. All drawings and diagrams shall be CAD generated using AutoCAD Version 2011, prepared on drawing sheets 30" x 42" in size, and shall contain no extraneous information. Marked up copies of catalog data sheets or manufacturer's "typical" diagrams are not acceptable in lieu of the required drawings or diagrams. All other information required for this submittal shall be submitted in one or more appropriately labeled and indexed 3-ring binders.
- I. All drawings and diagrams shall include the Fire Protection Contractor's title block, complete with drawing title, Fire Protection Contractor's name, address, date (including revisions), and preparer's and reviewer's initials.
- J. Upon approval of the Working Plans, including completion of any required revisions, the Fire Protection Contractor shall provide one (1) complete, reproducible set and three blue-line sets for the Owner, Engineer, and Architect's use in performing field observations during construction.

- K. Working Plans for sprinkler systems shall be complete and in full accordance with NFPA 13 Chapter, FM Global on Plans and Calculations.
- L. All drawings and calculations shall be reviewed and accepted by the jurisdictional fire department, building department fire marshal, as applicable, and the insurance carrier or insurance reviewing authority prior to submitting to the Engineer. Indication of review and acceptance by all agencies, as appropriate, shall be certified by name of reviewer, agency, and date affixed to the plans or reproducibles submitted to the Engineer. None will be accepted or reviewed until compliance with these terms has been established.
- M. Operation and Maintenance Manuals shall be prepared specifically for this project and bound in an indexed 3-ring binder, containing:
  - 1. A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including a testing and maintenance schedule and detailed testing and maintenance instructions for each type of device installed. This description shall include:
    - a. A listing of the individual system components that require periodic testing and maintenance.
    - b. Step-by-step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed, for each type of device installed. These instructions shall include copies of NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems and NFPA 72 - National Fire Alarm Code.
  - 2. A schedule, which correlates the step-by-step testing and maintenance procedures with the listing of individual components. This schedule shall be completed for the duration of the warranty period or for one complete testing/maintenance cycle whichever is longer.
  - 3. A service directory, including installing company's name and telephone numbers for whoever should be called to obtain both normal warranty service and 24-hour emergency service.
  - 4. Drawings and diagrams, as required.
  - 5. System Calculations.
  - 6. Test reports for system, flow rates, and residual pressures.
  - 7. Certified pump curves (all pumps).
  - 8. Wiring diagrams for all system devices.
- N. Upon completion of the installation, submit Record Drawings and Contractor's Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.
- O. Record Drawings shall include all variations from the approved Working Plans, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between trades. Variations shall be indicated in sufficient detail to accurately reflect the as-built conditions. Upon completion of the work, before final acceptance, the Fire Protection Contractor shall deliver to the Owner, two (2) additional full size sets of blue lines and one set of AutoCAD drawing data files.



## 1.10 PROJECT CONDITIONS

- A. Contractor shall not install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

## 1.11 WARRANTIES

- A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

## PART 2 - PRODUCTS

## 2.1 PRODUCT LISTINGS AND APPROVALS

- A. All system components for which UL listings categories exist shall be listed by Underwriters Laboratories (UL) or Factory Mutual Research (FM).
  - 1. All components shall be listed in the current edition of the UL Fire Protection Equipment Directory. Components shall be delivered to the project site with factory applied UL stickers.
  - 2. Components for which UL listing approvals are “pending” are not acceptable.
- B. All system components shall be used in accordance with the manufacturer’s recommendations and their listing.
- C. All system components are subject to the approval of the engineer with regard to their fitness for the intended application.

## 2.2 UNDERGROUND EXTERIOR PIPING

- A. Pipe, Fittings and Joints, Exterior and Buried:
  - 1. General: The use of cast-iron, asbestos cement, steel, or other piping materials and systems is prohibited, unless specifically accepted by the Engineer.

## 2. Pipe Fittings and Joints:

- a. Ductile iron pipe with mechanical joint fittings. Joints to be provided with set screw retainer glands.

Make:	U.S. Pipe Company
Size:	2" thru 48"
Laying Condition:	Type 1
Thickness Class:	50 or 51 as required by U.S. Pipe.
Standards:	ANSI A21.51/A21.51 AWWA C-150/151, U.L., F.M., NSF.
Pressure Rating:	250 psi
Fittings:	Ductile iron conforming to ANSI A21.10/A21.16 and AWWA C-110/111.
Retaining Glands:	Set screw type ductile.
Hydrant Connections:	Tee DI rotatable x MJ Hydrant Connector. DI rotatable 13" long x MJ

## 3. Polyvinylchloride pipe with mechanical joint, ductile fittings, and joint restraints:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	200 (DR 14) as determined by dia. of pipe O.D. divided by the wall thickness (SDR method) conforming to ASTM D-1599 burst test (985 psi minimum) and minimum 100 ft-lbs of impact per ASTM D-2444. Meet all requirements of AWWA C-900, U.L., F.M., and N.S.F.
Pressure Rating:	200 psi minimum operating @ 73 deg. F
Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern only.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps, coated rods, and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping, not offset or deflected, may be J-M "Ring Tite" locked joints in lieu of mechanical joint ductile iron connectors or fittings.

4. Fiberglass reinforced PVC pipe with mechanical joint ductile iron fittings, for use where pressures exceed 200 psi up to 350 psi:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	350 (4"=DR 32, 6" & 8"=DR 36, 10" & 12"=DR 41)
Pressure Rating:	350 psi minimum operating @ 73 deg. F
Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps and coated rods and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping not offset or deflected may be J-M "Lock-ring" joints in lieu of mechanical joint fittings or connectors.

5. Rotatable Fittings:

- a. Provide for all service risers, fire hydrants and valves, U.S. Pipe Company U-591 and U-592 MJ x PE or rotatable MJ gland tees and connecting pieces to provide plumb and true hydrant, valve and service riser settings.

B. Tapping Tees and Valves:

1. Where the water utility does not install its own service tap, provide tapping tees and valves for wet taps. Provide service saddle, valve, and service box with indexed cover in accordance with the utility's standards.

C. Backflow Preventer: Provide backflow preventer in accessible free draining pit or vault, or above ground in heated enclosure or area, or above ground heat traced with self regulating cable, in accordance with Section 230529.

- Double check assembly, U.L. Classified, FM Approved, with shut-off valves. Ames C200, or approved equal.
- Reduced pressure assembly, U.L. Classified, FM Approved, with shut-off valves. Ames C400, or approved equal.

D. Thrust Blocks - Tie Rods:

1. Provide 3000 lb type II concrete thrust blocks with soil contact area based on not more than 2000 psf horizontal soil bearing quality, and enveloping 1/2 of pipe, fitting, or valve. Provide saddle reinforcing as required.

2. Submit calculations for each thrust block and dead man provided.

Provide 1/2" minimum machine thread rods and clamps (felt padded clamps for plastic pipe) on all service entries from last joint underground to riser elbow or wall entry and to first joint in the building. All rods, clamps, and bolts double coated with "ZRC" brand cold galvanizing coating after installation and draw up. Provide 1 coat of coal tar coating over galvanizing. NOTE: Clamps and rods to not preclude the requirements for thrust blocks or deadmen.

E. Cathodic Protection:

1. Provide 8 mil thick minimum polyethylene pipe wrap, overlap at joints and seal joint with 2" wide minimum polyethylene tape triple wrapped and extending at least 6" both ways beyond joint seam or provide machine wrapped scotchwrap #51 PVC tape with 50% overlap wrap on pipe primed with scotchwrap primer. Double wrap all fittings to 6" beyond fitting onto pipe. Provide primer on fittings, bolts, and nuts prior to wrapping.

2.3 SOLVENTS FOR PLASTIC PIPING

- A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.4 INTERIOR AND EXTERIOR ABOVE-GROUND PIPING

A. Pipe and Joints:

1. Black steel and galvanized steel threaded or roll grooved schedule 40 conforming to ASTM A-135 or A-53. Light wall (Schedule 10) conforming to ASTM A-135 or ASTM A-795, where prior approval is obtained from Owner and jurisdiction having authority. All pipe shall conform to NFPA #13, Chapter 3 and Jurisdictional Authorities and Insurance Agency. Where required to meet insurance agency or jurisdictional requirements, all dry pipe system and drain piping shall be galvanized.

B. Fittings:

1. Threaded cast iron, pressure class in accordance with developed system pressures, conforming to ASME B16.4. Threaded malleable iron, pressure class in accordance with developed system pressures, conforming to ASME B16.3. Threaded ductile iron, pressure class in accordance with developed system pressures, conforming to ASTM A-536 and ASME B 16.3.
2. Weld type fittings: Buttweld conforming to ASME B16.9. Flanges conforming to ASME B16.25. Socket weld conforming to ASME B16.11. All welds by certified welder in accordance with Section 230529.

3. Grooved fittings shall conform to ASTM-A47 (malleable), ASTM 536 (ductile), or ASTM-106 GRB (forged steel), ASTM A-53 type E, F, or S GRB (nipples), ASME B-16.5 or B16.1 cast iron and carbon steel flanges.

C. Flexible Connectors:

1. Flexible connector to be stainless steel (304) corrugated tube surrounded with stainless steel (304) wire braid. Provide threaded fittings on each end of the flexible connector.
2. Connector shall have the frictional equivalent of a maximum of 23 ft. of 1" steel pipe (assumes 4' long tube with four 90° bends).
3. Connectors shall be UL listed, F.M. approved.
4. Provide with support bracing and clamps.

D. Valves:

1. All valves are to be indicating type.
2. All valves U.L. listed, F.M. approved.
3. Refer to Section 230529 for valve specifications.

E. Hangers:

1. All hangers, attachments and components U.L. listed, F.M. approved.
2. All piping hangers shall conform to Jurisdictional Authorities requirements.
3. Powder driven studs shall not be included in normal installation. Permission to use this type anchoring system must be accepted by the Structural Engineer prior to submitting pricing or bids to any contractor or agent relative to this project.

## 2.5 SPRINKLER SYSTEM

- A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish, and color provided by the specified make and model.
1. Sprinkler Heads, Alarm, Dry and Deluge Valves, Accelerators, Detector Check Valves, Alarm Horn/Strobe, Air Maintenance Devices, Sprinkler Emergency Cabinets, and Specialties: Automatic, Central, Grinnell, Gem, Reliable, Viking, Notifier, Victaulic, Croker, Potter, Elkhart, Star.

**B. Sprinkler Heads:**

Heads shall be U.L. Listed and of the type required to properly protect the intended space. Heads shall be of ordinary-temperature classification except as required by ceiling temperature, location, or service as allowed or required by code. Provide quick-response heads in all light hazard occupancies.

LOCATION	ORIENTATION	HEAD FINISH	COVER OR ESCUTCHEON
Office	Recessed	Chrome	White
Conference Rooms	Recessed	Chrome	White
Elevator Lobbies	Recessed	Chrome	Chrome
Entry Lobby	Concealed	Brass	White
Storage	Recessed	Brass	Chrome
Corridors	Recessed	Brass	White
Open Areas (No Ceilings)	Upright/Pendant	Brass	-
Equipment Rooms	Upright/Pendant	Brass	Chrome

**C. Escutcheons shall be part of the U.L. Listed sprinkler assembly.****D. Sprinkler Head Cabinets:**

1. Steel with red enamel finish for 6, 12, or 24 heads complete with appropriate heads, wrench and mounting.

**E. Sprinkler Head Guard:**

1. Steel wire cage, chrome finish.

**F. Water Flow and Pressure Switches:**

1. Paddle Type Flow Switch U.L. Listed, for pipe sizes 1" thru 8", for vertical or horizontal mounting, retard adjustment from 0 to 70 seconds instantly recycling, 10 amp, 120v AC, dual contacts. Notifier Model WFD, or approved equal.

**G. Supervisory Switches:**

1. Post indicator valve, and gear operator type, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model PIBV2, or approved equal.
2. Gate, OS&Y, and other exposed rising stem type valves, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model OSY2, or approved equal.

**H. Alarms:**

1. Exterior Audible and Visual Alarm, U.L. Listed for outdoor use, weatherproof faceplate, horn and strobe. Notifier Model GMS, or approved equal.

## 2.6 STANDPIPE SYSTEM

- A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish and color provided by the specified make and model.

Hose cabinets, hose racks, valves and regulating valves: Croker, Moon, Elkhart, Potter, Powhattan, Sierra, Goodall, Allenco, Central, Grinnell, Gem, Reliable, Viking, Victaulic, Star.

- B. Cabinets:

1. Fire Hose Cabinet: Recessed welded steel cabinet, continuous steel hinge, primer finish. Steel door frame, half panel door with plexiglass window.

- C. Hose Valves: U.L. Listed, FM approved, globe type, polished brass finish.

1. Provide pressure limiting valves for stand pipe outlets and sprinkler supply as required.

## 2.7 FIRE DEPARTMENT CONNECTION - INLET (SIAMESE)

- A. Cast brass, single clapper, straight or angle style as indicated. Provide siamese connections of sizes, styles and patterns required, caps and chains, and wall plate.

- B. Style: Flush.

- C. Finish: Polished Brass.

## PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Field Measurements: Verify all dimensions before proceeding with the work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for the accuracy of such measurements and precise fitting and assembly of finished work. Prefabrication of systems is done at this Contractor's own risk.

- B. Coordination: Coordinate all work and placement of components with other trades, thorough coordination of design and field installation is expected. Remedial field work may be required to eliminate conflicts and provide an acceptable finished product.

## 3.2 EXCAVATION, BACKFILL, CUTS AND RESTORATION

- A. Provide all excavations and backfill in accordance with Section 230529 - Basic Mechanical Materials and Methods.

## B. Cuts - Restoration:

1. All concrete, asphalt, or other hard permanent surface shall be saw cut. Turf areas shall be cut clean with straight edge.
2. Restore all planted, paved, and surfaced areas to original color, texture and condition, replanting where necessary and left in the same or better condition as was found existing.

## 3.3 INSTALLATION

- A. General: Provide a complete operable system designed and installed in accordance with applicable local, state, federal and jurisdictional codes, enforcement agencies and insurance rating or underwriting agencies.
- B. All systems shall be drainable with proper drainage devices, and drain terminations either to exterior of building or to proper receptacles within building.
- C. All systems shall be supported and braced for conformance to proper and applicable standards.
- D. Care shall be taken with chrome plated or other polished finish components so that marring does not occur to the finish, and installation provides for a uniform pattern and true installation.
- E. Where piping passes thru masonry units or concrete walls or floors or other building construction, sleeves may be used. Where exposed piping passes thru finished work, chrome plated, or other finish acceptable to Architect, split wall plates or escutcheons shall be installed to fit snugly around piping. Where rated walls are penetrated, approved safing shall be provided at each hole to assure effectiveness of construction as a fire stop.
- F. All openings for piping should be anticipated and coordinated with General Contractor. Indicate such openings on the shop drawings. Any additional cutting of openings must be coordinated with the General Contractor.
- G. Contractor shall complete the automatic fire sprinkler ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges, if any will be paid for by the Owner.
- H. Use no face bushings.
- I. Furnish and install all wiring for all flow switches, tamper switches, exterior and interior alarm items furnished in this Section. This work may be subcontracted to the Division 26 Contractor if desired by the Section 211000 Contractor but the Section 211000 Contractor shall include the wiring costs in his bid.
- J. Provide seismic restraints in accordance with Jurisdictional Agencies.
- K. The sprinkler piping shall be concealed from view in all common and public areas with a finished ceiling. Exposed piping shall be cleaned and left ready for painting by others.



- L. Provide seismic separation assembly in accordance with NFPA 13 where pipes cross building seismic separation joints or expansion joints.

### 3.4 PERFORMANCE

- A. General: Systems shall be engineered and designed for proper densities, ease of maintenance and accessibility. Final main drain flow tests shall be made to prove system design and installation.

### 3.5 CLEANING

- A. General: Flush all systems free of all debris and certify system clean and ready for use.

### 3.6 TESTING AND CERTIFICATE OF COMPLETION

- A. The entire system shall be hydrostatically tested at not less than 200 psig for not less than 2 hours with 0 psig pressure drop. Tests shall be witnessed by the Architect's or General Contractor's representative - mandatory.
- B. Obtain certificate of compliance and completion for jurisdictional agencies, as applicable and present to Owner - mandatory.

END OF SECTION 211000

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## SECTION 221410 - PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Water Piping.
- B. Soil, Waste and Vent Piping.
- C. Storm Water Piping.
- D. Testing.

#### 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500 - Basic Mechanical Requirements.

#### 1.3 RELATED SECTIONS

- A. Section 230529 - Basic Mechanical Materials and Methods.
- B. Section 230540 - Mechanical Sound and Vibration Control.
- C. Section 230548 - Mechanical Seismic Control.
- D. Section 230700 - Mechanical Insulation.
- E. Section 221411 - Disinfecting Water Supply System.
- F. Section 221430 - Plumbing Specialties.
- G. Section 224440 – Plumbing Fixtures.
- H. Section 224450 – Plumbing Equipment.
- I. Section 224460 - Special Plumbing Equipment Systems.

## 1.4 SUBMITTALS

- A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Water Piping, Fittings, and Joints.

## PART 2 - PRODUCTS

### 2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

- A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:
  - a. Copper tube ASTM B88 Type K shall be soldered, to wrought or cast fittings using 95-5 class SnSb (Tin-antimony) solder.
  - b. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.
  - c. Cast bronze solder joint fittings shall conform to ANSI B16.18.
2. Cast Iron Pipe Fittings and Joints:
  - a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
  - b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
  - c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.
3. Ductile Iron Pipe Fittings and Joints:
  - a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
  - b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

4. Polyvinylchloride Water Pipe, Fittings, and Joints:

- a. Rigid polyvinylchloride (PVC) pipe for potable water systems shall conform with NSF Standards #14 and #61. NSF pw logo shall be affixed (printed or molded) on all pipe fittings and joining materials. Materials shall meet requirements of cell classification 12454-A or -B per ASTM D-1784.
- b. Pipe to be IPS size conforming to ASTM D 2241, be provided with integral bell end steel reinforced gasket and comply with ASTM D 3139.
- c. Pipe markings shall include nominal and O.D. base sizes, PVC 1120, DR 21, AWWA pressure class 200, ASTM D 2241, manufacturer name or trademark, production code, and NSF seal, AWWA C-900, UL as appropriate.
- d. Certified 800 psi test, in accordance with AWWA loading criteria, must be furnished to the Engineer for supplied pipe.
- e. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed Joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3" and larger tube.

2. Provide crosslinked polyethylene tubing in accordance with ASTM F 876 and ASTM F 877 for all water distribution piping inside building/structure. Piping to be rated for 140°F maximum temperature and 80 psig maximum pressure. Pipe to be rated for recirculation (continuous). Pipe to be plenum rated, conform to ASTM E84 listing, or pipe larger than ¾ to be insulated, pipe to be not less than 4" spacing, see specification section 230700. Joints shall be made with ASTM F 1960 cold expansion fittings, PEX manufactured by Uponor, Viega or equal.

a. Manifolds:

Material:

- 1) Type L copper body with UNS 3600 series brass PEX outlet connections.
- 2) Engineered Plastic (EP) body with PEX outlet connections.

Manifold Type:

- 1) 1" copper manifold.
- 2) 1" EP manifold.
- 3) All manifolds manufactured with the appropriate sized PEX fittings on the manifold supply inlets.

b. Accessories:

- 1) Angle stops and straight stops that are compatible with PEX tubing shall be supplied by the PEX tubing manufacturer.
- 2) Bend supports designed for maintaining tight radius bends shall be supplied by the PEX tubing manufacturer.
- 3) PEX expander tool to install the ASTM F 1960 compatible fittings shall be supplied by the PEX tubing manufacturer.
- 4) The tubing manufacturer will provide clips and/or PEX rails for supporting tubing runs.
- 5) All horizontal pipe hangers and riser clamps shall be epoxy-coated material.

## 2.2 SOIL DRAIN WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

### A. General:

1. Cast iron pipe centrifugally cast service weight (SV) soil pipe with cast iron drainage fittings conforming to ASTM A 74. Joint materials and systems may be hub and spigot with neoprene gaskets and lubricant conforming to ASA-021 and ASTM C-564 SV pattern. Gaskets shall be equal to U.S. Pipe Company Veri-tite conforming to ASTM-C564 and pipe and fittings be certified in writing to the Engineer that the following criteria has been met, thru testing by a recognized independent testing laboratory. Cast iron hubless pipe and fittings conforming to ASTM A 888, CISPI 301. Hubless couplings shall conform to ASTM C 1277 for standard and ASTM C 1540 for heavy duty or CISPI 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.

Criteria: Sizes 2" thru 6" shall withstand 15 psig hydrostatic pressure for 10 minutes with unrestrained joints, and no leakage, and using restrained joints must be able to withstand 25 psig air pressure and 40 psig hydrostatic pressure with no leakage. Offset joints shall withstand 1056 pounds of horizontal force without joint separation or detectable leakage.

2.
  - a. Polyvinylchloride (PVC) sewer pipe and fittings shall conform to DR-35, ASTM D3034, bell and spigot type with reinforced rubber ring gasket integral with bell joint, minimum pipe stiffness at 5% deflection is 46, material to meet ASTM D1784, D2444 and joint tightness in accordance with ASTM D3212.
  - b. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

### B. Buried Pipe:

1. Provide SV hub and spigot cast iron pipe and fittings to 5'-0" beyond building excavation line, continue past this point with SV cast iron or XS vitrified clay to termination points with hub and spigot joints.

C. Interior Pipe Supported By Hangers and Clamps:

1. Provide hubless cast iron pipe using hubless cast iron soil pipe couplings certified to withstand a minimum of 50 psi internal pressure. Where stack pressures may theoretically exceed 50 psi, use clamp all or heavy-duty couplings with restrained joints horizontal and vertical up to 80 psig. For pressures above 80 psi, use Schedule 40 ASTM A-120 galvanized steel pipe with threaded cast iron drainage fittings. Roll grooved schedule 40 pipe with Victaulic Style 77M galvanized couplers may be used on horizontal and vertical stacks and mains. Use Teflon tape or compound for all threaded joint make-up.

2.3 COPPER DRAIN, WASTE AND VENT TUBE ABOVE GROUND

- A. Copper waste, vent and soil pipe and fittings will be acceptable for exposed piping in food service areas when conforming to the following:
  1. Type DWV copper (ASTM B-306) with DWV pattern cast copper or brass solder joint fittings (ASA B16.23; ASTM B-62) and 50-50 Class Sn Pb soldered joints.

2.4 PLASTIC DRAIN, WASTE AND VENT PIPING

- A. Plastic drain, waste and vent piping may be installed when in compliance with jurisdictional codes and this specification.
- B. Plastic DWV may be either P.V.C. or A.B.S. as required by code and utilizing drainage pattern fittings.
- C. P.V.C. (polyvinylchloride) pipe and fittings shall conform to ASTM D2665 with a flame spread rating of 25 or less and shall consist of Schedule 40 DWV pattern.
- D. A.B.S. (acrylonitrile - butadiene - styrene) pipe and fittings shall conform to ASTM D2661, CS 270-65, Schedule 40 DWV pattern.
- E. All plastic DWV piping shall bear the seal of the National Sanitation Foundation (N.S.F.). None will be accepted without this seal.

2.5 SOLVENTS FOR PLASTIC PIPING

- A. Solvents for plastic piping joints shall be certified low volatile organic compound (VOC) to meet SCAQMD Rule #1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes. Product: IPS Weld-On #2700 or equal.



## PART 3 - EXECUTION

### 3.1 WATER TUBE, FITTINGS AND JOINTS

#### A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 230529.
5. Pull tee (T-drill) fittings are forbidden.

#### B. Domestic Hot Water Circulating Systems:

1. Provide a calibrated balancing valve in each branch line and where additional valves are shown on the drawings.

### 3.2 PEX INSTALLATION

#### A. PEX Tubing:

1. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
2. Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures.
3. Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
4. Do not expose PEX tubing to direct sunlight for more than 30 days.
5. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
6. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
7. Protect PEX tubing with sleeves where abrasion may occur.
8. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
9. Use tubing manufacturer supplied bend supports where bends are less than six times the outside pipe diameter.
10. Minimum horizontal supports are to be installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
11. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
12. Insulate as required to maintain plenum rating.
13. A mid-story support is required for riser applications.

14. Pressurize PEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
  15. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- B. Through Penetration Firestop:
1. Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with ASTM E 814.
- C. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.

### 3.3 SOIL, DRAIN, WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

- A. General:
1. Provide bedding, restraints and hangers as appropriate and in accordance with manufacturers recommendations based upon type of pipe, fittings, joints, and bury depth using final finished grading as the basis.
  2. Piping shall be run true, plumb, and straight, with all restraints and hangers adjusted to carry their proportional load and locked to prevent pipe "wag" misalignment, movement or shear.
  3. Provide anchors for piping risers on every floor using riser clamps, wall brackets, knee brackets, and foot blocks for all vertical piping over 20 feet straight height.
  4. Furnish and install all soil, waste and vent piping for the complete sanitary system in accordance with jurisdictional code requirements.
  5. All soil and waste piping shall be run at the following minimum slope unless otherwise indicated on drawings.

Slope of Horizontal Drainage Pipe	
Size (In.)	Min. Slope (In./Ft.)
2-1/2 or less	1/4
3 to 6	1/8
8 or larger	1/16

6. Bushings in soil waste or vent piping shall be prohibited. Tapped spigots or tees shall be used when changing from cast iron pipe to steel waste or vent piping, and for appropriate cleanout plugs.
7. Vertical Piping: All vertical soil and vent stacks shall be supported with riser clamps at each floor slab. When soil stacks over two stories in height terminate at the bottom on slab fill or native soil, provide stack base elbows set on 24" x 24" x 8" thick minimum poured reinforced concrete pads set directly on undisturbed native soil or fill compacted to same density as undisturbed earth.

8. Horizontal Piping (suspended):
  - a. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
  - b. Cast iron soil pipe - Where joints occur, suspended cast iron soil pipe shall be supported at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length, may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen (18) inches of the hub or joint. Hubless or compression gasket joints must be supported at least at every other joint except that when the developed length between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection. Supports shall be placed on or immediately adjacent to the coupling. Suspended lines shall be suitably braced to prevent horizontal movement.
  - c. Threaded pipe - Threaded pipe (IPS), shall be supported in accordance with Section 230529.
  - d. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
  - e. For pipe sizes greater than 4 inches, axial restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.
9. The waste connections between fixtures and their respective collection and venting systems shall consist of galvanized steel nipples and cast iron drainage fittings.
10. All interior waste, soil, and vent piping up to 1-1/2" shall consist of galvanized steel with cast iron drainage fittings, all piping 1-1/2" and over shall consist of S.V. cast iron soil pipe and fittings.
11. All pipe and fittings shall have affixed thereon the CISPI grade mark of identification.
12. All vents shall be installed through the roof of at least the minimum size as required by jurisdictional code and shall be cast iron.
13. All vents protruding through the roof shall be not less than 2" size and extended to not less than 12 inches above the finished roof. Vents through built-up roofing shall be flashed with 24" x 24" x 4 lb. sheet lead. The flashing shall extend to top of vent and the edges turned down into a cast iron vent pipe. Single ply rubberized roofing systems shall be flashed around vent with top edge of roofing clamped to vent pipe and sealed with compatible sealant.
14. All vents shall be located in accordance with jurisdictional code and in no case less than two (2) feet from roof edge or parapet, or wall line of an "on the roof structure". Vent terminations shall not occur within twenty-five (25) feet of any outside air intake.
15. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 230548) and jurisdictional authority.

### 3.4 PROHIBITED PIPE ROUTING

- A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall not be routed through or above the following locations:
  - 1. Electrical panel rooms
  - 2. Electrical switch gear rooms
  - 3. Electrical transformer rooms
  - 4. Elevator shafts
  - 5. Elevator equipment rooms
  - 6. Data Centers
  - 7. File Server Rooms / MDF / IDF
- B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

### 3.5 COPPER DRAIN, WASTE AND VENT TUBE

- A. All soil and waste lines below ground floor or buried below grade shall be SV cast iron pipe and fittings with gasketed joints.
- B. Vents shall be type DWV or L copper with cast copper or brass drainage pattern fittings and shall terminate at least 12" above the finished roof construction, and flashed with self sealing neoprene boots with integral lead or copper flashing pans.
- C. Bushings for soil, waste, drainage, or vent lines shall not be used.
- D. Provide 50-50 Class Sn Pb soldered joints.
- E. Support vertical soil, waste, drainage, stacks and vents from building structure with padded riser clamps, allow for adequate expansion of all copper piping.

### 3.6 PLASTIC DRAIN WASTE AND VENT PIPING

- A. Plastic piping shall be installed with caution towards expansion and contraction characteristics. The piping shall be free to flex and move without bindings. The pipe shall be securely anchored at the roof to prevent movement at the roof penetrations.
- B. Roof penetrations shall be made with self-sealing neoprene boots with integral lead or copper flashing pans.
- C. Provide solvent weld joints.
- D. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

- E. Support vertical soil, waste, drainage stacks and vents from building structure with padded riser clamps.

### 3.7 TESTING

#### A. Schedule of Testing:

Service	Allowable Test Methods				Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
	H <sub>2</sub> O	CA	N <sub>2</sub>	V			
1. Potable Water Pipe Valves & Fittings	X	X			125 100	60 60	-0- +1/2
2. Sanitary, Storm & Acid Waste and Vent System:							
*Stack Height:							
0-23 FT.	X				10	30	-0-
24-34 FT.	X				15	30	-0-
35-46 FT.	X				20	20	-0-
47-57 FT.	X				25	20	-0-
58-69 FT.	X				30	10	-0-
70-80 FT.	X				35	10	-0-
81-92 FT.	X				40	10	-0-
93-103 FT.	X				45	10	-0-
Over 104 FT.	X				50	10	-0-

- B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N<sub>2</sub> and vacuum testing can be made from connections anywhere in the system tested.
- C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.
- D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made. The General Contractor/Construction Manager shall witness and SIGN the required test form.
- E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.
- F. Proper restraining of piping and test plugs shall be accomplished prior to test.

END OF SECTION 221410

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## SECTION 221411 - DISINFECTING WATER SUPPLY SYSTEM

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Disinfection of Domestic Water Supply System.

#### 1.2 RELATED WORK

- A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.
- B. Section 230500 - Basic Mechanical Requirements.
- C. Section 221410 - Plumbing Piping.

#### 1.3 DEFINITIONS

- A. Disinfectant residual means the quantity of disinfectant in treated water.
- B. pH factor means the measure of alkalinity and acidity in water.
- C. ppm means parts per million.

#### 1.4 CONTRACTOR'S QUALIFICATIONS

- A. Water Treatment Contractor: At least three years experience performing work specified herein.
- B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

#### 1.5 REGULATORY AGENCY REQUIREMENTS

- A. Comply with requirements of Local and State Regulations.

#### 1.6 SUBMITTALS

- A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:
  - 1. Water treatment contractor's evidence of experience.

2. Bacteriological laboratory's evidence of certification.
- B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:
1. Disinfection Report:
    - a. Include the following:
      - Date issued.
      - Project name and location.
      - Treatment Contractor's name, address, and phone number.
      - Type and form of disinfectant used.
      - Time and date of disinfectant injection start.
      - Time and date of disinfectant injection completion.
      - Test locations.
      - Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
      - Time and date of flushing start.
      - Time and date of flushing completion.
      - Disinfectant residual after flushing in ppm for each outlet tested.



2. Bacteriological Report:

a. Include the following:

Date issued.

Project name and location.

Laboratory's name, certification number, address and phone number.

Time and date of water sample collection.

Name of person collecting samples.

Test locations.

Time and date of laboratory test start.

Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.

Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect against damage and discoloration.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg.F and 80 deg.F.
- D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

1.8 PROTECTING WORK OF OTHER TRADES

- A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.
- B. Protect against damage and discoloration caused by work of this Section.

## PART 2 - PRODUCTS

### 2.1 DISINFECTANT

- A. Free chlorine; liquid, powder, tablet, or gas.

### 2.2 ALKALI

- A. Caustic Soda or Soda Ash.

### 2.3 ACID

- A. Hydrochloric type.

## PART 3 - EXECUTION

### 3.1 EXISTING CONDITIONS

- A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.
- B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.
- C. Do not start work until conditions are satisfactory.

### 3.2 PREPARATION OF WATER FOR TREATMENT

- A. Verify pH factor of water to be treated.
- B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.
- C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

### 3.3 SYSTEM TREATMENT

- A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.
- B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

- C. Test for disinfectant residual at each of the following locations:
  - 1. Ends of piping runs.
  - 2. Remote outlets. (Ends of each multiple fixture branch line)
  - 3. Tanks and domestic water heaters.
  - 4. At least 15% of outlets on each floor as directed by Architect/Engineer.
- D. Maintain disinfectant in system for 24 hours.
- E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

### 3.4 FLUSHING

- A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

### 3.5 BACTERIOLOGICAL TEST

- A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.
- B. Take water samples at each of the following locations:
  - 1. Where water enters system.
  - 2. Ends of piping runs.
  - 3. Remote outlets.
  - 4. Tanks.
  - 5. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.
- C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.
- D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

### 3.6 PRODUCT CLEANING & REPAIRING

- A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.
- B. Remove debris from Project Site upon work completion or sooner, if directed.

END OF SECTION 221411

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## SECTION 221430 - PLUMBING SPECIALTIES

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Drains and drainage products.
- B. Downspout nozzle.
- C. Storm drain expansion joints.
- D. Cleanouts.
- E. Safe pans and drain flashings.
- F. Sillcocks, yard hydrants, hose bibbs and hose stations.
- G. Pressure gauges, thermometers, and test plugs.
- H. Shock arrestors.
- I. Backflow preventers.
- J. Pressure reducing valves.
- K. Pressure and temperature relief valves.
- L. Trap chargers and accessories.

## 1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish electrical outlets installed in Washer Wall Box for Division 26 power wiring installation.

## 1.3 RELATED WORK

- A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.
- B. Section 230500 - Basic Mechanical Requirements.
- C. Section 230529 - Basic Mechanical Materials and Methods.

#### 1.4 SUBMITTALS

- A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:
1. Floor Drains (FD)
  2. Floor Sinks (FS)
  3. Roof Drains (RD)
  4. Overflow Drains (OD)
  5. Downspout Nozzles (DSN)
  6. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
  7. Hose bibbs (HB) and Hose Stations (HV)
  8. Pressure gauges (PG)
  9. Thermometers (T)
  10. Shock Arrestors (SA)
  11. Backflow Preventer (BP)
  12. Pressure Reducing Valve (PRV)
  13. Trap Primers (TP)
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:
1. Backflow Preventer (BP)
  2. Pressure Reducing Valve (PRV)

#### 1.5 WARRANTIES

- A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Where acceptable manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, function, and appearance to the manufacturer listed as the base manufacturer in the specification body or drawing schedules. Deviations of any type will not be acceptable.
- B. Where other acceptable manufacturers are not listed, only the base manufacturer will be accepted.
- C. All items of like nomenclature shall be supplied by one manufacturer only.

**2.2 FLOOR DRAINS (FD)**

- A. Acceptable manufacturers: Wade series 1100, JR Smith series 2005, Josam series 30000, Zurn series Z-415, Watts FD-100 series, MIFAB series F-1100.

- B. Schedule: See Schedule on Drawings.

Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

Note 2: Finished areas, showers, toilets, etc.

**2.3 FLOOR DRAINS, HEAVY DUTY**

- A. Acceptable manufacturers: Wade series 1240, JR Smith series 2330, Josam series 31200, Zurn series Z-512, Watts FD-340 series, MIFAB series F-1340C.

- B. Schedule: See Schedule on Drawings.

Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

Note 2: Mechanical equipment rooms, shops, etc.

**2.4 FLOOR SINKS (FS)**

- A. Acceptable manufacturers: Wade series 9110/9140, JR Smith series 3100/3150, Josam series 49000/49040, Zurn series Z-1900/Z-1910, Watts FD-860 series, MIFAB series FS-1520/FS-1730.

- B. Schedule: See Schedule on Drawings.

Note 1: Provide full grate unless otherwise noted, provide 1/2 or 3/4 grate where indicated on Drawings.

Note 2: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

Note 3: Indirect waste for kitchen, laundry, etc.

Note 4: Indirect waste and floor drainage for mechanical equipment rooms.

Note 5: Indirect waste for icemakers, sterilizers, etc.

**2.5 ROOF DRAINS**

- A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200.

- B. Schedule: See Schedule on Drawings.

## 2.6 OVERFLOW DRAIN

- A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200-R.
- B. Schedule: See Schedule on Drawings.

Note 1: Provide overflow drains with 2" high stand pipe or dam as appropriate for the style of drain furnished.

## 2.7 DOWNSPOUT NOZZLES

- A. Acceptable manufacturers: Wade series 3940, JR Smith series 1770, Josam series 25010, Zurn series Z-199, Watts RD-940 series, MIFAB series R-1940.
- B. Schedule: See Schedule on Drawings.

## 2.8 EXPANSION JOINTS

- A. Acceptable manufacturers: Wade series 3900, JR Smith series 1710, Josam series 26200, Zurn series Z-190, Watts RD-900 series, Metraflex, MIFAB series R-1900, Hyspan.
- B. Schedule:

Plan Code	EJ
Material	Cast Iron
Sleeve	Bronze/Brass
Gasket	Neoprene or Graphite
Size	2"-10"

## 2.9 FLOOR CLEANOUTS

- A. Acceptable manufacturers: Wade series 6000, JR Smith series 4020/4100/4200, Josam series 56000, Zurn series Z-1400, Watts CO-200-R/200-RX/200-US series, MIFAB series C1100-R/C1100-XR/C1100-UR.
- B. Cast iron adjustable body, ABS plug.
1. Provide flange and flashing clamp for Cleanouts in areas with waterproof membrane and all cleanouts above slab-on-grade.
  2. Provide nickel bronze top to match floor finish as indicated in the Architectural finish schedule. Provide heavy duty nickel bronze top for cleanouts in storage rooms, kitchens, and similar areas. Provide heavy duty cast iron or ductile iron top for cleanouts in equipment rooms, traffic areas, parking areas, and similar unfinished areas.



## 2.10 WALL CLEANOUTS

- A. Acceptable manufacturers: Wade series 8560 with 8480R, JR Smith series 4530, Josam series 58790, Zurn series 1446, Watts CO-460-RD series, MIFAB series C-1460.
- B. Cast iron clean out tee, ABS plug, stainless steel cover with screw.

## 2.11 GRADE CLEANOUTS

- A. Acceptable manufacturers: Wade series 8300 MF with 6000 spigot outlet, JR Smith series 4250, Josam series 58850, Zurn series Z-1474 with Z-1449, Watts CO-300 series, MIFAB series C-1300.
- B. Heavy duty cast iron clean out housing, heavy duty cast iron or ductile iron cover, cast iron ferrule, ABS plug, vandal proof security screws.
  - 1. Provide piping system identification cast into cover; "SAN" for sanitary waste cleanouts, "STORM" for storm drainage cleanouts.

## 2.12 VENT CAPS

- A. Acceptable manufacturers: JR Smith series 1748, Josam series 26700, Zurn series Z-193, Watts RD-680 series, MIFAB series R-1930.
- B. Cast iron body and dome, vandal proof screws.

## 2.13 SAFE PANS AND DRAIN FLASHINGS

- A. Provide one of following systems:
  - 1. #24 B&S gauge (0.021") minimum sheet copper with 15 lb. asphaltic felt sub pan (underliner).
  - 2. 0.040" non-plasticized chlorinated polyethylene sheet with 30 lb. felt underliner.
  - 3. 3 ply 15 mil polyvinylchloride sheet with 30 lb. felt underliner.

## 2.14 WATER HEATER SAFETY PAN (WHSP)

- A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater on all sides and minimum 1-1/2" deep with side or bottom drain fitting on electric water heaters installed under counters or on wood flooring.
- B. Provide Ruud Mfg. Co. "Heater Pan", Canplas or equivalent spun aluminum pan 2" larger than heater on all sides and minimum 1-1/2" deep with side or bottom drain fitting on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

- C. For installations suspended above the floor, provide Holdrite Quickstand or equivalent suspended equipment platform and drain pan, made of galvanized steel with welded drain fitting. Pan walls minimum 2-1/2" deep. Included Allthread attachment points for suspending from overhead structure, or wall mount hardware as appropriate.

## 2.15 SILLCOCK, EXPOSED, NON-FREEZE

- A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71050, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.
- B. Schedule: See Schedule on Drawings.

## 2.16 HOSE BIBBS

- A. Acceptable manufacturers: As listed in schedule.
- B. Schedule: See Schedule on Drawings.

Note 1: Toilet rooms, Janitor's mop station, etc.

Note 2: Finished areas.

Note 3: Equipment rooms, unfinished areas.

## 2.17 STATIONARY PRESSURE GAUGES

- A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments.
- B. Schedule:

Type	4-1/2" Dial
Bourbon Tube/Socket	Stainless Steel Tube 316 Stainless Steel Socket
Accuracy	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast Aluminum
Window	Clear Glass
Snubber	Yes
Coil Syphon	For Steam Service
Gauge Cock	Yes
Set Hand	No
Silicone Filled	No
Weatherproof	No

- C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems.

- Domestic Water 0 to +160 psi

## 2.18 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Terrice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Type	Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic
Tube	Lens front, magnifying
Stem	Aluminum, insertable
Separable Socket	Brass
Fill Type	Spirit: Blue colored, organic

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

- |    |                     |              |
|----|---------------------|--------------|
| 1. | Domestic cold water | 0 to 100 °F  |
| 2. | Domestic hot water  | 30 to 240 °F |

## 2.19 SHOCK ARRESTORS FOR WATER (SA)

A. Manufacturer: Precision Plumbing Products Co., Wade Shokstop, J.R. Smith series 5000, Josam series 75000, Zurn Z-1700, Watts SS series.

B. Schedule:

"P.D.I." SIZE	FIXTURE UNITS
A	1-11
B	12-32
C	33-60
D	61-113
E	114-154
F	155-330

## 2.20 REDUCED PRESSURE BACKFLOW PREVENTER

A. Acceptable manufacturers: Conbraco Series 40-200, Watts series 009 and 909, Febco series 825Y, Hersey series FRP-II.

B. Bronze body, independent spring loaded check valves, diaphragm type differential pressure relief valve, shut-off ball valves, strainer, test cocks. Suitable for water temperature range of 33-140 °F.

- C. Approved under ASSE 1013 and AWWA C511.
- D. Backflow preventer test kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions, in a corrosion resistant carrying case.

## 2.21 PRESSURE REDUCING VALVE (PRV)

- A. Acceptable manufacturers: Watts series LF223, Conbraco, Hoffman.
- B. 300 psi bronze body, replaceable seat, strainer, adjustable outlet pressure, thermal expansion by-pass. Suitable for water temperature up to 160 °F.
- C. Approved under ASSE 1003 and IAPMO.

## 2.22 TEMPERATURE AND PRESSURE RELIEF VALVES (T&P)

- A. Acceptable Manufacturers: Kunkle, Watts, Conbraco, McDonnell and Miller.
- B. Schedule:

TYPES	SIZE	MAKE	MODEL	SERVICE	MAX PRESS	ASME MAX TEMP	ASME RATING BTUH MAXIMUM
T & P	3/4"	Kunkle	137	Water Pressure Vessel	125 psig	250 F	2,230,000
Press	3/4"	Kunkle	84-45	Air	125 psig	300 F	NA
Vac	3/4"	Kunkle	80-45	Vacuum	15" Hg	300 F	NA
T & P	3/4"	Watts	40XL8	Water Heater	125 psig	210 F	777,600

## 2.23 TRAP CHARGERS AND ACCESSORIES (NO PLAN CODE)

- A. Barrier Type Floor Drain Trap Seal:
  - 1. Meet ASSE Standard 1072.
  - 2. Approved Manufacturers: Sure-Seal Manufacturing or approved equal.

## PART 3 - EXECUTION

## 3.1 DRAINS

- A. Coordinate drain placement with Contractor for Division 3 - Concrete.
- B. Drain, strainer, and grate finishes shall be as specified, cover all finished surfaces during construction to prevent damage.
- C. Install drains with "P" pattern traps and vents as required.
- D. All drain bodies shall be plugged during construction to prevent foreign objects, dirt, concrete, etc. from entering the drain and drainage piping.
- E. Planter drains shall not receive domes until final landscaping is accomplished. Provide closure plugs until landscaping and dome installation is furnished.
- F. Drains shall be set flush and level with finished surfaces, with grate pattern parallel or perpendicular to adjacent walls or floor patterns.
- G. Flash all drains on roofs, upper floors, and floor over crawl spaces with 24"x24" minimum flashing pans. Shower pans shall be turned up in walls to a minimum of 6" above the shower receptor threshold.
- H. Clean and polish all drain bowls, rims, strainers, and grates prior to final inspection.

## 3.2 CLEANOUTS

- A. Provide cleanouts in waste, soil, and storm piping at each change in direction greater than 45°, as required by Jurisdictional Code.
- B. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, and at each base of waste, soil or storm pipe stack or drop, 100 feet on center for all exterior sanitary and storm piping or as required by jurisdictional code.
- C. Provide appropriate access tops for imposed construction.
- D. Coordinate interior floor cleanout locations with contractor for Division 3 - Concrete.
- E. Cleanouts to be provided with ABS or Delrin plugs. Lead sealed, brass, or cast iron plugs will not be acceptable unless specifically required by jurisdictional code authority.
- F. Provide 24"x24" minimum flashing pans and clamp devices for all cleanouts located on upper floors or floors over crawl spaces.
- G. Where cleanout arms extend horizontally and/or vertically more than 15 feet from the sewer main which they are serving, provide 2" minimum vent off the end of the arm and connect to the building vent system.

- H. Clean and polish all cleanout access covers prior to final inspection.
- I. Cleanout access covers shall be flush and level with finished building surfaces.
- J. Install cleanout plugs on exposed or accessible piping. Plugs shall be line size up to 3" and over 8", 4" plugs for sizes 4" thru 8".
- K. Provide wall cleanouts where piping is concealed in walls or non-accessible chases, use tapped cleanout tee or tapped extension to within 4" of wall face. Do not use no-hub type blind plugs for wall cleanouts.
- L. Provide 12"x12"x8" thick 3000 lb. concrete pads for all grade cleanouts. Concrete shall be in accordance with Division 3 - Concrete. Tops of pads to be 1" above finish grade and cleanout access flush and level and centered in pad surface.

### 3.3 DOWNSPOUT NOZZLES (DSN)

- A. Terminate storm and overflow drains into full size nickel bronze downspout nozzles, seal annular space between wall opening and pipe with silicone seal, anchor nozzle wall flange with three 1/4" flat head machine bolts and lead expanders. Set DSN a minimum of 6" and a maximum of 12" above the splash block surface, unless otherwise noted.
- B. Install drain pipe to thread adaptors and threaded galvanized schedule 40 nipples or short pipe through exterior wall for threading on the DSN. T.O.E. nipples or short pipe may be used for "NO-HUB" system where galvanized and drain pipe are joined by an approved No Hub coupling adaptor. Anchor pipe to building immediately downstream of adaptor.
- C. Coordinate required location of standard splash blocks at all DSN locations for Construction Manager/General Contractor.

### 3.4 STORM DRAIN EXPANSION JOINTS (EJ)

- A. Install vertical expansion joints at the roof drain outlet for all drains having straight vertical run directly from the drain of 10 feet or more.
- B. Install special horizontal expansion joints at center of runs for horizontal storm piping having one hundred feet of straight run. Anchor ends of run. Provide expansion joints where storm drains cross a building expansion joint. Anchor both sides of building joint or provide adequate swing joints with appropriate anchors.

### 3.5 SANITARY VENT CAPS

- A. Install where shown on drawings, vandal resistant vent caps a minimum of 14" above the roof surface.
- B. Provide 24"x24"x4 lb. sheet lead flashing up 12" above roof to vent flashing collar.
- C. Secure dome and entire assembly tight to pipe.

## 3.6 SAFE PANS AND DRAIN FLASHINGS (no plan code)

- A. Provide safe pans for all shower bases, shower rooms, wet rooms and kitchen areas. Pans shall extend wall to wall and turn up at least 6" above finish floor level or receptor rims into wall construction. Pans shall be laid over non-puncturing base such as heavy asphaltic felt, fine sand that bears no silica, or other acceptable material.
- B. All drains on upper floors or over crawl spaces shall be flashed with flashing extending a minimum of 12" beyond the drain top dimensions.
- C. Seams to be folded and shaped as required:
  - 1. Solder lead seams.
  - 2. Solder sheet copper seams with 50/50 (50% tin, 50% lead) or 45/55 (45% tin, 55% lead) commercial grade solder.
  - 3. Solvent weld PVC and un-plasticized chlorinated polyethylene seams.

## 3.7 WATER HEATER SAFETY PAN (WHSP)

- A. Install safety pans for all electric water heaters installed above ceilings, under counters or on wood flooring. Route drain to floor sink/drain with indirect connection.
- B. Install safety pans for all gas fired water heaters installed on combustible foundations or where leakage will cause damage. Route drain to floor sink/drain with indirect connection.
- C. Provide structural supports, air gapped pan drains, drain extensions and pan drain connections as required.

## 3.8 SILLCOCKS (SC)

- A. Provide sillcocks at 100 feet maximum spacing around building perimeter, and at other locations shown on Drawings.
- B. Provide all sillcocks with accessible stop and drain valves in heated areas, provide access panels where required.
- C. Provide flush or surface mounting, square and plumb to building walls, with supply tube pitched for complete drainout.
- D. Anchor all sillcocks with anchor flange provided by manufacturer.
- E. Caulk annular space between walls and sillcock and sillcock piping with non-hardening silicone base sealant.
- F. Mount sillcocks at 24" above finished grade or surfacing.

- G. Where mounting heights other than 24" are shown on the Drawings, the Drawings shall supercede the Specifications.
- H. Vacuum breakers to be non-removable.
- I. Clean all surfaces including faceplate, box, access door, cam lock and interior of box prior to final inspection.
- J. Sillcocks shall not be operated by hand tools, provide 2 keys per sillcock. Units found to be marred due to hand tool operation or other causes, shall be replaced at no increase to the Contract Sum.
- K. Clean and polish entire sillcock prior to final inspection.

### 3.9 HOSE BIBBS (HB)

- A. Provide hose bibbs in each equipment room, toilet room and kitchen area equipped with floor drainage systems and where shown on drawings, maximum spacing shall accommodate 50 feet of hose to any point within the drainage area measured around obstructions and equipment, in lieu of straight line measurement. Hose bibbs in toilet rooms mounted under standard lavatory, do not install near ADA lavatory where it could impede access.
- B. Anchor hose bibb within wall for rigid flush flange mounting.
- C. Install bibb true and plumb with wall flange flush to surface, caulk annular space between wall and flange.
- D. Mounting height to be 18" above floor in toilet rooms and immediately under furthest lavatory from entry, 60" above floor in equipment rooms or as shown on drawings.
- E. Hose bibbs shall not be operated with hand tools, use only tee handle, furnish one tee handle per bibb. Units found marred due to hand tool operation or other causes will be replaced at Contractors expense.
- F. Clean and polish hose bibbs prior to final inspection.

### 3.10 STATIONARY PRESSURE GAUGES (PG)

- A. Provide gauges for steam, water, air and vacuum systems, complete with gauge cocks and snubbers, where required by Drawings.
- B. Install in semi or upright position, tilted so as to be readable from floor level.
- C. Clean gauge, and glass, and calibrate by test prior to final inspection.



## 3.11 STATIONARY THERMOMETERS (T)

- A. Install thermometers where indicated on Drawings in upright position with case tilted to be readable from floor level.
- B. Clean case and glass prior to final inspection.

## 3.12 TEMPERATURE AND PRESSURE PLUGS (T&amp;PTP)

- A. Provide plugs where periodic temperature and/or pressure indication is required as shown on drawings. Provide 1/4" MPT tapping, cap and seal for plug and extension for insulated pipe as applicable.

## 3.13 SHOCK ARRESTORS FOR WATER (SA)

- A. Provide shock arrestors in accordance with Plumbing Drainage Institute (PDI) Standard WH-201 and as shown on drawings.
- B. Provide 8"x8" minimum access panels centered on each shock arrestor that is otherwise inaccessible.
- C. Shock arrestors shall be mounted as close to the line or quick closing valve as possible. Remote mounting or excessive (over 6") nipple mounting will not be acceptable.
- D. Provide ball valve at each shock arrestor to allow units to be easily removed/replaced.
- E. Each shock absorber piston shall be exercised at least once prior to final installation. (Physically move the piston up into chamber from throat of unit. Use wooden push rod only in the performance of this exercise.)

## 3.14 REDUCED PRESSURE BACKFLOW PREVENTER (BP)

- A. Provide reduced pressure type backflow preventers on all connections between the domestic water system and make-up supplies to any non potable system, i.e.: Heating, Boilers, Cooling Towers, Chiller, Evaporative Coolers, and the like.
- B. Anchor backflow preventer in place.
- C. Clean and test assembly in place in accordance with State Health Code.
- D. Provide funnels and attach to unit per manufacturers instructions, in true, level and plumb position.
- E. Provide IPS to solder adaptor to funnel outlet and run type M copper tubing in an unobtrusive manner routed to an approved drain receptor.
- F. Hang and anchor drain tubing so as to be rigid and stable.

- G. Permanently affix drain outlet at drain receptor so as to be rigid and unmovable.

### 3.15 PRESSURE REDUCING VALVE (PRV)

- A. Provide unistrut or similar frame for mounting all components of the pressure reducing valve station.
- B. Arrangement shall be as shown on Drawings including by-pass.
- C. Provide drain valves both sides of station on headers on low points.
- D. Provide unions, strainer, valves, petcocks, gauges, straps and other accessories as detailed on Drawings.
- E. Set each pressure reducing valve using full system pressure and flow individually to outlet pressures specified.
- F. All gauges shall be installed to be readable from floor level. Provide petcocks on each gauge connection.

### 3.16 TEMPERATURE AND PRESSURE RELIEF VALVES (T & P)

- A. Provide temperature and pressure relief valves, with full size drains extended and air gapped to floor drains or approved receptor. Provide relief valves on all water heaters, pressure vessels and closed piping systems.

### 3.17 TRAP CHARGERS AND ACCESSORIES

- A. Provide trap primer valve, gooseneck connection, distribution boxes, distribution tubing, air gap or vacuum breaker, extension drains, and pattern traps with charger connections for all emergency floor drains.
- B. Support and brace charger, distribution boxes, piping and connections as appropriate.

END OF SECTION 221430

## SECTION 224440 - PLUMBING FIXTURES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Plumbing Fixtures and Trim.
- B. Plumbing Fixture Accessories.

## 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500 - Basic Mechanical Requirements.

## 1.3 RELATED SECTIONS

- A. Section 221410 - Plumbing Piping.
- B. Section 221430 - Plumbing Specialties.
- C. Section 224450 - Plumbing Equipment.
- D. Section 224460 - Special Plumbing Equipment Systems.
- E. Section 230529 - Basic Mechanical Materials and Methods.

## 1.4 REFERENCES

- A. Comply with the applicable provisions and recommendations of the following:
  - 1. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
  - 2. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
  - 3. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.

## 1.5 SYSTEM DESCRIPTION

- A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

## 1.6 QUALITY ASSURANCE

## A. Qualification:

1. Provide fixtures trim and specialties in accordance with style, type, quality and function as established by the named manufacturer and model specified for each item.
2. Provide all installations in accordance with jurisdictional code and health authorities standards, restrictions and recommendations.
3. Provide all fixtures and trim using a single manufacturer where possible, deviation will be allowed only where specifications indicate otherwise.

## 1.7 SUBMITTALS

## A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures
2. Carriers
3. P-Traps
4. Disposers
5. Faucets, valves, cocks, supplies and stops.
6. Finishes, material and colors.
7. Fixture specialties

## B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Flush Valves and Faucets.
2. Disposers

## 1.8 WARRANTIES

## A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

## PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

- A. Cast iron and vitreous china: Kohler - Eljer - American Standard – Crane - Zurn – Toto - Mansfield.
- B. Stainless steel sink 302 18 gauge minimum: Elkay - Just - Haws - Kohler.
- C. Molded Stone: Fiat - Florestone - Stern Williams - E.L. Mustee.

- D. Terrazzo: Fiat - Florestone - Stern Williams - Bradley.
- E. Low Flow Urinals: Sloan – Zurn – Toto – Kohler - Mansfield.
- F. Electric Water Coolers: Elkay - Halsey Taylor - Cordley - Haws - Sunroc - Filtrine - Oasis - Acorn.
- G. Water Mixing Valves Thermostatic, or Pressure Balanced: Leonard - Symmons - Kohler - Powers - Lawler – Bradley – Watts – Armstrong International - Delta.
- H. Flush Valves: Sloan Royal - Delany Flushboy – Zurn - Aquaflush – Toto – Moen (hands free) - Speakman.
  - 1. All flush valves require ‘dirt grabber’ flush valve filter field installed. See paragraph 2.23 in this section.
- P. Toilet Seats: Comfort Seats – Bemis - Beneke - Sperzel - Church.
- Q. Garbage Disposers: Waste King - Insinkerator - Big Genie.
- R. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman - McGuire – Zurn - Delta.
- S. Chair Carriers: Josam - J.R. Smith - Zurn - Wade – Mifab - Watts.
- T. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Moen - Symmons - Speakman - T&S Brass – Zurn - Watts.
- U. Sensor Faucets: Sloan – Zurn – Toto - Moen - Speakman - Bradley - T&S Brass – Delta – Chicago Faucets - Symmons.

## 2.2 WATER CLOSETS

- A. Wall Hung, Siphon Jet, Valve Operated, Water Saver, 5" rough with open front seat: See Schedule on Drawings.

## 2.3 LAVATORIES

- A. Wall Hung, Vitreous China, Carrier Mounted: See Schedule on Drawings.
- B. Counter Top Mounted Oval: See Schedule on Drawings.
- C. Counter Top Mounted Round: See Schedule on Drawings.
- D. Counter Top Mounted (Under Counter Mtd. Oval): See Schedule on Drawings.

## 2.4 LOW FLOW URINALS

- A. See Schedule on Drawings.

## 2.5 SERVICE SINKS

- A. Molded Stone: See Schedule on Drawings.

## 2.6 ELECTRIC WATER COOLERS

- A. Wall Hung, Carrier Mounted, Two Level: See Schedule on Drawings.

## 2.7 SINKS

- A. Stainless Steel, Self Rim: See Schedule on Drawings.

## 2.8 GARBAGE DISPOSAL UNITS

- A. Continuous Feed Type w/Overload Protection: See Schedule on Drawings.

## 2.9 MASTER THERMOSTATIC MIXING VALVES

- A. Cabinet mounted and exposed type master mixing valves: adjustable setpoint, thermostatic type, adjustable limit stops, ball valve shut-offs, inlet checkstops, outlet thermometer. Provide recessed locking stainless steel cabinet where indicated.
- B. Provide valves of sizes and capacities scheduled on Drawings. Provide high-low manifold type where specified and where required to meet specified range of flow.
- C. Leonard Type TM, Symmons Series 5, Bradley.

## 2.10 LAVATORY THERMOSTATIC MIXING VALVES

- A. Adjustable high temperature limit stop (factory set for 110°F), thermostatic type, inlet checkstops. Provide recessed locking stainless steel cabinet where indicated.
- B. Provide valves of sizes and capacities scheduled on Drawings.
- C. Models:
  - 1. Exposed: Leonard 210-SB, Symmons Series 5.
  - 2. S.S. Cabinet: Leonard TA-254-STSTL, Symmons Series 5B., Bradley.

## 2.11 FIXTURE SUPPLIES &amp; STOPS

## A. Schedule:

Sink & Lavatory Supplies: (1/4 turn chrome ball valve, stainless steel braided tube, 1/2" x 3/8")

(L.K. Stops, 12" Riser, 1/2 x 3/8)

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912	1694 LK	7824-2LK	2712 KCW	BV8940LK

DF & Lavatory Supplies: (W.H. Stops, 12" Riser, 1/2" x 3/8")

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912	1694	7824-2	2712 SCW	BV8940LK

Sink Supplies: (L.K. Stop, 20" Riser, 1/2" x 1/2")

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 3920	1666 or 1786	8135-2/8218-2	None	BV8940LK

Sink Supplies: (W.H. Stop, 20" Riser, 1/2" x 1/2")

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 3920A	1695 MOD	7816-2	None	BV8940LK

Water Closet Tank Supplies: (L.K.) Stop. 12" Riser, 1/2 x 3/8)

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912 DL	1770 LK	7925-2LK	3112 KCW	BV8940LK

Water Closet Tank Supplies: (W.H. Stop, 12" Riser, 1/2 x 3/8)

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912 DL	1170	7925-2	3112 SCW	BV8940LK

## 2.12 FLUSH VALVE FILTER 'DIRT GRABBER'

A. 'Dirt Grabber' Flush Valve Filter #SFDG1, South Fork Manufacturing Telephone (801) 953-3001.

## PART 3 - EXECUTION

## 3.1 INSPECTION

A. Examination: Examine the contract documents and provide all necessary attachments, accessories, support equipment and materials as necessary to fit allocated spaces.

### 3.2 PREPARATION

- A. Field Measurements: Verify all dimensions and installation requirements so that work can be accurately fitted to other construction and in accordance with the intent of the contract documents. Be responsible for accuracy of measurements and adequate space requirements for the precise fitting and assembly of finished work.

### 3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Water Closets:

1. Wall Mounted

- a. Closet carriers are to be rigidly anchored to the floor structure in accordance with manufactures installation instructions.
- b. Wall mounted water closets will be rigidly supported with brass mounting studs on a concealed metal carrier. Transmitting fixture weight loads to the fixture pipe connection or wall framing will not be acceptable.
- c. Water closets and trim shall be set level and plumb.
- d. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
- e. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the "open side" of the toilet stall (opposite of the grab bar side).

2. Floor Mounted

- a. Floor mounted water closet flanges are to be solidly anchored to the floor with lag screws, or bolts and expanders as appropriate for floor construction.
- b. Water closet bowls are to be rigidly anchored to the floor flanges.
- c. Provide fixture bolt caps to match fixture color for all exposed fixture bolts and nuts.
- d. Water closets and trim shall be set level and plumb. Insert copper shims under base of bowl if required to level unit.
- e. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
- f. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the "open side" of the toilet stall (opposite of the grab bar side).

3. Water Closet Supplies

- a. Supplies shall be roughed with "L" copper tube nipple through wall cut to exact length and finished with escutcheon, matching fixture trim finish.



## 4. Water Closet Seats

- a. Secure seats to water closets and adjust self-sustaining check hinge to hold the seat at any raised position. Removable bumpers shall match seat color and be secured.

## B. Lavatories:

## 1. Wall and Counter Mounted

- a. Wall mounted lavatory carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
- b. Carriers are to be furnished with a metal mounting plate and bearing plate or concealed arm carriers.
- c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection is not acceptable.
- d. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
- e. Carriers are to become part of the structure and the lavatories shall not exert any weight or stress on the interior wall.
- f. Lavatories and trim shall be set level and plumb.
- g. Spacing of lavatories shall be in accordance with contract documents and jurisdictional codes.

## C. Urinals:

## 1. Wall Mounted

- a. Wall mounted urinal carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
- b. Wall mounted urinals are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection will not be acceptable.
- c. Wood or metal mounting plates anchored to the wall framing or studs are not acceptable.
- d. Carriers are to become part of the structure and the urinals shall not exert any weight or stress on the interior wall.
- e. Urinals and trim shall be set level and plumb.
- f. Spacing of urinals shall be in accordance with contract documents and jurisdictional codes.
- g. Install urinals in accordance with manufacturers installation instructions.

## D. Service Sink:

- 1. Install service sink in accordance with manufacturers installation instructions.
- 2. Terrazzo service sinks shall be set on a minimum of 1/4" of silica free sand bedding shimmed with copper shims.

3. Wall mounted service sink trap standards are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
4. Install mop hangers over service sinks, on wall adjacent and perpendicular to faucet mounting, so mops drain into sink.
5. Install hose brackets and attach hoses to service sink faucets.
6. Service sinks and trim shall be set level and plumb.

E. Electric Water Cooler:

1. Wall Mounted
  - a. Electric water cooler carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
  - b. Wall mounted electric water coolers are to be supported by concealed metal carriers. Transmitting fixture weight load to the fixture pipe connection will not be acceptable.
  - c. Wood or metal mounting plates anchored to studs or wall framing will not be acceptable.
  - d. Carriers are to become part of the structure and the electric water coolers shall not exert any weight or stress on the interior wall.
2. Fully Recessed
  - a. Fully recessed electric water coolers shall be furnished with wall mounting boxes anchored to building construction. Electric water coolers shall be mounted flush to finished wall.

F. Sinks:

1. Each sink compartment shall be separately trapped and wasted to wall, continuous waste is not acceptable.
2. Undercounter dishwasher waste shall be provided with air gap fitting through sink backledge and waste to a dishwasher directional tee upstream of sink trap. Do not connect dishwasher to disposer tap inlet.
3. Furnish separate loose key angle or straight stops on dishwasher supplies.

G. Garbage Disposal Units:

1. Garbage disposal units are to be trapped separately from any other fixtures or sink compartments. Two inch minimum.
2. Sinks in which garbage disposers units are installed shall have a waste opening not less than 3-1/2 inches in diameter.

H. Master Thermostatic Mixing Valves:

1. Install master thermostatic mixing valves in accordance with manufacturers installation instructions. Limit maximum temperature to 110 deg. F. by setting temperature limit stop for handle.

## I. Fixture Supplies and Stops:

1. Provide fixture supplies and stops on every individual fixture or appliance.
2. Stops shall be compression by compression types with flexible straight copper tube risers, loose key or wheel handles stops. Provide one key per fixture for all loose key (L.K.) stops.
3. All components, stops, risers, inlet pipe and escutcheon shall be chrome plated brass, polished stainless steel, or special finish as specified for fixture trim.
4. Supplies and stops shall be anchored rigidly behind walls, eliminating push or pull movement.

## J. Escutcheon Plates:

1. Provide cast brass chrome plated single piece escutcheons for all penetrations of piping thru walls, floors, or ceilings in finished and unfinished areas.

## K. Faucets and Flushometers:

1. Faucets and flushometers shall be anchored rigidly behind walls, eliminating any push or pull movement.

## L. Caulking:

1. All wall and floor mounted fixtures shall be caulked with a non-hardening white or fixture color match for colored fixtures adhesive elastomeric sealant compound providing a watertight seal at the joint with the walls or floor.

## 3.4 ELECTRICAL COORDINATION

- A. Coordination of electrical service for all electric water coolers, garbage disposal units and whirlpool tubs will be the responsibility of the Division 23 Contractor in accordance with Section 230529.

## 3.5 FIXTURE CONNECTIONS

- A. Provide supply and waste connections for fixtures in accordance with the following table of minimum sizes or larger to accommodate horizontal fixture branches, as required by jurisdictional codes, or drawings.

Fixture Description:	Hot Water:	Cold Water:	Waste:	Vent:
Water Closet (WC)				
Flush Valve:	NA	1"	4"	2"
Water Closet (WC)				
Tank Operated:	NA	1/2"	4"	2"
Lavatory (L):	1/2"	1/2"	1-1/4"	1-1/4"
Urinal (U):				
Flush Valve:	NA	3/4"	2"	1-1/2"
Service Sinks (SS):	1/2"	1/2"	3"	1-1/2"
Sink (S):	1/2"	1/2"	1-1/2"	1-1/2"
Electric Water Cooler (EWC):	NA	1/2"	1-1/4"	1-1/4"

## 3.6 FAUCET OPERATING ROTATION

- A. Standard 2 handle faucets shall rotate as follows:
- Hot Water clockwise to "on", counter clockwise to "off".
  - Cold Water counter clockwise to "on", clockwise to "off".
- B. Wrist blade handle faucets:
- Initial setting at "off" (rest) position shall have handles parallel to the fixture apron or counter front.
  - Hot Water; Counter clockwise to full on (1/4 turn), clockwise to "off".
  - Cold Water; clockwise to full on (1/4 turn), counter clockwise to "off".

## 3.7 ADJUSTMENT AND CLEANING

- A. Adjustment: Adjust all flush valves, faucets, metering devices, shower heads, gas, air and vacuum cocks, and bubblers for proper flow and action after flushing operations are accomplished.
- B. Cleaning: Clean all fixtures, trim, accessories and attachments including strainers, traps, aerators, and valves.

## 3.8 FLUSH VALVE FILTER 'DIRT GRABBER'

- A. Plumbing Contractor shall install a SFDG1 'Dirt Grabber' Flush Valve Filter according to manufacturer's installation instructions in each urinal or toilet diaphragm-type flush valve manufactured by Sloan or Zurn prior to turning on water to the flush valve, but after water lines have been flushed and disinfected per the specifications.

All other flush valves must contain a filtering device similar to the 'Dirt Grabber' to protect the seating area from foreign debris which may enter the flush valve with the water. (The filtering media shall contain openings no larger than .0092" and consist of a minimum of 2-3/4 square inches of filtering material and shall not restrict water flow or result in a reduced volume of water per flush.)

NOTE: The SFDG1 'Dirt Grabber' Flush Valve Filter is manufactured by:

South Fork Manufacturing  
798 No. Sage Dr.  
Morgan, UT 84050  
Phone: 801-953-3001  
Fax: 801-829-4146

END OF SECTION 224440

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## SECTION 224450 - PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Water Heaters and Accessories

#### 1.2 RELATED WORK

- A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.
- B. Section 230500 - Basic Mechanical Requirements.
- C. Section 230529 - Basic Mechanical Materials and Methods.
- D. Section 230540 - Mechanical Sound and Vibration Control.
- E. Section 230548 - Mechanical Seismic Control.
- F. Section 221410 - Plumbing Piping.
- G. Section 221430 - Plumbing Specialties.

#### 1.3 SUBMITTALS

- A. Submit product specification data for the following items under provision of The General Conditions of the Contract:
  - 1. Water Heaters, Accessories and Controls.
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:
  - 1. Water Heaters and Accessories.

#### 1.4 WARRANTIES

- A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500.

## PART 2 - PRODUCTS

### 2.1 PRODUCT ACCEPTANCE

- A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.
- B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.
- C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

### 2.2 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

- A. Acceptable Manufacturers: International Technology Sales Corp. (trade name ITS), Chronomite Industries, Bradford White, Rinnai, Noritz, Takagi, Bosch, Stiebel Eltron.
- B. Warranty: 1 year full non-prorated for entire unit, including the element.
- C. Standard: UL 499 for electric, tankless water heating appliances.
- D. Construction: Copper piping or tubing complying with NSF 61, with ASME B 1.20.1 pipe thread connections, rated to 150 PSIG, flow control fitting, electric resistance heating element, high-temperature limit cutoff, and housed in an aluminum or steel jacket with enamel or plastic finish.
- E. Schedule: See Schedule on Drawings.
- F. Provide power cord; plug, mounting brackets, stops, and connection as required. Be responsible to coordinate with appropriate power supply receptacle provided by Division 26 Contractor.

### 2.3 DOMESTIC HOT WATER CIRCULATING PUMPS

- A. Acceptable Manufacturers:
  - 1. Taco
  - 2. Bell and Gossett
  - 3. Grundfos
  - 4. Armstrong
  - 5. Patterson



- B. Provide in-line type circulating pumps, all bronze construction, bronze face bracket, cast bronze one piece enclosed type impeller hydraulically and dynamically balanced, alloy steel shaft with cupro-nickel shaft sleeve, carbon/ceramic mechanical shaft seal, non-metallic noiseless coupler, resilient mounted dry proof motor with sleeve bearings and over load protection, pump bearing and seal assembly shall be replaceable cartridge design, one cartridge and seal to fit all pumps supplied, provide two extra cartridges and seals, oil level dip sticks (one for each pump), and oil drain plug, 125 psig @ 240 deg.F rating.
- C. Provide one contactor per pump to allow the 230900 controls system to start/stop each pump.
- D. Schedule: See Schedule on Drawings.

### PART 3 - EXECUTION

#### 3.1 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

- A. Attach firmly to structure, provide union connections and install per manufacturers, U.L., and jurisdictional authorities requirements and recommendations.
- B. Units shall be level, plumb and square.
- C. Provide unit isolation valves and unions.
- D. Provide factory trained technician for start up of all units.
- E. Coordinate electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

#### 3.2 DOMESTIC HOT WATER CIRCULATING PUMPS

- A. Coordinate contactor for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.
- B. Set pump level, plumb and square where indicated on contract documents on vertical pipe leg extended to and supported by floor, provide floor plate and capped leg at floor.
- C. Provide drain valve on pump support leg at 18" above floor.
- D. Anchor vertical pump leg pipe so as to prevent movement and vibration.

#### 3.3 THERMOSTATIC MIXING VALVE MANIFOLD

- A. Follow all manufacturer's installation recommendations.

- B. Adjust PRV settings and thermostatic valve settings so the factory assembly provides 110°F water to the plumbing fixtures it serves at all flow rates.
- C. Provide spring check valves in the cold water supply and hot water inlet ports of the factory assembly.

END OF SECTION 224450

## SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Basic requirements common to the work in general of Division 21/22/23 and other Divisions and Sections of the Specification where referenced.
- B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under Division 21/22 and other Sections of this Division 23.
- C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.
- D. Inspection: Inspect work preceding or interfacing with work of Division 21/22/23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.
- E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 21/22/23 work.

## 1.2 RELATED WORK

- A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

## 1.3 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

- A. Provide all building services extensions and connections to off-site and on-site utilities.
- B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 23 Contractor.
- C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Owner.
- D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.

- E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.
- F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 23 Contractor.
- G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.
- H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.
  - 1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
  - 2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

#### 1.4 REFERENCES

- A. General:
  - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
  - 2. The date of the standard is that in effect at the date of the Contract Documents, except when a specific date is specified.
  - 3. When required by individual Specification sections, obtain copy of standard. Maintain copy at job site during work until substantial completion.
- B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC	Air Diffusion Council 1000 E. Woodfield Rd. Schaumburg, IL 60173 <a href="http://www.flexibleduct.org">www.flexibleduct.org</a>
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AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 <a href="http://www.aga.org">www.aga.org</a>
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 <a href="http://www.amca.org">www.amca.org</a>
ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 <a href="http://www.ansi.org">www.ansi.org</a>
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 <a href="http://www.ari.org">www.ari.org</a>
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 <a href="http://www.ashrae.org">www.ashrae.org</a>
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 <a href="http://www.asme.org">www.asme.org</a>
ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 <a href="http://www.aspe.org">www.aspe.org</a>
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 <a href="http://www.asse-plumbing.org">www.asse-plumbing.org</a>
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428 <a href="http://www.astm.org">www.astm.org</a>

AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 <a href="http://www.aws.org">www.aws.org</a>
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 <a href="http://www.awwa.org">www.awwa.org</a>
CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 <a href="http://www.copper.org">www.copper.org</a>
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 <a href="http://www.cispi.org">www.cispi.org</a>
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 <a href="http://www.cti.org">www.cti.org</a>
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 <a href="http://www.intlcode.org">www.intlcode.org</a>
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 <a href="http://www.iapmo.org">www.iapmo.org</a>
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 <a href="http://www.nebb.org">www.nebb.org</a>
NEC	National Electric Code (of NFPA)

NEMA	National Electric Manufacturer's Association 1300 N. 17 <sup>th</sup> Street Rosslyn, VA 22209 <a href="http://www.nema.org">www.nema.org</a>
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 <a href="http://www.nfpa.org">www.nfpa.org</a>
NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 <a href="http://www.nsf.gov">www.nsf.gov</a>
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 <a href="http://www.osha.gov">www.osha.gov</a>
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 <a href="http://www.pdionline.org">www.pdionline.org</a>
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 <a href="http://www.smacna.org">www.smacna.org</a>
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 <a href="http://www.ul.com">www.ul.com</a>

## 1.5 DEFINITIONS

- A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

- B.     Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- C.     Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
- D.     Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- E.     Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- F.     General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.
- G.     Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

## 1.6     QUALITY ASSURANCE

- A.     Quality Control:
  - 1.     Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
  - 2.     Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
  - 3.     Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.



## B. Proof of Performance:

1. Division 23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.

## 1.7 REGULATORY REQUIREMENTS

- A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

- B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code  
International Plumbing Code  
International Fuel Gas Code  
International Energy Conservation Code  
State Department of Health Requirements  
State Energy Code  
National Fire Protection Association Standards  
International Fire Code  
International Building Code  
National Electrical Code NFPA-70  
State Boiler Code  
Jurisdictional County Health Department  
Jurisdictional City Wastewater Management Division or District  
Jurisdictional City Water Department  
Jurisdictional Water Conservation Standards

- C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.
- D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

## 1.8 SUBMITTALS

- A. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the 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. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.
- B. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder. In the event submittals are submitted in electronic format, the submittal shall be in the form of a single PDF file in which all equipment has been electronically bookmarked and all bookmarks have been identified using the equipment tags used on the drawings. Individual PDF files for separate pieces of equipment or specification sections will not be accepted.
- C. Test Reports: Submit certified test reports as required by various Sections of Division 23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.
- D. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.
- E. Submittals will be reviewed and marked as follows:
  - 1. No Exceptions Taken: No action required.
  - 2. Make Corrections Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to engineer.
  - 3. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to engineer.
  - 4. Submittal Not Requested: Submittal not required per specification. Submittal returned with no review.
- F. Note that the submittal review process does not relieve Contractor of responsibility for ensuring that submitted items satisfy all requirements of the Contract Documents.

## G. Site Condition and Coordination:

1. Before any ductwork is fabricated or equipment installed and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer 1/4" scale drawings of all mechanical rooms and main access walkways coordinated with all trades with submitted equipment and verify all other areas to assure himself that they can be run and installed as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work and maintain access walkways are clear for maintenance.

## 1.9 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.
- B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. NOTE: When alternate or substitute materials and equipment are used Division 23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 23 Contractor.

## 1.10 PROJECT RECORD DOCUMENTS

- A. General: Comply with Division 1.
- B. Job Site Documents: Maintain at the job site, one record copy of the following:
  1. Drawings
  2. Specifications
  3. Addenda
  4. Reviewed Product Submittals and Shop Drawings
  5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

- C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

- D. Record following information on Drawings:
1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
  2. Dimensioned location of internal utilities and appurtenances concealed in construction.
  3. Field changes of dimension and detail.
  4. Changes by change order or field order.
  5. Details not on original contract drawings.
  6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.
- E. Record the following information on Specifications:
1. Changes by change order or field order.
  2. Other matters not originally specified.
- F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.
- G. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

#### 1.11 OPERATING AND MAINTENANCE DATA

- A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of final reviewed submittals shall be included for all equipment items.
- B. Five sets of bound manuals will be required for this project. These are to be submitted for approval to the Project Manager. Five electronic versions of the manuals are also required, as described in Paragraph I below.
- C. Organization of the manuals shall follow the recommendations in ASHRAE Guideline current edition.
- D. Enclose the material in rigid 3-ring or metal post binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram or metal post binders or prior approved equal with block lettering. Simple binders with slide-in cover sheets are not acceptable. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches. The following information shall appear on the front cover and backbone:
1. "Operation and Maintenance Manual"
  2. Project Name (and volume number if more than one volume)
  3. Project number

4. Building name, number, and street address
5. Architect's name
6. Engineer's name
7. General Contractor's name
8. Mechanical Contractor's name

\* Items "5" through "8" need not be printed on the backbone.

- E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.
- F. The manual shall include the following:
1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
  2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown
  3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
  4. All test reports and proof of performance certificates.
  5. Manufacturer's data and instruction sheets for each piece of equipment, marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed on the project. These data sheet shall be accompanied by reviewed submittals that had no exceptions taken to them. Provide original printed material in each book, faxes are NOT acceptable. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
    - a. Installation instructions.
    - b. Drawings and specifications (final shop drawings).
    - c. Complete parts lists, and a source of supply for each piece of equipment, marked with model, size, and plan symbol.
    - d. A copy of the reviewed submittals for each piece of equipment, with any/all corrections identified during the submittal process made to the final submittal documents.
    - e. Performance curves and capacity data, marked with model number, size, and plan code.
    - f. Complete "as-builts" wiring and temperature control diagrams. (Shop drawings are not acceptable).
    - g. Lubrication and other preventative maintenance data.
    - h. Equipment warranties.
    - i. The final balance report.
  6. Design Intent Document furnished by Engineer.
  7. Include a Table of Contents and tabbed index dividers

- G. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
  2. Tag all valves per requirements in Section 230529.
  3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating valve ID number, location, service or function of each tagged item, and normal valve position. Insert a copy of tag list in each "Maintenance Manual". Also provide one copy of the list in a plastic closure as manufactured by Seton Name Plant Company, New Haven, Conn; or approved equal. The plastic closure shall include two holes punched at the top, with a brass or nickel grommet in each hole, and an 8" long length of nickel plated bead chain run through the holes, allowing the list to be hung from a wall peg.
  4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.
- H. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified
1. Submit training certificate to Owner's Representatives at end of training and have certificate signed to indicate adequate training has been received.
- I. Operating and Maintenance Data documents must be provided in digital format as follows:
1. Provide O&Ms in an intuitive format on a CD-ROM or DVD. Electronic manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete electronic operation and maintenance manual. Qualifications shall be submitted for approval. One source of procurement used on past projects is Emanuals by Scanitall in Sandy, UT (tel. 801-619-2082). This is the responsibility of the Division 21/22/23 contractor.
  2. A single CD or DVD to be authored with the latest edition of Adobe Acrobat, and be in a "non-protected" network accessible format.
  3. All information on the CD-ROM or DVD shall be printable on 8.5"x11" or 11"x17" plain paper.
  4. Capture images using OCR technology such that the user can key word search for information.
  5. Provide a hypertext alphabetical index of all equipment and building products. All hypertext shall be blue in color.
  6. Provide 3 copies of the O&M CD-ROM or DVD.

## 1.12 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.
- B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.
- C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.
- D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Lined ductwork on which the liner becomes wet shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

## 1.13 PROJECT CONDITIONS

- A. Accessibility:
  - 1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
  - 2. Division 23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock arrestors, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
  - 3. Division 23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.

## B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

## C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection. Buried pipe shall be installed minimum 6" below frost depth, unless noted otherwise in the documents.

## D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

## 1.14 COORDINATION

- A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Electrical Work: Section 230529.
- C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.
- D. Cutting and Patching: Section 230529.
- E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.
- F. Each Division 22/23 subcontractor shall coordinate with all other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).
- G. Coordinate with all subcontractors to maintain adequate access to all equipment for maintenance and for future replacement of equipment.



- H. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.
- I. Order of Precedence: The precedence of mechanical construction documents are as follows:
  - 1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
  - 2. Should there be a conflict within the Specifications or within Drawings of the same scale, or between the Specifications and the Drawings, the more stringent or higher quality requirements shall apply.
  - 3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
  - 4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

#### 1.15 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.
- B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

#### 1.16 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

- C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.
- D. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.
- E. Make all specified tests on piping, ductwork and related systems as specified in this specification.
- F. Make sure operational and performance tests are made on seasonal equipment.
- G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.
- H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

#### 1.17 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.
- C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

#### 1.18 WARRANTIES

- A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

- B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.
- C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

#### 1.19 PROJECT CLOSEOUT

- A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

#### 1.20 CERTIFICATES AND KEYS

- A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.
- B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

END OF SECTION 230500

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## SECTION 230529 - BASIC MECHANICAL MATERIALS AND METHODS

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Work furnished but not installed by this Contractor:
  - 1. Access doors in accordance with paragraph 2.3 in this Section 230529.

## 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

## 1.3 QUALITY ASSURANCE

- A. Welder Qualifications: Welding shall be performed by an ASME Certified welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work. Welder Qualifications:
  - 1. Each welder shall have passed a qualification test within the past 6 months.
  - 2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
  - 3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
  - 4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

## 1.4 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
  - 1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.

2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.
4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

## 1.5 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
  1. Legend and color of piping and equipment identification.
  2. Proposed access door sizes and locations
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.
  1. Motors.
  2. Starters.
- C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

## PART 2 - PRODUCTS

### 2.1 MOTORS

- A. General: Furnish motors necessary to operate mechanical equipment.
- B. Motor Characteristics: Comply with the following requirements:
  1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.
  2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.

3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F insulated.
4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 95% under rated load conditions. The 95% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 95% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 95% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be premium efficiency type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.
  - a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
  - b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 23 for other enclosure requirements.
  - c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.

- d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
- e. Motor Connections: Provide conduit connection boxes.
- f. Motors shall not exceed 80dbA rating when running their full speed and power range.

## 2.2 STARTERS

- A. Note that some starters are furnished and installed under Division 26. Review electrical plans before bidding.
- B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 23.** Approved manufacturers shall be those listed in Division 26 or this specification.
- C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 26 will be accepted. All starters shall comply with Division 26 requirements.
- D. Manual Control:
  - 1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
  - 2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.
- E. Automatic Control:
  - 1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:
    - a. Maximum number of auxiliary contacts available: three or more.
    - b. "Hand-Off-Automatic" switches in starter cover.
    - c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.
    - d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.
      - 1) Control circuit conductors to be protected in accord with the National Electrical Code.
    - e. Trip-free thermal overload relays, each phase.



- f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
  - g. Undervoltage release or protection.
  - h. Phase failure/phase reversal protection on all legs.
- F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

### 2.3 ACCESS DOORS

- A. Furnish steel access doors, minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.
- B. Standard Doors:
  - 1. Frames: 16 ga. steel.
  - 2. Panels: 14 ga. steel.
  - 3. Finish: Chemically bonded prime coat of baked enamel.
  - 4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
  - 5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
  - 6. Style of doors shall be appropriate for architectural finish at door location. Furnish masonry anchors where required.
- C. Fire Rated Doors:
  - 1. Frames: 16 ga. steel.
  - 2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
  - 3. Finish: Chemically bonded prime coat of baked enamel.
  - 4. Hinge: Continuous type, steel with stainless steel pin.
  - 5. Closer: Automatic closing mechanism.
  - 6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
  - 7. Style of doors shall be appropriate for architectural finish at door location.
  - 8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.
- D. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect. Coordinate with General Contractor and Architect.

## 2.4 VALVES

## A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2" and smaller. Use gate valves on pipes larger than 2". Use globe valves on manual bypass lines.
4. Provide like type valves of one manufacturer only unless specified otherwise.
5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

## B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.
  - a. Bronze Valves: Powell, Milwaukee, Red-White, Crane, Hammond, Nibco.
  - b. Iron Body Valves: Powell, Milwaukee, Red-White, Traverse City, Kennedy, Mueller, Iowa, American, Nibco.
  - c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Mueller, Pratt, Kennedy, Mission, Milwaukee, Hammond.
  - d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco, FNW.
  - e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco, IFC, FNW, Bray, EBRO.
  - f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
  - g. Non-Lubricated Eccentric Plug Valves: DeZurik.
  - h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Red-White, Prier, Nibco or United Brass.
  - i. Gas Cock: Peter Healy or Crane.
  - j. Check Valves: Nibco, IFC, DFT, Crane.

## C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/B62. No brass materials will be accepted.
  - a. Check, Gate, and globe with union bonnet and rising stem.
  - b. Sizes 1/8 through 2 inches.
  - c. Schedule:

Plan Code:	G.V.	GL.V.	C.V. *	L.C.V. *
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	CRANE
Straight Threaded:	T-134	T-235Y	T-433Y	366E
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

\* Pressure drop across check valves shall not exceed 1 psi at design flow.

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.
  - a. Gate, globe and check.
  - b. Sizes 1/8 through 2 inches.
  - c. Schedule:

Plan Code	G.V.	GL.V.	C.V. *	L.C.V. *
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-174-A	T-275-Y	T-473-Y	
Straight Soldered:	--	--	--	366E
Angle Threaded:	--	T-375-Y	--	--
Angle Soldered:	--	--	--	--

\* Pressure drop across check valves shall not exceed 1 psi at design flow.

3. Standard Iron Body Valves - 125 SWP/200 CWP.
  - a. Gate, globe and check.
  - b. Sizes 2-1/2 through 12 inches.

## c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V. *	W.C.V. *	N.S.C.V. *
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Nibco	CRANE
Straight Threaded:	T-619	T-617-0	--	T-918-B	--	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918-B	F-918BLW	223
Angle Threaded:	----	----	--		----	----
Angle Threaded:	----	----	F-818B	----	----	----

\* Pressure drop across check valves shall not exceed 1 psi at design flow.

## 4. Standard Iron Body Valves - 150 SWP/300 CWP.

- a. Gate, globe and check.
- b. Sizes 2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing *	Non Slam *
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	--	--	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	

\* Pressure drop across check valves shall not exceed 1 psi at design flow.

## 5. Standard Iron Body Valves - 250 SWP/500 CWP.

- a. Gate, globe and check.
- b. Sizes 2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing *	Non Slam *
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	--	--	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

\* Pressure drop across check valves shall not exceed 1 psi at design flow.

## 6. UL and FM Approved Valves.

- a. Gate, check and butterfly.
- b. Sizes all.

## c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--
Wafer:	--	--	KW-900-W	NE-H	--

## 7. UL and FM Approved Valves - 175 Pound Water.

- a. Post indicator with indicator post.
- b. Sizes 4 through 12 inches.
- c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

## 8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

- a. Gate valves with service boxes.
- b. Sizes (see schedule).
- c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

## 9. Ball Valve:

- a. Blowout proof stem.
- b. Full port type with appropriate seals and seat, as specified.

- c. Bronze bodies per ASTM B61/B62 or ASTM B-584. No brass material will be accepted.
- d. Stainless steel bodies per ASTM A-351, Grade CF3M.
- e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.
Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	1/2" thru 2"
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-580-70-66	T-585-70-66	--	T-595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--
Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	full

\* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

#### 10. Butterfly Valves:

- a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV	
Style:	Lugged	
Pressure Rating ANSI Class:	150 minimum	
Body:	ASTM A126 Cast Iron or ASTM A395 Ductile Iron	
Disc:	Aluminum Bronze	
Stem:	316 Stainless	17-4 PH Stainless or 18-8 Stainless
Seat:	EPDM (-40 deg.F to 250 deg.F)	
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.	
Make:	Keystone	
Size:	2"-12"	14"-36
Model:	222	AR2

- b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

Plan Code:	BFV	
Style:	Lug	
Pressure Rating ANSI Class:	300 minimum	
Body:	Carbon steel ASTM A-216	
Disc:	316 stainless steel ASTM A-216	
Stem:	Stainless steel ASTM A564 Type 630 (17-4PH)	
Seat:	Virgin TFE	
Actuator:	3" and 4": Ratchet handle with lock. 6 and over: Worm gear with lock.	
Make:	Flowseal (Mark Controls Corp.)	
Size:	3" and 4"	6" and over
Model:	XX-3L-121TTH-L	XX-3L-121TTH-2

11. Stop Check Valve:

- a. Schedule:

Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

12. Eccentric Plug Valve:

- a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

## 13. Gas Valves:

- a. Gas cock and lubricated plug.
- b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

## 14. Specialty Valves:

- a. Petcock, stop and drain, drain, needle.
- b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and 3/4	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

## 2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

## A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturer's safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:
  - a. Safety factor of 5 (actual load vs. ultimate load).



- b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
  - c. Factory Mutual Engineering Division (FM) as applicable.
  - d. Manufacturers Standardization Society (MSS).
5. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96.

B. Material:

- 1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "Galviline by ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "Galviline by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275, [www.zrcworldwide.com](http://www.zrcworldwide.com)" or equal.
- 2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot-proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
- 3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
- 4. Hangers for insulated piping shall be sized to accommodate the insulation. Provide with insulation shields or insulation saddles\* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
½" thru 3"	12"	18	Galvanized
4"	12"	16	Galvanized
5"	15"	16	Galvanized
6"	18"	16	Galvanized
8"	24"	--	B-line (B3160-3165)
over 8"	36"	--	B-line (B3160-3165)

\* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

- 5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".
- 6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.

7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
  8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
  9. Hanger spacing and minimum rod sizes shall be based on the applicable Mechanical and Plumbing Codes for the type of piping installed.
  10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
  11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
  12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum). At a minimum, install pipe clamps on every other trapeze hanger, and where required to comply with seismic restraint design.
  13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
  14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factor of 5.
  15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
- All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
16. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Owner.
  17. For plenum applications use pipe supports that meet ASTM E-84 25/50 standards.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.
  - a. B-Line
  - b. Fee & Mason

- c. Grinnell
- d. Hubbard Enterprises/HOLDRITE
- e. P.H.D.
- f. Michigan
- g. Tolco
- h. MAPA
- i. Hilti

## 2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

### A. Materials for identification shall be as follows:

- 1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
- 2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.
- 3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

**\*\*\* OR \*\*\***

- 3. Pressure Sensitive Markers: Brady Type 350 flexible vinyl film identification markers and tape, with legend, size and color coding per ANSI A13.1. or approved equal.

**\*\*\* OR \*\*\***

- 3. Semi-rigid Plastic Identification Pipe Markers: Section Setmark with legend, size and color coding per ANSI A13.1 Direction of flow arrows are to be included on each marker, unless otherwise specified.
  - a. Setmark Type Snap-Around markers to be used on diameters 3/4" thru 5".
  - b. Setmark Type Strap-Around markers to be used on diameters 6" or larger.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

## 2.7 DIELECTRIC PIPE FITTINGS AND ISOLATORS

- A. Manufacturer: Epco Sales Inc., Victaulic.
- B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	1/2" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

- C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion
Face Gasket:	Same as Isolators		

- D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

## 2.8 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
  - 1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
  - 2. Joints: Screwed, or grooved mechanical couplings.
- B. Copper Tubing: ASTM B88, Type M, hard drawn.
  - 1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
  - 2. Joints: ASTM B32, solder, Grade 95TA.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

- A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends.
- B. Protection:
  - 1. Close ends of pipe and ductwork during construction and cover equipment to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.
- C. Quiet Operation and Vibration:
  - 1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
  - 2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 23.

## 3.2 WELDING

- A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.
- B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.
- C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

## 3.3 ELECTRIC WIRING

- A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.
- B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.
- C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

## ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters	MC – Except when shown on MCC	EC	EC	MC
Variable Frequency Drives (VFDs)	MC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC
Fire/Smoke and Smoke Dampers	MC	MC	EC – Requires emergency power circuit if air system served is on emergency power.	EC
Control Relays & Transformer (See Note 2)	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats	MC	MC	MC	MC
Pushbutton Stations & Pilot Lights (manually operated switches not carrying load currents).	MC	MC	N/A	MC
Pushbutton Stations & Pilot Lights carrying fully load current.	MC	EC	EC	N/A
Exhaust fans for kitchen hoods or fume hoods where interlocked with make-up air fans.	MC	MC	EC	EC

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system.	FPC	FPC	FPC	FPC
Temporary Heating Connections	MC	MC	EC	MC

- \* MC = Mechanical Contractor under Division 23 of the work.
- \* FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.
- \* FPC = Fire Protection Contractor.
- \* EC = Electrical Contractor under Division 26 of the work.
- \* MGES = Medical Gas Equipment Supplier (Section 226313).

- D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

### 3.4 SLEEVES, PLATES AND CLOSURES

- A. Division 23 Contractor shall provide and locate pipe sleeves, and inserts required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located.
- B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.
- C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure. Link seal shall not be used on fire lines.
- D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:
  - 1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
  - 2. Seal annular space around pipes watertight at floor penetrations.
  - 3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.



4. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.
- E. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries or Willoughby Industries.
- F. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.
- G. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.
- H. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract and paragraph 3.7 of this Section.
- I. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

### 3.5 FOUNDATIONS, PADS AND CURBS

- A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.
- B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 23 Contractor.
- C. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

### 3.6 EXCAVATING AND BACKFILLING

- A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

- B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.
- C. Do not place backfill over pipe lines until lines are properly tested.
- D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

### 3.7 CUTTING AND PATCHING

- A. Openings in New Construction:
  - 1. Provisions for New Openings: The Division 23 Contractor shall verify all openings required in the new construction in connection with the work under Division 23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.
- B. Cutting in New Construction:
  - 1. Failure on the part of the Division 23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.
- C. Patching in New Construction:
  - 1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.
  - 2. The Division 23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

## D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 23 Contractor to coordinate all requirements.

## E. Patching in Existing Building:

1. The General Contractor shall patch all existing walls and floors to match existing.

## 3.8 PIPE HANGERS/SUPPORTS

- A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.
- B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.
- C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.
- D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.
- E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.
- F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

## 3.9 INSTALLATION OF VALVES

## A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each branch of domestic hot water circulating system, all heating/cooling water returns or supplies to equipment, and as shown on Contract Documents.

5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitor's closets, storage rooms, etc.
6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.
  - a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
  - b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
  - c. Backflow prevention: Check.
  - d. Water hammer prevention: Silent or pilot operated non slam check.
  - e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

### 3.10 PAINTING

- A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.
- B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.
- C. Exposed gas piping to be cleaned, primed and two coats of paint (grey).
- D. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 23 Contractor.

## 3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.
- B. Methods for identification shall be as follows:
1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
  2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.
  3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.  
Size of Legend and Letters for Stencils:

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work.)

Legend	Background Color	Direction Arrow	Pressure
Condensate	Yellow	Arrow	PSI
Domestic Cold Water	Light Green		
Domestic Hot Water	Yellow		
Sprinkler-Fire	Red		
Natural Gas	Orange		

5. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.
  6. Semi-Rigid Plastic Identification Markers: Seton Setmark premolded (not pressure sensitive) identification markers may be used at Contractor's option on service piping which is accessible for maintenance operations (but not on piping in finished spaces). This type marker shall not be installed on bare pipe when surface temperature exceeds 180 deg.F unless a 1" thick insulation band is first provided under marker for protection from the hot pipe.
- C. Identification of Piping: Identify all piping accessible for maintenance above ceilings, and access spaces as well as exposed to view utilizing either pressure sensitive markers, semi-rigid plastic markers, or stenciled markings according to the following procedures:
1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
  2. If flow can be in both directions, use a double-headed arrow indication.
  3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
  4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
  5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
  6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
  7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
  8. Insulated piping equipped with electric heat trace shall additionally be labeled "Electric Traced" with label of same size and color as the pipe legend.
- D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).
- E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.
- F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.

- G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.
- H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.
- I. Air Conditioning Equipment: Air conditioning equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.
- J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.
- K. Lift Out Ceilings: Provide engraved nameplates or black lettering on transparent adhesive labels on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.
- L. Expansion tanks shall be labeled to indicate system served and precharge pressure.
- M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

### 3.12 DRIP PANS

- A. Provide drip pans under all fluid conducting piping which runs over servers, telecom equipment, electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.
- B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.
- C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.
- D. Provide a drip pan under all coils that may have condensate during operation like heat recovery coils, etc. Pipe drain to nearest drain.

## 3.13 FIRE SAFING

- A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

## DIELECTRIC PIPE FITTINGS AND ISOLATORS

- A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.
- B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.
- C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.

Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

## 3.14 DRAIN LINES

- A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to nearest drain or to termination indicated.
- B. Do not route condensate lines above electrical panels, switch gear, transformers, motor starters, elevator equipment, servers, or telecom equipment. Should there be a conflict with the plans and this paragraph, notify the Engineer immediately for corrective instruction prior to starting work.

END OF SECTION 230529



## SECTION 230540 - MECHANICAL SOUND AND VIBRATION CONTROL

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. Requirements: Provide Mechanical Sound and Vibration Control in accordance with the Contract Documents.

- B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements

Section 230529 - Basic Mechanical Materials and Methods

Section 232113 - HVAC Piping & Specialties

Section 233300 - Ductwork and Accessories - Flexible Ductwork Connections

## 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:

1. Support isolation for motor/driven mechanical equipment.
2. Rails or beams for distribution of equipment loading to isolation units.
3. Fabricated bases for distribution of equipment loading to isolation units.
4. Inertia base frames in conjunction with equipment isolation.
5. Isolation of pipes and ductwork.
6. Sound attenuating units.
7. Sound-linings.
8. Sound proofing of construction.
9. External sound proofing.

## 1.3 QUALITY ASSURANCE

- A. The Division 23 Contractor shall be responsible for assuring that all the following sound pressure level criteria are met. Sound pressure level tests shall be carried out by the Section 230593 Contractor in compliance with the Section 230593 specifications.

## B. Acoustical Criteria:

1. Noise levels due to equipment and ductwork to permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC curves:

All occupied spaces ----- RC-35

except

Occupied spaces within 15 foot radius from mechanical rooms, main supply and return duct shafts ----- RC-40

Lobbies, Toilets, Commons Area ----- RC-40

Kitchen ----- RC-45-50

Mechanical Rooms ----- RC-60-80

## C. Mechanical Acoustical Performance:

1. Air Distribution system equipment terminal device noise:
  - a. Maximum permissible discharge sound-power levels in octave bands of airborne transmission through the terminal units or related pressure reducing devices, when operated in installed condition per Drawings and Specifications shall be as per Table 1, following:

TABLE 1 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	68	73	78	83
3	61	66	71	76
4	59	64	69	74
5	51	56	61	66
6	48	53	58	63
7	39	44	49	54

2. Pressure reducing variable air volume boxes radiated noise:
- a. Maximum permissible radiated sound-power levels in octave bands when operated in an installed condition over occupied spaces, shall be as per Table 2 following:

TABLE 2 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	62	67	72	77
3	58	63	68	73
4	55	60	65	70
5	53	58	63	68
6	50	55	60	65
7	46	51	56	61

3. Motor Acoustical Performance:
- a. Motor drives for pumps when installed per Drawings and Specifications shall operate with noise levels not exceeding 90dba.
- b. Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.
4. Refrigeration Machine Cooler, Condenser, Compressor and Compressor Piping Acoustical Performance:
- a. The maximum permissible noise levels under design operating conditions, when measured in accordance with the methods and qualifications specified herein shall not exceed 90 dbA.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract.
- Each type of isolator including spring diameters, deflections, compressed spring height and solid spring height.
  - Sound Attenuators.
  - Sound Lining.
  - Inertia Bases.
- B. Test Reports: Submit certified test reports showing compliance in accordance with General Conditions of the Contract of the following items:
- Pressure drop and insertion loss ratings for sound attenuators.

2. Certification that sound lining meets erosion test method described in UL Publication No. 181.

## PART 2 - PRODUCTS

### 2.1 PIPING AND EQUIPMENT ISOLATION

- A. Manufacturer: Amber/Booth Co., Kinetics, Korfund, Mason Industries, Inc., Vibration Mountings and Control Co., Vibro-Acoustics.
- B. Neoprene Mounting Pads (Specification Schedule Type 1)
  1. Kinetics Noise Control Type NPD.
  2. Minimum static deflection 0.04" for 0.22" thick pad.
  3. Cross, double ribbed elastomer in-shear pads, capable of 60 or 120 PSI loading, depending on load density of equipment being isolated.
  4. Material thickness as required to provide minimum deflections listed in table at end of the specification section.
- C. Double Deflection Neoprene Mountings (Specification Schedule Type 2)
  1. Mason Industries Type ND Mounting, Type DNR Rails.
  2. Minimum static deflection 0.35 inch.
  3. Bolt holes where required.
  4. Steel rails above mountings to compensate for overhang where required.
- D. Spring Isolator Mountings (Specification Schedule Type 3)
  1. Mason Industries Type SLF.
  2. Free-standing, laterally stable without housing, complete with 1/4 inch neoprene acoustical friction pads between base plate and support and with leveling bolts that must be rigidly bolted to equipment.
  3. Spring diameters no less than 0.8 of the compressed height of the spring at rated load.
  4. Springs with minimum additional travel to solid equal to 50 percent rated deflection.
- E. Restrained Spring Isolator Mountings (Specification Schedule Type 4)
  1. Mason Industries Type SLR.
  2. Spring isolator mounting equal to Type SLF but with housing that includes vertical resilient limit stops to prevent spring extension when weight is removed from equipment.
  3. Provide hot dipped galvanized mountings exposed to weather.
- F. Vibration Hangers (Specification Schedule Type 6)
  1. Mason Industries Type DNH.
  2. Spring and double deflection neoprene element in series.

3. Neoprene element minimum deflection 0.35 inch.
4. Spring diameters no less than 0.8 of compressed height of spring at rated load.
5. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

G. Integral Structural Steel Base (Specification Schedule Type B)

1. Mason Industries Type WF.
2. Rectangular for equipment other than "T" or "L" shaped pump bases.
3. Pump bases for split case pumps to include supports for suction and discharge base ells.
4. Beams for perimeter members minimum depth equal to one tenth of the longest dimension of the base. Depth need not exceed 14 inches if deflection and misalignment is kept within acceptable limits by manufacturer.
5. Provide height saving brackets to provide a clearance of one inch.

H. Steel Rail Base (Specification Schedule Type B)

1. Mason Industries Type ICS.
2. Steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base.
3. Provide members sufficiently rigid to prevent strains in the equipment.

I. Concrete Inertia Bases (Specification Schedule C)

1. Mason Industries Type K.
2. Rectangular structural beam or channel concrete forms for floating foundations.
3. Provide bases for split case pumps large enough for suction and discharge base ells supports.
4. In general, unless shown otherwise on the Drawings, provide bases with a minimum depth of one twelfth of the longest dimension of the base, but not less than 6 inches.
5. Forms to include minimum concrete reinforcement consisting of 1/2 inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as is required by the structural conditions.
6. Forms furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
7. Provide height saving brackets to maintain a 1 inch clearance below base.

## 2.2 SOUND ATTENUATORS

- A. Acceptable Manufacturers: SEMCO Manufacturing, Industrial Acoustics Company, Acoustifoil Noise Control Products, Koppers, Rink, Commercial Acoustics, Dynasonics, Vibro-Acoustics, Price.
- B. Factory prefabricated.

## C. Shell:

1. Galvanized Steel: 22 ga. minimum.
2. Leakproof at pressure differential of 8 in. w.g.

## D. Media:

1. Flamespread: Maximum 25.
2. Fuel contributed and smoke developed: Maximum 50.
3. Maximum 4.5 lbs. per cubic foot density glass or mineral fiber packed under 5 percent compression.
4. Filler to be inert, vermin and moisture proof.
5. Non-erosive and non-pregnable.

## E. Internal Construction:

1. Galvanized perforated steel baffles: Minimum 24 gauge.
2. Cleanable construction.

## F. Net Insertion Ratings:

1. Determined by duct-to-reverberant room test method at design airflow shall be as per Table 3 following:

TABLE 3			
Band No.	Band Center Freq. (HZ)	Sound Trap Dynamic Insertion Loss(db)	
		5 Feet	3 Feet
1	63	6	4
2	125	10	7
3	250	18	12
4	500	30	19
5	1000	42	23
6	2000	34	23

- G. Maximum self-generated noise at 2000 ft. per minute face velocity shall be as per Table 4 following:

TABLE 4 - Sound Trap Self-Noise Level		
Band No.	Band Center Freq. (HZ)	Sound Trap Self-Noise (db re 10E-12W) 5 ft. & 3 ft.
1	63	63
2	125	54
3	250	52
4	500	50
5	1000	47
6	2000	48

## 2.3 SOUND LININGS

- A. Acceptable Manufacturer: Johns Manville Permacote, Linacoustic and Spiracoustic.
- B. Other acceptable manufacturers offering equivalent products: Knauf, CertainTeed ToughGuard R.
- C. Product: Fibrous glass, acrylic surface coating, stenciled NFPA, conforming to ASTM C1071 (air velocity), ASTM G21 (fungi resistance) and ASTM G22 (bacteria resistance). Product shall not allow growth of mold or bacteria. This anti-microbial compound shall be tested for efficacy by a nationally recognized testing laboratory (NRTL) and be registered by the EPA for use in HVAC systems.
- D. Minimum thickness: As indicated in Part 3 of this specification.
- E. Sound Absorption Coefficient for 1.5" thickness per the following:
- |                 |   |      |      |      |      |      |      |      |
|-----------------|---|------|------|------|------|------|------|------|
| Frequency (cps) | = | 125  | 250  | 500  | 1000 | 2000 | 4000 | NRC  |
| Coefficient     | = | 0.10 | 0.47 | 0.85 | 1.01 | 1.02 | 0.99 | 0.85 |
- F. Flamespread Index: Maximum 25.  
Smoke Developed Index: Maximum 50.  
Tested in accordance with ASTM E84 and UL723. Provide UL labels on product packaging.
- G. Suitable for duct velocity of 5000 fpm. Lining shall meet erosion test method described in UL Publication No. 181.
- H. Dynamic loss coefficient: Maximum 1.2.

- I. Thermal conductivity 0.24 Btu inch/h Ft<sup>2</sup> °F @ 75°F mean temperature.

## 2.4 ADHESIVE AND SEALER

- A. Acceptable Products: Adhesive, Benjamin Foster "81-99", or accepted equal, Sealer, Benjamin Foster "82-07" or accepted equal.
- B. In conformance with NFPA 90A.
- C. Flamespread: Maximum 25.
- D. Fuel contributed and smoke developed: Maximum 50.

## 2.5 NON-HARDENING CAULKING

- A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.
- B. Guaranteed to be permanently elastic.

## 2.6 EXTERNAL SOUND BARRIER INSULATION (PIPING)

- A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.
- B. Model: KNM 100 ALQ-1.
- C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft<sup>2</sup> mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.
- D. Sound Transmission Loss:
- Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28



- E. Flamespread: Maximum 25.
- F. Fuel contributed and smoke developed: Maximum 50.

## 2.7 EXTERNAL SOUND BARRIER INSULATION (SHEET METAL)

- A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.
- B. Model: KNM 100 ALQ-1.
- C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft<sup>2</sup> mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.
- D. Sound Transmission Loss:
  - 1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

- E. Flamespread: Maximum 25.
- F. Fuel contributed and smoke developed: Maximum 50.

## PART 3 - EXECUTION

### 3.1 GENERAL - PIPING AND EQUIPMENT ISOLATION

- A. Unless otherwise noted on the Equipment Mounting Schedule, provide mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators to be selected in accordance with the weight distribution so as to produce reasonable uniform

deflection. Deflections to be as noted on the Equipment Mounting Schedule included at the end of this section.

- B. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following the isolation work, to avoid any contact which would reduce the vibration isolation.
- C. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.
- D. Support the machine to be isolated with a structural steel frame.
- E. Provide brackets to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket to be recommended by the isolator manufacturer.
- F. For restrained spring isolators, use housing as blocking during erection so that installed and operating heights can be the same. Maintain a minimum clearance of 1/2 inch around restraining bolts between housing and spring to avoid interference with spring action. Limit stops to be out of contact during normal operation.

### 3.2 HANGERS

- A. Install type 2 or 3 vibration isolation piping hangers where indicated in Equipment Mounting Schedule at the end of this section and within 20 feet (measured along piping) upstream and downstream of all pumps 3 HP or larger.
- B. Install the isolators with the isolator hanger box attached to or hung as close as possible to the structure.
- C. Suspend the isolators from substantial structural members, not from slab diaphragm unless specifically accepted.
- D. Align hanger rods to clear hanger box.

### 3.3 EQUIPMENT BASES

- A. Provide minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor of 1 inch. Provide minimum operating clearance between concrete inertia base and the housekeeping pad or floor of 1 inch.

### 3.4 FLEXIBLE PIPING CONNECTORS

- A. Provide flexible connectors for equipment that is supported by or mounted on vibration isolators except when connected piping is made up with a Victaulic Flex coupling system. Connectors to be installed under Section 232113.
- B. Hoses shall be installed on the equipment side of the shut-off valves and horizontally wherever possible.
- C. Provide connectors at pump suction and discharge, and elsewhere as required to accommodate thermal expansion, vibration and misalignment.
- D. Provide flexible connectors on all suction and discharge connections to all base mounted centrifugal pumps, vertical turbine pumps, air compressors, dryers, vacuum pumps or other equipment items producing vibration, shock, noise, or thermal motion of piping.
- E. Provide 300 psi companion flanges for connector for threaded, welded, soldered, or brazed piping as appropriate.
- F. Connectors to be aligned, centered, and shall not bear weight of pipe, fittings, or pipeline accessories such as valves. Piping shall be supported both sides of horizontal or vertical connectors.

### 3.5 PIPE FLOOR SUPPORTS

- A. Provide type 3 mountings with a minimum static deflection of 1.5 inches on horizontal pipe floor supported at slab in equipment rooms above grade.

### 3.6 SOUND ATTENUATORS

- A. Install in accordance with manufacturers' recommendations to obtain published performance.
- B. After installation, measure total system pressure before and after attenuators.
- C. If pressure loss exceeds maximum static pressure loss schedules on drawings: modify entrance or discharge aerodynamic flow to obtain specified performance.
- D. For maximum structural integrity, sound attenuator baffles should be installed in a vertical position; where this is not possible, structural reinforcement is required for attenuators wider than 24 in.
- E. When elbows precede attenuators, baffles shall be parallel to the plane of the elbow radius.

### 3.7 SOUND LININGS

- A. Dimensions of lined ductwork are clear inside dimensions after lining has been installed.

- B. Sound linings to be held in place with mechanical fasteners as per the latest SMACNA duct liner application standard, with joints and any tears to be coated with Benjamin Foster or accepted equal adhesive. The transverse joints to be coated prior to installation so that the ends of the liner are compressed together while the adhesive is still moist, forming a seal of the leading and trailing edge of each joint. Excess adhesive to be brushed to an even finish over the joint.
- C. Provide continuous sheet metal edge protectors at entering and leaving edges of lined duct sections where adjacent to unlined duct sections.

Extent of 1" ductwork sound linings:

- 1. Upstream of toilet/general exhaust fans and relief air fans, a minimum distance of 20'-0".
- 2. Transfer air ducts and shaft return stub ducts.
- 3. Return air elbow boots over ceiling grilles.
- 4. In all return and all rectangular exhaust ducts.

Extent of 1.5" ductwork sound linings:

- 1. Rectangular ductwork downstream of VAV boxes.
- 2. In all low pressure rectangular supply ducting.
- 3. In plenums above supply diffusers.
- 4. Elsewhere when specifically indicated on drawings.
- 5. Do not install liner in duct serving evaporative cooled systems 10'-0" downstream of media.

- D. Extent of plenum sound linings:

- 1. Mixed and outside air plenum walls and ceilings.
- 2. Supply air discharge and filter plenum walls and ceiling.
- 3. Return/Exhaust air plenums.
- 4. Return air plenum from riser to mixed air plenum.
- 5. Return/Exhaust air plenums inside packaged rooftop units when not factory installed.

### 3.8 SOUND PROOFING OF CONSTRUCTION

- A. Required for opening between ductwork and piping and following construction:

- 1. Equipment room walls.
- 2. Floors, except in shafts.
- 3. Roofs, specifically inside roof curbs for mechanical equipment and where ductwork penetrates roof deck.

## B. Sound proofing:

1. Fill openings with tightly packed fibrous glass blanket or board for full depth of penetration.
2. Caulk each side of opening with non-hardening, non-aging caulking compound.

## 3.9 EXTERNAL VIBRATION DAMPENING

- A. For typical floor supply duct take-offs from main supply riser when required to meet specified sound levels, provide 1/8 inch thick duct exterior coating of vibration dampening compound. These treatments to be provided over the rectangular portion (flat sides) of the floor take-off ducts.

## 3.10 EQUIPMENT MOUNTING SCHEDULE

- A. Manufacturer: Mason Industries, Inc., Kinetics, Vibro-Acoustics.
- B. Schedule: See the following pages.

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled –Base Mounted						
1. Up to 7 1/2 HP	B/C	3	.25	C	3	.75

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
CENTRIFUGAL FANS & VENTILATION SETS						
A. Up to 22 in. Wheel dia.	A/B	2	.25	A/B	3	.75
PACKAGED AIR HANDLING EQUIPMENT						
A. Up to 10 HP	A	2	.25	A	3	.75
B. 15 HP & Over	A	2	.25	A	3	.75

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PACKAGED ROOFTOP AIR CONDITIONING UNIT	--	--	--	D	3	.75
<p><u>BASE TYPES:</u></p> <p>A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT  B = STRUCTURAL STEEL RAILS OR BASE  C = CONCRETE INERTIA BASE  D = CURB-MOUNTED BASE</p> <p><u>ISOLATOR TYPES</u></p> <p>1 = RUBBER OR GLASS FIBER PAD  2 = RUBBER FLOOR ISOLATOR OR HANGER  3 = SPRING FLOOR ISOLATOR OR HANGER  4 = RESTRAINED SPRING ISOLATOR  5 = SPRING AND RUBBER IN SERIES HANGER</p> <p><u>NOTES:</u></p> <p>1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.</p> <p>2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 2007 EDITION).</p>						

END OF SECTION 230540



## SECTION 230548 - MECHANICAL SEISMIC CONTROL

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Anchorage and seismic restraint systems for all Division 23 isolated and non-isolated equipment, ductwork and piping systems.
- B. All Division 22 and 23 equipment/piping/ductwork shall be isolated and/or seismically supported in accordance with all requirements of the IBC and ASCE 7. This includes, but not limited to, the following:
  - 1. Piping
  - 2. Ductwork
  - 3. Sound Attenuators
  - 4. Unit Heaters
  - 5. Radiant Ceiling Panels
  - 6. Expansion Tanks
  - 7. Condensers
  - 8. Supply Air Fans
  - 9. Hanging Exhaust Fans
  - 10. Air Handling Units
  - 11. Domestic Water Heaters
  - 12. Refrigerant Compressors

## 1.2 RELATED WORK

- A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.
- B. Section 230500 - Basic Mechanical Requirements.
- C. Section 230529 - Basic Mechanical Materials and Methods.
- D. Section 230540 - Mechanical Sound and Vibration Control.

## 1.3 REFERENCES

- A. International Building Code, Current Edition in use by Jurisdictional Authority.
- B. NFPA Bulletin 90A, Current Edition.
- C. UL Standard 181.

- D. SMACNA Seismic Restraint Manual: Guidelines for mechanical systems.

#### 1.4 SYSTEM DESCRIPTION

- A. The Division 23 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Short period design spectral response acceleration coefficient  $S_{DS} = .541g$ .
2. One-second period design spectral response acceleration coefficient  $S_{D1} = .276g$ .
3. Site Class D.
4. Seismic Design Category D.

- B. The following components have a component importance factor  $I_P$  of 1.5:

1. Fire Sprinkler Protection System
2. Natural Gas Piping

All other components have an importance factor  $I_P$  of 1.0.

#### 1.5 QUALITY ASSURANCE

- A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment. Shop drawings included with deferred submittal for earthquake bracing and anchors from the restraint manufacturer shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 23 equipment and systems shall be provided by a single firm.
- B. The above qualified professional engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect/Engineer for this project.
- C. The Division 23 Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases/skids/curbs designed to receive seismic bracing and/or anchorage. All isolated and non-isolated mechanical equipment bracing to be used in the project shall be designed from the equipment submittals and certified to be code-compliant by the equipment manufacturer for seismic description loads defined above, with direct anchorage capability.

#### 1.6 SUBMITTALS

- A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 23 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.
- B. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:
  - 1. Complete engineering calculations and shop drawings for all seismic restraint requirements for all equipment as required by the IBC.
  - 2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
  - 3. Details for all seismic bracing.
  - 4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
  - 5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
  - 6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
  - 7. Include confirmation that all calculations are based on the design criteria listed in Paragraph 1.4.A of this Section.

## PART 2 - PRODUCTS

### 2.1 RESTRAINT EQUIPMENT AND SYSTEMS

- A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:
  - 1. Mason Industries, Inc.
  - 2. Korfund
  - 3. Amber/Booth Company
  - 4. Vibration Mountings and Control Company
  - 5. Kinetics
  - 6. International Seismic Application Technology
  - 7. Tolco
  - 8. Vibro Acoustics
  - 9. Hilti
  - 10. Vibration & Seismic Technologies
- B. Manufacture of restraints and anchors for isolated equipment required by this specification section shall also furnish the vibration isolators required by Specification Section 230540.

### 2.2 SNUBBERS

- A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

- B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.
- C. Snubbers shall be Mason Industries Z - 1011 or accepted equivalent.

## PART 3 - EXECUTION

### 3.1 DESIGN AND INSTALLATION

- A. General:
  - 1. All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein. The following mechanical components are exempt from seismic restraint requirements:
    - a. Components in Seismic Design Categories A and B.
    - b. Components in Seismic Design Category C that have an importance factor  $I_p$  of 1.0.
    - c. Components that have an importance factor  $I_p$  of 1.0, that are mounted less than four feet above the floor, that weigh less than 400 pounds, and that have flexible ductwork, piping, and conduit connections.
    - d. Components that have an importance factor  $I_p$  of 1.0, that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.
  - 2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.
  - 3. Attachments and supports for mechanical equipment shall meet the following provisions:
    - a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).
    - b. Friction clips shall not be used for anchorage attachment.
    - c. Expansion anchors shall not be used for mechanical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.
    - d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.

- e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.
  - f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as  $2F_p$ . The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.
  - g. Seismic supports shall be constructed so that support engagement is maintained.
- B. Install ceiling mounted items in accordance with ASTM C 636.
- 1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
  - 2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
  - 3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.
- C. Spring Isolated Equipment:
- 1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.
- D. Non-Isolated Equipment:
- 1. The Division 230548 Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment to be restrained. This Contractor shall be responsible for certifying that non-isolated equipment is mounted and braced such that it adheres to the system description criteria in this specification section.
- E. Piping:
- 1. Seismic braces for piping may be omitted when the distance from the top of the pipe to the supporting structure is 12" or less. Where pipes are supported by a trapeze, seismic braces may be omitted when the trapeze shall be supported by hangers having a length of 12" or less.

2. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
3. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
4. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
5. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

F. Ductwork:

1. Seismic restraints are not required for HVAC ducts with importance factor  $I_p$  of 1.0, provided that either of the following conditions are met for the full length of each duct run:
  - a. HVAC ducts are suspended from rod hangers and hangers are 12 inches or less in length from the point rod attaches to duct, to the point rod connects to the supporting structure. Rods must be secured to both top and bottom cross angles with locking nuts above and below angle iron.
  - b. HVAC ducts have a cross-sectional area of less than 6 square feet.
  - c. This exception is not valid if the top of ductwork is not secured to hanger rods to limit pendulum length to 12 inches.
2. Equipment items installed in-line with the duct systems with an operating weight greater than 75 pounds shall be supported and laterally braced independently of the duct system.

END OF SECTION 230548

## SECTION 230593 - TESTING, ADJUSTING AND BALANCING

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these Documents.
- B. Related work specified in other Sections:
  - Section 230500 - Basic Mechanical Requirements
  - Section 233300 – Ductwork and Accessories

## 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:
  - 1. Upon completion of the installation of all the plumbing, air and heating or cooling water systems all necessary adjustments shall be made to provide capacities listed on the Drawings to properly balance these systems.
  - 2. Submittals and written reports as specified.
  - 3. Testing requirements as described in Specification Section 230500, paragraph 1.16.
  - 4. Witness duct leakage test required by Specification Section 233300 – Ductwork and Accessories.
  - 5. Provide assistance, in cooperation with the various trades, in the final adjustments and test of the Life Safety Systems to comply with the requirements of the Building and Fire Departments.
  - 6. Provide Owner training as described in Specification Section 230500.

## 1.3 QUALITY ASSURANCE

- A. Work under this section shall be executed under the direct supervision of a Registered Professional Engineer having an established professional office in the State of Utah and having an experience record of not less than five (5) years in the mechanical contracting industry, engaged in testing, balancing and adjusting of air and hydronic mechanical systems for not less than two (2) years of that time, or, under the direct supervision of a qualified testing, adjusting and balancing supervisor, possessing certification from the National Environmental Balancing Bureau (NEBB) or from the Associated Air Balance Council (AABC).
- B. Comply with the applicable procedures in the chapter on Testing, Adjusting and Balancing in the latest ASHRAE Edition of the NEBB, AABC, and SMACNA Test and Balance documents.

- C. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations, and calibration histories for each instrument shall be available for examination.
- D. Accuracy of measurements shall be in accordance with the applicable measurement means as listed in the latest edition of NEBB, AABC, and SMACNA Test and Balance documents.
- E. Allowable Tolerances:
  - 1. Tolerances of adjustment for air handling systems are plus or minus 10% for supply, return, and exhaust systems at air devices and plus 10%/minus 0% at all fans/source equipment from figures shown on drawings.
  - 2. Tolerances of adjustment for hydronic systems, are plus or minus 10% of design conditions shown on drawings at terminal devices and equipment, and plus 10%/minus 0% at all pumps.
- F. Final Testing, Adjusting and Balancing of all hydronic and air systems shall be performed by an approved separate professional Testing, Adjusting and Balancing subcontractor meeting the above Quality Assurance requirements. Acceptable separate professional subcontractors approved to work on this project are as follows:
  - 1. BTC Services, Inc.
  - 2. Certified Testing & Balancing, Inc.
  - 3. RS Analysis, Inc.
  - 4. Bonneville Test & Balance
  - 5. Danis Test & Balance, Inc.
  - 6. Independent Test & Balance, LLC
  - 7. Intermountain Test & Balance
- G. Subcontractors not listed above must submit for acceptance.
- H. Within 30 days after execution of the Owner-Contractor Agreement, transmit to Architect/Engineer the name and qualifications of the organization proposed to perform the services.

#### 1.4 SUBMITTALS

- A. Procedure: Submit Qualifications, Documentation, Test Schedules and Reports in accordance with the General Conditions of the Contract.
- B. Qualifications:
  - 1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:
    - a. Organization supervisor and personnel training and qualifications.
    - b. Specimen copy of each of the report forms proposed for use.



- C. Preliminary Report: At least fifteen days prior to starting field work, submit three copies of:
1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.
  2. A complete list of instruments proposed to be used, organized in appropriate categories, with data-sheets for each. Show:
    - a. Manufacturer and model number.
    - b. Description and use when needed to further identify the instrument.
    - c. Size of capacity range.
    - d. Latest calibration date.
  3. Architect/Engineer will review submittals for compliance with Contract Documents, and will return one set marked to indicate:
    - a. Discrepancies noted between measured data and Contract Documents.
    - b. Additional, or more accurate, instruments required.
    - c. Requests for re-calibration of specific instruments.
- D. Schedules:
1. Schedule tests to comply with project completion schedules.
  2. Schedule testing and balancing of parts of the systems which are delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor, as early as the proper conditions will allow, after consultation with Architect/Engineer.
  3. Submit reports of delayed testing promptly after execution of those services.
- E. Final Report: At least fifteen days prior to Contractor's request for final inspection, submit three copies of final reports, on applicable reporting forms, for review. Submit a fourth copy directly to the Engineer. Each individual final reporting form must bear the signature of the person who recorded data and that of the NEBB or AABC certified supervisor of the reporting organization. Identify instruments of all types which were used and last date of calibration of each. Report shall include:
1. A detailed letter to Engineer outlining all abnormal or notable conditions not covered in above data specifically identifying all locations where specified flow tolerances could not be met.
  2. A set of reduced black and white or blue line prints with all air openings clearly marked to correspond with data sheets and with thermometer locations clearly marked.
  3. Data sheets showing amount of air handled at each opening, instrument used, velocity readings, and manufacturer free area factor.
  4. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the heating season. Logs shall be taken when outside temperature is 30 deg.F or colder.

5. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the cooling season. Logs shall be taken with full occupant load, full lighting, and maximum solar conditions.
6. Equipment data sheets giving make, size and model, of fans, starters and motors with rated amps and service factors, and drives. Include pumps, supply fans, exhaust and recirculating fans.
7. Operating data including fan RPM, inlet and outlet pressures, pressure drop across filters, face and bypass dampers, and measured motor current and voltage, BHP and CFM (total).
8. Heating equipment operating data including air temperatures entering and leaving heating coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperature entering and leaving heating coil, water flow and pressure drop through heating coil.
9. Cooling equipment operating data including air temperatures entering and leaving cooling coils together with corresponding air flow and air pressure drop, water temperature entering and leaving cooling coil, and water flow and pressure drop through cooling coil.
10. Equipment and operating data as required to show performance of pumps, heat exchangers, domestic hot water circulating systems, heating, ventilating, and air conditioning units, cabinet heaters, unit heaters, unit ventilators, fans and temperature control devices.
11. Sound pressure levels showing readings in all 8 octave bands and plotted on RC(II) charts shall be submitted for the following:
  - a. All sides of Mechanical Rooms.
  - b. Lobbies, Labs, and Commercial Area.
  - c. Conference Rooms.
  - d. Spaces within 20 ft. of parking garage ventilation fan inlets and outlets.
  - e. All spaces exhibiting abnormally high or annoying noise levels.
12. Domestic hot water recirculation data including flow at each branch shown requiring specific flow, and at the pump.

## 1.5 PROJECT CONDITIONS

- A. The following job conditions must be verified before any testing, adjusting or balancing of the environmental systems begin:
  1. Installation of the designated system is complete and in full operation.
  2. On hydronic systems, strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, and other such conditions requiring correction.
  3. Air systems shall be checked for dirty filters, filter leakage, equipment vibrations, damper operation, fan rotation, and other such conditions requiring correction.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 - EXECUTION

## 3.1 PROCEDURE

- A. Confirm that project conditions have been verified and that necessary corrections have been made before proceeding with the Work.
- B. The Test and Balance Contractor must proportion air/water flows in the system while introducing a minimum amount of resistance. All systems are to be proportionally balanced.
- C. Air Systems:
  - 1. The balancing firm shall adjust all dampers, diffusers, registers, belts and sheaves for the delivery and distribution of air quantities shown in the Contract Documents and shall mark each balancing device at final setting.
  - 2. Adjust fan speeds and motor drives within drive limitations for required air volume, provide new sheaves as necessary, or adjustable bands on constant volume plenum fans, and notify Division 26 Contractor of any thermal overloads that need to be changed/replaced.
  - 3. Measure static air pressure conditions on air supply units, including individual filter and coil pressure drops, and total pressure across the fan. Make allowances for 0.5" w.c., equivalent to 50% loading of filters.
  - 4. Exhaust and recirculation air systems shall be adjusted for air quantities shown on Drawings.
  - 5. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
  - 6. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
  - 7. Measure building static pressure in both economizer mode and minimum outside air mode, and adjust supply, return and exhaust air systems to provide the required relationship between each to maintain approximately 0.05 inches water column positive static pressure at the Building Entries.
  - 8. Distribution system shall be adjusted to obtain uniform space temperatures free from objectionable drafts and noise.
  - 9. Report: After all adjustments are made, a detailed report shall be prepared by the balancing firm and submitted to the Architect for approval. Owner reserves the right to spot check the report prior to final acceptance.
- D. Plumbing System
  - 1. Hot Water Recirculation Systems: Set flow at each balancing valve shown. Record flow at each pump. Verify the proper installation of automatic flow control valves.

END OF SECTION 230593

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## SECTION 230700 - MECHANICAL INSULATION

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. Requirements: Provide insulation in accordance with the Contract Documents.
- B. Related work specified in other Sections:

- Section 224450 - Plumbing Equipment
- Section 230500 - Basic Mechanical Requirements
- Section 230529 - Basic Mechanical Materials and Methods
- Section 230540 - Mechanical Sound and Vibration Control
- Section 232113 – HVAC Piping & Specialties
- Section 233100 – Air Distribution
- Section 235700 - Heat Transfer
- Section 236400 - Refrigeration

## 1.2 SYSTEM DESCRIPTION

- A. The mechanical insulation work required by this Section shall include materials and methods as described herein and on the Drawings and as required by applicable energy codes.
- B. The work includes, but is not limited to providing insulation on the following:
  - 1. Plumbing Systems:
    - Domestic Hot Water-Supply, Recirculating, Hot Water Converters, and Storage Tanks
    - Tempered Domestic Water-Supply, Recirculating and Storage Tanks
    - Tempered Domestic Water Circulating
    - Domestic Cold Water
    - Primary Roof Drain System
    - Overflow Roof Drain Bowls
  - 2. Refrigerant Systems:
    - Refrigerant Piping

## 3. Air Distribution Systems:

Exterior surfaces of all plenums and ducts which are a part of the following systems where duct or plenum is not lined (see Section 230540):

Outside Air

Combustion Air

Mixed Air

Low Pressure Supply Air

Return Air

Rigid Round Runouts to Diffusers

## 4. Other Systems:

Cold Condensate Drains

## 1.3 QUALITY ASSURANCE

- A. Qualifications: The firm executing the work of this Section shall have at least 3 years successful installation experience on projects with mechanical insulations similar in scope and nature to that required for this Project.
- B. Requirements of Regulatory Agencies: All insulation shall be in accordance with Jurisdictional Building Code and State and Federal Energy Conservation Standards.

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation in accordance with the General Conditions of the Contract. Include schedule showing manufacturer's product number, thickness and furnished accessories for each mechanical system requiring insulation.
- B. Provide schedule of pipe sizes with insulation thickness at corresponding fluid temperatures.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Deliver insulation, coverings, adhesives, and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.
- B. Storage of Materials: Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

## PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers of insulation materials shall be as follows:

3M/Thermal Ceramics (FireMaster)  
 Armstrong  
 Certain-teed  
 Dow Chemical  
 Gilsulate International, Inc. (Gilsulate 500XR Loose-Fill Insulation)  
 Johns Manville  
 Knauf  
 Manson Insulation Products  
 Owens-Corning  
 Renler (Pyroscat FastR Wrap)  
 SpecSeal (Claymac)  
 Unifrax (Fyrewrap)

## 2.2 MATERIALS

- A. Conductivity:

TYPE OF INSULATION	MAXIMUM THERMAL CONDUCTIVITY/INCH
Calcium Silicate	0.47 at 600 degrees Fahrenheit
Glass Fiber Pipe Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Equipment Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Duct Insulation	0.24 at 75 degrees Fahrenheit
Glass Fiber Blanket Duct Insulation	0.29 at 75 degrees Fahrenheit
Expanded Polystyrene	0.24 at 75 degrees Fahrenheit
Ceramic Fiber Grease Duct Wrap	0.25 at 70 degrees Fahrenheit
Polyisocyanurate Foam	0.19 at 75 degrees Fahrenheit
Granular Loose Fill	See below

- B. Duct Wrap: Blanket-type fiberglass insulation 1-1/2" thick, 0.75 pounds per cubic foot density.
- C. Vapor Barrier Coatings: To have a perm rating not more than 0.25 when tested in accordance with ASTM E96, procedure A.

- D. Adhesives, Sealers, Facings and Vapor Barrier Coatings: To be compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings as recommended by the manufacturer of insulation materials.
- E. Chemicals for Treating Paper: Non-soluble.
- F. Non-Collapsing Inserts: Calcium Silicate or Polyisocyanurate (Dow Trymer 2000). No Polystyrene inserts are allowed.
- G. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.
  - 1. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F.
  - 2. Application Temperature Range: 35 to 800 deg F.
  - 3. Dry Density: 40 to 42 lb/cu. ft.
  - 4. Strength: 12,000 lb/sq. ft.

### 2.3 PERFORMANCE CRITERIA

- A. Insulation and accessory materials to meet the following criteria:
  - 1. Insulation Materials: To be noncombustible as defined in National Fire Protection Association Pamphlet 220 and to be Underwriter's Laboratory listed.
  - 2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

### 2.4 HANDICAP LAVATORY INSULATION

- A. Insulation System: Molded closed cell insulation, 3/16-inch nominal wall thickness; provide pre-molded fittings to completely cover tail piece, P-trap, trap arm, hot and cold water supply stop valves and exposed supply tubing; include nylon fasteners for all fittings.
- B. Handi Lav-Guard manufactured by Truebro; Trap Wrap manufactured by Brocar Products; Zeston Snap-Trap manufactured by Johns Manville or approved equal.
- C. Install at all handicap accessible lavatories installed in this project.



## PART 3 - EXECUTION

## 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Testing of piping and ductwork to be completed prior to application of insulation.
- B. Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together.
- C. Make insulation continuous through sleeves or openings in walls and floors.
- D. Run sealed vapor barriers continuous throughout all cold surface insulation systems.
- E. Avoid the use of staples on vapor barrier jackets. Seal all vapor barrier penetrations with white vapor barrier sealant.
- F. Apply adhesives so as not to exceed the coverages recommended by the manufacturers.
- G. Leave surfaces clean and ready for painting.
- H. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to the edges of such openings and stop with sheet metal rings.
- I. Provide non-collapsing inserts between pipe and all shields/saddles on all insulated piping 2" and larger.

## 3.2 SPECIFIC INSTALLATION REQUIREMENTS

- A. Minimum Pipe Insulation Schedule:

International Energy Conservation Code

PIPE INSULATION THICKNESS IN INCHES*			
Fluid	Nominal Pipe Diameter		
	< 1.5"	≥ 1.5"	≥ 8"
Hot Water	1.5	2.0	2.0
Refrigerant	1.0	1.0	1.5

\*Based on insulation having a conductivity not exceeding 0.27 BTU per inch/h·ft<sup>2</sup>·°F.

Exceptions:

- 1. Factory installed piping within HVAC equipment tested and rated in accordance with IECC referenced procedures.

2. Strainers, control valves, and balancing valves associated with piping 1-inch or less in diameter on heating water systems.

<b>DUCT AND PLENUM INSULATION</b>	
Location	Min. Insulation Value
In unconditioned spaces (i.e. ceiling spaces or unheated spaces)	R-6
Outside building envelope	R-8

Exceptions:

- a. When located within equipment.
- b. When design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (i.e. return air ducts in ceiling spaces).

**B. Plumbing System:**

1. Domestic Cold Water:

All piping is required, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap.

2. Roof Drains:

Horizontal mains and vertical from horizontal to and including drain bowls, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap.

Overflow roof drain bowls shall be insulated but not overflow drain piping. Vertical mains shall be insulated.

3. Domestic Hot and Tempered Supply and Circulating Water:

Insulate entire system.  
Thicknesses per table of 230700-3.2, A.

4. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for return air plenum use.

5. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas and heavy coat of vapor barrier mastic coating.

**C. Chilling System:**

1. Fiberglass pipe covering with all service jacket self-seal lap.
2. Fittings:  
  
All systems: Premolded PVC fitting covers with fiberglass insert. Seal all fittings at end and throat.
3. Valves:  
  
All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.
4. Cold Condensate Drain Piping:  
  
1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.
5. Refrigerant Suction and Liquid Piping: Thicknesses per Refrigerant Piping System of Section 230700 - 3.2, A.  
  
Fiberglass pipe covering with all service jacket self-seal lap. At Contractor's Option, a closed cell insulation with all joints butted and cemented may be used in lieu of fiberglass. Armaflex 22 or equal. If closed cell insulation is exposed to sunlight, coat all surfaces with UV protection to prevent long term deterioration from sunlight.

D. Buried Piping:

1. Do not disturb the bottom of trench, or compact and stabilize it to ensure proper support.
2. Remove any standing water in the bottom of trench.
3. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.
4. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.
5. Place insulation and backfill after field quality-control testing has been completed and results approved.
6. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors.
7. Wrap piping at bends, expansion loops, and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.
8. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.
9. Remove temporary hangers and supports.
10. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils (0.10 mm) thick, and empty loose-fill insulation bags on top.
11. Manually backfill 6 inches (150 mm) of clean backfill. If mechanical compaction is required, manually backfill to 12 inches (300 mm) before using mechanical-compaction equipment.

## E. Refrigerant System:

1. Expanded polystyrene pipe covering with all service jacket and self-seal lap.
2. Refrigerant piping and brine piping: Insulate with thickness per Section 230700-3.2, A. Thickness over 2-1/2 inch may be applied in two layers. Ends of inner layer sections shall be staggered and taped. End and longitudinal joints of outer layer shall be staggered with inner layer joints. Secure with 1-inch fiberglass filament tape 12 inches on center. Provide factory applied all service jacket on outer layer. Seal all ends of insulation runs.
3. Valves and Fittings: Pre-molded covers fabricated of same material and thickness as pipe insulation. Fill gaps with injected foam insulation. Secure covers with 1 inch fiberglass filament tape.
4. Vessels: Insulate with two layers of prefabricated curved segments to fit vessel. Stagger all joints. Secure with banding 18 inches on center. Extend side insulation past tank head to thickness of insulation, insert circular end insulation. Fill voids with injected foam insulation.

## F. Air Distribution System:

1. Exterior surfaces of outside air, combustion air, mixed air, and recovery coil discharge:  
  
One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.
2. Exterior surfaces of supply and return air plenums where not indicated to be lined:  
  
One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins.
3. Exterior surfaces of exposed supply ductwork not lined:  
  
One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.
4. Concealed supply ductwork not lined:  
  
Two inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.
5. Low pressure round runouts to diffusers:  
  
Two inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

6. See Specification Section 230540 – Mechanical Sound and Vibration Control for requirements for lined ductwork.

7. Above ground, exposed rectangular supply and return air duct insulation:

Flexible elastomeric 1 inch thick or Polyolefin 1 inch thick. Install aluminum, corrugated 0.032 inch thick over duct insulation. Jacket to have 2 inch overlap on all seams and joints. Install per manufacturers recommendations.

G. Other Systems:

1. Piping Insulation Exposed to Rainfall:

Provide 0.016-inch thick corrugated aluminum jacket and fitting covers on all insulation exposed to rainfall. Install seam on bottom of horizontal and angled piping. Seal all joints weather-tight. Seal jacket seams with silicone sealant.

2. Condensate Drains Inside Buildings:

1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

END OF SECTION 230700

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## SECTION 230810 - VARIABLE FREQUENCY DRIVE

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. The contractor shall furnish and install a complete Variable Frequency Drive and Energy Efficient motor system on the following equipment as described in this specification and as indicated on the drawings.
  - 1. Air handler supply fans
- B. The Variable Frequency Drive shall convert 208 volt, three phase, 60 Hz utility power to adjustable voltage and frequency, three phase, A-C power for stepless motor control from 6 to 60 Hz.
- C. This contractor shall coordinate motor selection with Variable Frequency Drive.
- D. Variable Frequency Drive Systems shall be compatible with any standard NEMA B or C design 3-phase induction motor. Variable Frequency Drive Systems shall be sized to insure the motor full load amps does not exceed the controller continuous RMS amps at project altitude (6800 ft.)
- E. The VFD shall be interfaced to the building control system as specified in Section 230900.

## 1.2 QUALITY ASSURANCE

- A. The equipment supplied under this specification shall conform to the latest applicable codes and standards of the following:
  - 1. NEC – (NFPA 70) – National Electric Code.
  - 2. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
  - 3. NEMA AB1 – Molded Case Circuit Breakers.
  - 4. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
  - 5. IEEE Standard 519-1992 – Recommended Practices for Harmonic Control in Electrical Power Systems.
  - 6. ANSI C37 – Standards for Circuit Breakers, Switchgear, Relays, Substations and Fuses.
  - 7. ANSI C57 – Distribution, Power, and Regulating Transformers (includes Reactors).
  - 8. UL 508C – Power Conversion Equipment.
  - 9. NEMA ICS 3.1 – Safety Standards for Construction and Guide for Selection, Installation, and Operation of Variable Frequency Drive Systems.
  - 10. FCC CFR 47 Part 15 subpart B.

- B. The VFDs shall be UL listed for conformance to UL-508C. An equivalent safety labeling program by ETL or CSA documenting compliance with these industry standards will be acceptable.
- C. The Division 23 Contractor shall coordinate and assume system responsibility and compatibility between the various approved suppliers' equipment and services required to meet these specifications.
- D. The VFD system vendor shall provide a complete parts and labor warranty (including travel and shipping expenses) for one (1) year from the date of substantial completion. The warranty shall cover the entire VFD system including power devices, controllers, harmonics, mitigation devices, communications interface, etc. furnished as part of the system package.
- E. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application.

### 1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings and product data in accordance with Section 230500 – Basic Mechanical Requirements.
  - 1. VFD: Product data sheets, functional descriptions, performance ratings, dimensions, conduit entry/exit locations, installation instructions, complete wiring diagrams for power, controls, etc.
  - 2. Control System Interface: Furnish complete documentation of the controls system interface including bus specification, object list, wiring diagrams, XIF or configuration files, etc.
  - 3. Derate calculation for installation altitude above 3300 ft. and ambient temperature above 40°C.
- B. Operating Instructions and Maintenance Data: Submit printed operating instructions and maintenance data in accordance with Section 230500 – Basic Mechanical Requirements.
  - 1. VFD: Operating and Maintenance instructions, programming instructions, spare parts lists, troubleshooting instructions.
  - 2. Factory test reports.
  - 3. Start-up and commissioning reports.
  - 4. Power quality and harmonic test reports.



## PART 2 - PRODUCTS

## 2.1 APPROVED MANUFACTURERS

- A. The following manufacturers are acceptable, submit alternates for prior approval in accordance with the General Conditions and Division 1 Requirements.
1. ABB
  2. Yaskawa
  3. Graham/Danfoss
  4. Mitsubishi
  5. Grundfos Inc.
  6. Toshiba

## 2.2 CONSTRUCTION, VARIABLE FREQUENCY DRIVE

- A. The Variable Frequency Inverter(s) shall be PWM type using IGBTs, rated for the motor type, horsepower, and voltage as indicated on drawings.
- B. The Inverter shall be altitude compensated and sized for the elevation at which the unit will be installed. The inverter shall operate in an ambient temperature of  $-10^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  humidity of 0-90% non-condensing.
- C. The VFD system manufacturer shall integrate all components and equipment required to meet these specification features and functions as a single UL (or equivalent) labeled system. Vendors providing equipment requiring panel shop or job site modifications or additions that would not be valid under the original equipment manufacturer's (OEM's) safety labeling will not be acceptable.
- D. Pre-integrated equipment shall include but not be limited to incoming line filters, rectifier units, inverter units, control circuitry, operator interfaces, protective equipment, and other accessories and auxiliary items necessary to meet the highest standards for the type of service specified herein.
- E. All VFD system components shall be housed in a grounded, dead front, free-standing or wall mounted, NEMA 12 enclosure. The VFD system size shall not exceed the size allotments specified on the drawings nor shall any portion of the system exceed a height of 90 inches. Entry shall be provided for incoming line and load cables as required or as shown on the drawings.
- F. VFD systems mounted indoors shall be properly ventilated and sized to operate continuously at the job site elevation in an ambient environment of  $0^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ , 0-90% RH. VFD systems mounted outdoors shall include environment control provisions as required (or as shown on the plans) to operate in an ambient of  $-30^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ , 0-100% RH.

- G. All components of the VFD system shall be selected to operate continuously without any system trip or damage based on the nominal power specifications and requirements shown on the drawings or schedules. The above conditions must be maintained under the following expected variations:
1. Plus or minus 10% voltage fluctuation.
  2. Plus or minus 3% frequency variation (5% if served by a back-up generator).
  3. Distorted voltage waveform with up to 7% total voltage harmonic distortion.
- H. The VFD system shall employ voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions:
1. 0% voltage for 1 cycle.
  2. 60% voltage for 10 cycles.
  3. 87% voltage continuous.
- I. The VFD system shall employ door mounted industrial control operator devices, programming unit, and other devices as required to meet all functional and feature requirements of this specification. Operator pilot lights or LEDs, switches and pushbuttons (if required) shall be industrial oil tight industry standard devices.
- J. Control voltages shall be 120 volts or less supplied by machine tool type transformers employing both primary and secondary fusing.
- K. The VFD system factory wiring shall be permanently marked with hot emboss stamping or an equivalent marking system. All devices shall be labeled and identified with correct setting selections. All component identification and wiring shall be documented in the operation and maintenance manual.
- L. The VFD system shall be capable of starting and continuously driving the specified maximum motor load as identified on the drawings and schedules.
- M. VFD's driving variable torque loads shall be programmed to optimize load patterns which maximize system efficiency and minimize motor heating and stresses. VFD's driving constant torque or other loads shall be programmed to optimize load patterns for system or process performance as required.
- N. All VFD systems shall have an overload capacity of a minimum of 120% for one minute.
- O. The VFD solid state converter and inverter power switching components and control shall be selected to achieve a 0.95 efficiency or better at full load and speed. Other auxiliary devices required on the drawings or in these specifications including filters, line reactors, cooling or heating devices etc. shall be of a design to optimize efficiency as intended under this specification.

- P. The entire true system power factor (as measured at the input to the VFD system) shall be 0.95 or better across the operational speed and load range. Power factor that becomes leading under light load conditions (due to PF correction) is acceptable only if voltage rise is prevented from backfeeding to the rest of the system (meaning PF correction must act like a synchronous condenser). The voltage tolerance at the main VFD system input terminals shall not be compromised as a result of power factor correction techniques.
- Q. Short circuit protection shall be provided to the VFD system through an externally operated, door interlocked fused disconnect, circuit breaker or motor circuit protector (MCP). VFD shall have a minimum short circuit rating of 65,00 amps RMS (100,000 amps RMS with DC bus reactor) without additional input fusing. The door interlocked handle must be capable of being locked off to meet NEC.
- R. Overcurrent protection shall be provided in the VFD system through electronic motor overload (MOL) circuits with instantaneous trip, inverse time trip, and current limit functions. These shall be adjustable and optimized for the application.
- S. In addition to the overcurrent protection above, the VFD system shall provide over and under voltage protection, over temperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall remain in memory for future review.
- T. The VFD system customer terminations shall be clearly identified with terminal numbers and a permanent wiring diagram located in the VFD system enclosure. Coordinate all control work with Section 230900 Contractor.
- U. VFD shall meet the requirements for Radio Frequency Interference as specified by FCC Regulations, Part 15, Subpart J, Class A devices.

## 2.3 FEATURES, VARIABLE FREQUENCY DRIVES

- A. The following operator control and indication features shall be provided standard (unless shown differently on the drawings) as part of each VFD system:
  - 1. Hand-Off-Auto (local start at VFD, remote start with contact closure).
  - 2. Local-Remote speed control (local speed control at VFD, remote speed control through speed reference signal).
  - 3. Frequency (speed) indication.
  - 4. Motor voltage indication.
  - 5. Motor current indication.
  - 6. VFD run indication.
  - 7. VFD fault and diagnostic indication.

- B. The following customer connections and interface terminations shall be provided standard (unless shown differently on the drawings) as part of each VFD system:
1. VFD remote start/stop connection.
  2. External safeties connection.
  3. VFD run annunciation.
  4. VFD fault annunciation.
  5. VFD speed reference input connection (4-20mA or as shown on drawings).
  6. Minimum of three (3) programmable digital inputs.
  7. Minimum of two (2) 4-20mA input signals to integral controller.
- C. The following parameter adjustments shall be available to tune the VFD system:
1. Minimum and maximum speeds.
  2. Acceleration and deceleration times.
  3. Overcurrent trip point.
  4. Current limit response to overload.
  5. Maximum base motor voltage.
  6. Input speed reference signal gain and bias.
  7. Output speed reference signal gain and bias.
  8. Critical frequency avoidance.
  9. Multiple preset speed programming.
  10. Integral PI controller programming.
- D. The VFD shall be capable of starting into a rotating motor at any speed and rotation direction.
- E. The VFD shall auto restart after a power failure.
- F. For maintenance purposes, the VFD system shall be capable of starting, stopping, and running with stable operation with the motor completely disconnected (no load).
- G. VFD shall include an integral locking disconnect.
- H. VFD shall include an integral PI controller capable of closed loop control of motor speed based on external analog speed reference signals or programmed digital input signals.

#### 2.4 FACTORY TEST, VARIABLE FREQUENCY DRIVE

- A. Prior to shipping any equipment, the manufacturer shall individually test and certify each unit to document compliance. This certification report shall be submitted as part of the operation and maintenance manual and include the following minimum testing:
1. A visual inspection shall be made consisting of all system components, wiring connections, and safety mechanisms.

2. High pot testing shall be conducted on the completed VFD system including all accessory power components as a complete package. This test shall be conducted per UL 508C (two times the rated voltage plus 1000 volts AC for 60 seconds) using regularly calibrated high pot test equipment.
3. A system run test shall be conducted using an actual motor accelerated and decelerated through the entire speed range.
4. All control panel devices, including switches, pilot lamps, keypad and special control devices shall be functional tested.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Field start-up service shall be provided by an authorized factory representative. The supplier shall provide warranty and authorized factory services including field start-up and training. The following adjustments and tests shall be performed as a minimum with certified copies included in the operation and maintenance manual:
  1. Verify that the input voltage is within the manufacturer's specification tolerances.
  2. Verify that the motor rotation is correct in all modes of operation.
  3. Verify all operator devices, programming, and monitoring functions to be fully operational.
  4. Verify operation of all field signal control connections.
  5. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate rating at full speed. Check full load current measurements against nameplate data.
  6. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
  7. Conduct harmonic tests as identified in this specification. Measurements shall be recorded for each unit with the VFD system off, running at 50% speed, and running at full speed and load.
- B. Owner training shall be provided for each model and type of VFD system provided. Training shall consist of both classroom and actual equipment hands-on training.
- C. Installation shall be in accordance with manufacturer's printed instructions.
- D. The mechanical contractor shall coordinate the mounting location of the VFD with the electrical contractor to be certain that it is not mounted in the airstream of unfiltered exhaust air; i.e. in a parking garage application. If no location is feasible to meet this location criteria, the VFD may be mounted inside a NEMA 3R enclosure in the dirty air location.

3.2 SPARE PARTS

- A. Furnish one spare main logic board, key pad, and power supply board. Furnish one set of spare parts for each unique VFD design supplied.

END OF SECTION 230810

## SECTION 230900 - ELECTRONIC CONTROLS

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

- B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements  
Section 230529 - Basic Mechanical Materials and Methods  
Section 230540 - Mechanical Sound and Vibration Control  
Section 230593 - Testing, Adjusting and Balancing  
Section 230700 - Mechanical Insulation  
Section 232113 - HVAC Piping & Specialties  
Section 233300 - Ductwork and Accessories  
Section 233400 - Air Handling Fans  
Section 236400 - Refrigeration  
Section 237400 - Air Handling Systems

## 1.2 SYSTEM DESCRIPTION

- A. The work includes but is not limited to the following:
1. The automatic temperature control system shall be electronic analog, digital or a combination of both and compromised of controllers that are stand-alone. PID (Proportional Integral, Derivative) control algorithms shall be applied on all temperature and pressure applications as called for hereinafter in the control sequences.
  2. The system shall include all control devices, valves and automatic dampers, wire, conduit, etc., as specified and required and connected so as to perform all functions and operate according to the specified sequences.
  3. System to coordinate with specific equipment controls supplied with unit and integrate.

## 1.3 QUALITY ASSURANCE

- A. Manufacturing and Installation Qualifications:
1. The Controls Subcontractor firm executing the work of this section shall have 3 years experience in work of similar scope and nature to that specified.

- B. This work includes all material, equipment and appurtenant accessories necessary for or incidental to the installation of a complete solid-state electromagnetic system of Automatic Temperature Controls.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and manufacturer's data for the following items in accordance with the General Conditions of the Contract:
  - 1. Sensors
  - 2. PID Controllers
  - 3. Automatic control valves, schedule and wiring.
  - 4. Thermostats
  - 5. Thermometers
  - 6. Gauges
  - 7. Control diagrams
  - 8. Wiring diagrams
  - 9. Control panels
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.
  - 1. Controls and instrumentation.
- C. Certificate: ATC Contractor shall submit a letter certifying completion of the control system in accordance with the Contract Documents.

### PART 2 - PRODUCTS

#### 2.1 SENSORS & SWITCHES

- A. Temperature sensors shall be of the thermistor (NTC) type with a high resistance change versus temperature change to insure good resolution and accuracy. Sensors shall be available for room, duct or well mounting. Sensors shall connect to remote controller by means of a two-wire unshielded cable. Room type sensors shall be available with built-in setpoint potentiometer. Sensors shall be available in various ranges to properly suit the application.
- B. Humidity sensors shall be of the solid state type utilizing hygroscopic plastic as the sensing element. The sensor shall vary the output voltage with a change in relative humidity. Sensors shall be available for room or duct mounting. Sensors shall connect to remote controllers by means of a three-wire unshielded cable. Room type sensor shall be available with built-in setpoint potentiometer.
- C. Combination temperature and humidity sensor shall have thermistor (NTC) and hygroscopic plastic elements mounted in a common enclosure. Sensor shall connect to



remote controller by means of a four-wire unshielded cable. Room type sensor shall be available with built-in setpoint potentiometers for both temperature and humidity.

- D. Industrial temperature sensors shall be platinum (PTC) with high repeatability and accurate to  $+0.5^{\circ}\text{F}$ . Sensor shall be suitable for room, duct or well mounting. Sensor shall be suitable for various ranges by selecting the appropriate range cards. Sensor shall connect to controller by means of a three-wire unshielded cable.
- E. Zone dampening sensor element shall be suitable for duct mounting and capable of dampening an individual zone sensor by electronically paralleling the zone sensor's signal. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.
- F. Strap-on type sensor shall vary its resistance over its entire range of sensed water temperature from  $50^{\circ}\text{F}$  to  $230^{\circ}\text{F}$  in a pipe  $3/4"$  to  $2-1/2"$  in diameter without requiring immersion or well mounting. Sensor shall connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.
- G. Duct-mounted averaging type temperature sensor shall utilize a nickel resistance sensing element incorporated in a copper capillary of 27 feet. The sensor shall vary the output voltage with a change in temperature. Sensor shall connect to the remote controller by means of a three-wire unshielded cable.
- H. Differential pressure sensor shall vary the output voltage with a change in differential pressure. The sensor shall connect to the remote controller by means of a three-wire unshielded cable.
- I. Window surface temperature sensor shall mount to inside of window with adhesive strips assuring good surface contact and accurate glass temperature transmission while being unaffected by surrounding air temperature. Sensor shall vary resistance with a change in window temperature and connect to controller by means of a two-wire unshielded cable. Sensor shall be of the thermistor (NTC) type.
- J. Duct-mounted industrial humidity sensor shall utilize cold electrodes for sensing relative humidity from 0 - 100%. Accuracy shall be  $\pm 2\%$  from 10 - 80% and  $\pm 4\%$  from 0 - 20% and 80 - 100% RH. The sensor shall be a four-wire device and connect to controller by means of a four-wire unshielded cable. Sensor shall be available with integral PTC industrial platinum temperature sensor shall change its output voltage with change in sensed humidity.
- K. Absolute humidity (Dewpoint) sensor shall utilize a lithium chloride element to sense the actual quantity of water per volume of dry air when the relative humidity is from 12% to 100%. The sensor shall be highly repeatable at a given temperature and change its output resistance with a change of water content in the air. The four-wire sensor shall connect to the controller by means of a four-wire unshielded cable.
- L. Air velocity sensor shall be capable of linear indication of the velocity of air in a duct from 0 to 3000 FPM, and shall vary its output voltage with a change in air velocity. The sensor shall connect to the controller by means of a four-wire unshielded cable.

- M. Outdoor air sensor shall be of the thermistor (NTC) type with a high resistance change versus temperature change. Sensor shall be available for outdoor or duct mounting. Sensor shall connect to remote controller by means of a two-wire unshielded cable. Outdoor type sensor shall be available with integral wind sensor which changes its output voltage with a change in wind velocity. Combination sensor shall connect to controller by means of five-wire unshielded cable.
- N. Contamination sensor shall vary the conductivity as the degree of gas or smoke concentration changes. The sensor shall connect to the remote control by means of a three-wire unshielded cable.
- O. Solar sensor shall be designed to mount on the interior side of a window pane reference room. The side facing the sun shall be coated with a dull black lacquer to transform the incoming solar energy into heat. The temperature of the measuring plate shall represent an exact value of the radiation influence and shall not be affected by the ambient temperature in the reference room. The sensor shall connect to the remote controller by means of a two-wire unshielded cable.
- P. Duct sensor/adaptor shall be of the thermistor (NTC) type and suitable for mounting directly to the back of the integral sensor/controller making it capable of duct temperature sensing as a single unit.
- Q. Carbon Monoxide and Nitrogen Dioxide Sensors/Transmitters:
1. Fully addressable, the gas transmitter must be capable of transmitting gas concentrations digitally to the control system, and shall be capable of sending an analog 4-20mA signal to the building control system. The gas transmitters must be installed in a true daisy chain with an end of line resistor on the last transmitter. Capable of remote sensing at distances of up to 300 feet, the gas transmitter will incorporate an electrochemical cell. The unit's sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy, capable of operating within relative humidity ranges of 5-90% and temperature ranges of 0°F to 110°F (-18°C to 43°C).
  2. A 10-step LED display (with the possibility of adding to optional LCD) will provide gas concentration readings. A green LED will indicate normal operation and a yellow LED will indicate fault operation. The transmitter must also be capable of incorporating an audible alarm (rated at no less than 65Db at a distance of 3 feet), which will be activated at fully programmable levels through an associated control panel. The unit will be manufactured to UL 1244 label and CSA 22.2. Provided any necessary control panels from same manufacturer.
  3. Manufacturer/Model: Vulcain 201T CO and 201T NO2.
- R. Door Contact Sensor shall be suitable for mounting directly to glass roll up door. Sensor shall provide signal to air handler for open/close status.
- S. Carbon Dioxide Sensors/Transmitters:
1. Fully addressable, the gas transmitter must be capable of transmitting gas concentrations digitally to the control system, and shall be capable of sending an analog 4-20mA signal to the building control system with continuous monitoring.

2. Relay output with adjustable setpoint. Digital display. Electrically isolated.
3. Non-dispersive infrared sensor (NDIR). 0-5,000 PPM with  $\pm 5\%$  reading and  $\pm 75$  PPM tolerance. Minimum of 1 minute response time. Continuous proportional analog sensor signal output.
4. Manufacturer/Model: INTEC Controls I-301e.

## 2.2 FACILITY MANAGEMENT CONTROL SYSTEM (FMCS)

- A. The Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers. The FMCS shall incorporate technology using Free Topology Transceivers (FTT-10), or Ethernet in all unitary, terminal and other device controllers. The system shall include:
  1. Programmable Equipment Controllers (PEC's) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.
- B. Network Area Controllers (NAC's) for distributed system applications, databases and networking functions.
- C. Application Specific Controllers (ASC's) for control of VAV terminal units, Fan coil terminal units, Unit Vent terminal units, Heat Pump units and other terminal equipment.
- D. Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices.

2.3 The PEC and ASC network shall communicate at a minimum 78Kbps. The GUI and NAC shall reside on a Ethernet backbone.

2.4 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices.

## 2.5 NETWORK AREA CONTROLLER (NAC)

- A. The Network Area Controller (NAC) shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
  1. Calendar functions
  2. Scheduling
  3. Trending
  4. Alarm monitoring and routing
  5. Time synchronization
  6. Integration of controller data
  7. Integration of BACnet and MODBUS networks

- B. The NAC shall provide multiple, concurrent user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- C. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
  - 1. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
  - 2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
    - a. To alarm
    - b. Return to normal
    - c. To fault
  - 3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
  - 4. Provide timed (schedule) routing of alarms by class, object, group, or node.
  - 5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- D. Alarms shall be annunciated in any of the following manners as user defined:
  - 1. Screen message text.
  - 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
    - a. Day of week
    - b. Time of day
    - c. Recipient
- E. The following shall be recorded by the NAC for each alarm (at a minimum):
  - 1. Time and date
  - 2. Location (building, floor, zone, office number, etc.)
  - 3. Equipment (air handler #, accessway, etc.)
  - 4. Acknowledge time, date, and user who issued acknowledgement.
- F. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- G. A log of all alarms shall be maintained by the NAC and/or a server and shall be available for review by the user.
- H. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- I. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

- J. An Error Log to record system errors shall be provided and available for review by the user.
- K. Data Collection and Storage
1. The NAC shall collect data for any property of any object and store this data for future use.
  2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
    - a. Designating the log as interval or deviation.
    - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
    - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
    - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
    - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
  3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a standard Web Browser.
  4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
  5. All log data shall be available to the user in the following data formats:
    - a. HTML
    - b. XML
    - c. Plain Text
    - d. Comma or tab separated values
  6. The NAC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
    - a. Archive on time of day
    - b. Archive on user-defined number of data stores in the buffer (size)
    - c. Archive when buffer has reached it's user-defined capacity
- L. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
  2. User ID
  3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

- M. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time of day.
  - 1. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
  - 2. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

## 2.6 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

- A. Programmable Equipment Controllers (PEC's) shall be stand-alone, multi-tasking, real-time digital control processors.
- B. The PEC must communicate peer-to-peer with all of the network application specific, programmable controllers.
- C. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.
- D. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.
- E. PEC's shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
- F. A single process shall be able to incorporate measured or calculated data from any and all other PEC's on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC's on the network.
- G. Each PEC shall support firmware upgrades without the need to replace hardware.
- H. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC's to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
  - 1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.

2. All PEC's control programming and databases must be stored in Flash memory, therefore eliminating data loss, downtime and re-load time.
- J. Provide a separate PEC for each AHU or other HVAC system such that the inputs, calculations, and outputs shall reside on a single controller.

## 2.7 APPLICATION SPECIFIC CONTROLLERS (ASC)

- A. Each Application Specific Controller (ASC) shall operate as a stand-alone controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.
- B. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power.
- C. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.
- D. The control program shall reside in the ASC. The application program and the configuration information shall be stored in non-volatile memory with no battery back-up required.
- E. After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

## 2.8 GRAPHICAL USER INTERFACE SOFTWARE (GUI)

- A. Command of points from multiple manufacturers shall be transparent to the operator.
- B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows XP 32-bit operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line FMCS alarms and monitoring information. If the software is unable to display several different types of displays at the same time, the FMCS contractor shall provide at least two operator workstations at each location specified.
- C. Real-Time Displays. The Graphical User Interface (GUI), shall at a minimum, support the following graphical features and functions:
  1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures and streaming video.



2. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.
  3. A gallery of HVAC and automation symbols shall be provided, including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
  4. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
  5. Graphics shall include layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
  6. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
    - a. Schedule times will be easily adjustable by the operator.
    - b. Holidays shall be set by mouse command using a graphical calendar.
  7. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu.
- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies, alarms, and schedules.
  2. Add/delete objects to the system.
  3. Tune control loops through the adjustment of control loop parameters.
  4. Enable or disable control strategies.
  5. Generate hard copy records or control strategies on a printer.
  6. Select points to be alarmable and define the alarm state.
  7. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. All graphic displays shall be provided using web browser client as specified in 2.11.

- H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
- I. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable. The alarm console shall be loaded and operated at the following locations.

## 2.9 PROJECT SPECIFIC WEB PAGES

- A. Home page shall include a campus layout of the individual buildings at the site. Once an individual building is selected the following minimum web-based tree structure shall be provided. All graphics shall be submitted with the controls submittal package.
  - 1. Documents Page: The document page shall include the O&M Manuals for the control system in PDF format along with AutoCAD drawings for each drawing provided in the control system O&M Manual. This document page shall include links between the control diagrams and associated data sheet in PDF format, such that the system user shall be able to click on the control device and retrieve, in PDF format, the factory O&M sheets associated with that device.
  - 2. Station Functions:
    - a. Logging separate sheet of station functions for a particular selected building shall be the viewing of one or more logs or the creation of logs in which any value at any point, or the mode of any point, shall be selected via the web to be trended against any other point with an adjustable frequency in seconds, minutes, hours or days.
    - b. The alarm acknowledgement via the web shall allow the viewing and acknowledgement of the alarms.
    - c. Audit log shall be provided via the web to show the operator actions as well as other audit logs as specified in section 2.4 Network Area Controller (NAC) paragraph "M" Data Collection and Storage.
  - 3. Floor Plans:
    - a. AutoCAD drawings of floor plans shall be provided in the control system such that via the web the user shall be able to turn layers on and off on the mechanical floor plans. These floor plans shall also include an overlay of the temperature control as-built wiring for the project showing thermostat locations, communication runs, transformer locations, controller locations, etc.
    - b. Floor Display Summaries. The operator shall be able to select floor plans displaying the following formats:
      - 1) All zone temperatures

- 2) All zone heating percentages
  - 3) All zone cooling percentages
  - 4) All zone room names and numbers
  - 5) All zones cfm delivered.
4. Upon selecting a graphical floor plan layout the web page shall show all the zone temperature sensor locations on the floor. By clicking on the zone temperature location, an individual VAV box graphic shall be displayed with the following attributes:
- a. A manual menu that shall allow the operator to manually set the air flow set point, space temperature set point, damper position, cooling percentage, heating percentage, and zero the box.
  - b. A 24 hour log chart that shows space temperature history, flow history, and allows the operator to build custom charts by comparing this log to other associated selectable logs.
  - c. A display of the VAV box discharge temperature, air handler discharge temperature, space temperature, and space temperature set point.
  - d. The graphic shall display actual CFM, current air flow, and current air floor set point, percentage of heating and cooling changes and mode.
  - e. The damper position, reheat valve position, occupancy status, room name and heating/cooling mode shall also be shown.

B. Systems:

1. On selecting the systems menu, a tree structure shall allow the operator to select the air handlers, chillers, control valves, heat exchangers, med gas, etc. systems associated with that building. The graphics shall also show the piping and ductwork associated with the air handler as well as the safeties, temperature sensors, humidity sensors, dampers, VFD's, associated with that fan system. See points lists for specifics.
2. All devices that provide dynamic function in the primary equipment, i.e., fans, pumps, coils, dampers shall be dynamic in nature showing their operating status/percentage of capacity by movement on the web page.
3. The set points for the various control loops shall be adjustable via the web page. Individual controlled devices, i.e., valves, dampers, fans shall be controlled via the web page and be stopped or started or placed in a command state or percentage of value output.

## 2.10 FIELD DEVICES

- A. Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.

## B. Temperature Sensors:

1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application.
2. Space (room) sensors shall be available with setpoint adjustment and override switch.
3. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
4. Sunshields shall be provided for outside air sensors.
5. Thermo-wells for all immersion sensors shall be stainless steel or brass as required for the application.

C. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90%  $\pm 5\%$ . Supply air humidity sensors shall have a range of 10% to 90%  $\pm 5\%$ .

## D. Pressure Sensors: The differential pressure sensor shall be temperature compensated and shall vary the output voltage with a change in differential pressure. Sensing range shall be suitable for the application with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.

## E. Flat plate (flush mount) temperature sensors shall be installed as directed by architect in public corridors, behavior health and any other locations where gurneys and/or carts could damage sensors and where public access of setpoint is not desired.

## 2.11 SWITCHES AND THERMOSTATS

- A. The FMCS Contractor shall furnish all electric relays and coordinate with the supplier of magnetic starters for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
- B. Duct Smoke Detectors: Duct smoke detectors shall be supplied by others with an integral auxiliary contact to be used by the FMCS contractor to provide a digital input to the FMCS.
- C. Low Temperature Detection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction thereof.

- D. Differential Pressure Switches: Pressure differential switches shall have SPDT changeover contact, switching at an adjustable differential pressure setpoint.
- E. Current Sensing Relays: Motor status indications, where shown on the plans, shall be provided via current sensing relays. The switch output contact shall be rated for 30 VDC, .15 amps.
- F. Flow Switches: Motor status indications, where shown on the plans, shall be provided via flow switches. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow.
- G. Carbon Monoxide Detector and Controller shall meet or exceed UL 2034 standard and OSHA standards for CO exposure. Controller shall be solid state sensor. Fan relay shall activate at 35 ppm of CO averaged over 5 minutes. Alarm relay shall activate at 100 ppm after 30 minutes. Approved manufacturers shall be Macurco, Inc or approved equal.

## 2.12 TERMINAL EQUIPMENT CONTROLLERS (TEC)

- A. Terminal Equipment stats for all equipment shall include a digital key pad and display with the following functionality.
  - 1. The stat shall provide visual indication of occupancy status, heating and cooling mode, space temperature, space temperature set point. The operator shall be able to adjust space temperature set point and also change the zone mode from occupied to unoccupied.
  - 2. In the service mode or commissioning mode, on entry of the appropriate PIN number, the operator will be able to view and change heating dead band and cooling maximum volume setting. The operator shall be able to command the controller to heating or cooling, i.e., the thermostat key pad functions as a commissioning/programming device.
- B. Device shall have a back-lit digital display.
- C. The com port on this stat shall allow the building engineer to access and command any point on the network using a lap top computer.

## 2.13 DAMPER ACTUATORS

- A. Actuators shall be of the push-pull or rotary type for either modulating or two-positioning control. Actuators shall stroke by a rotating motion of an overload-proof synchronous motor. Control voltage shall be either 24 VAC or 0-10 VDC as required by the application. Actuators shall be available with spring return to the fully extended position upon power failure. Three (3) point floating actuator shall be available with adjustable end switches. Minimum/maximum manual positioners shall be available for all motors.
- B. Mixing box actuators shall be of the rotary drive type as required, capable of permanent stall operation without damage. Rotary drive actuators shall have adjustable stop pins for stroke limit and shall fit directly over the damper shaft. Gears shall be nickel steel. Gears and bearings shall be oil impregnated for lifetime lubrication.

- C. High temperature cut-outs (HTCO) shall be designed to be mounted in the return air or exhaust duct system and wired to shutdown fans when air temperature rises above its setpoint. HTCO shall be of the manual reset type and supplied for all fans over 2000 CFM.
- D. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow. Flow switches shall be of the vapor-proof type similar to McDonnell Miller FS8-V.
- E. Line voltage to 24 VAC transformer shall be supplied as required to provide adequate control voltage to control system.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Installation of the automatic control system shall be made and supervised by mechanics who are full time employees of the Controls Subcontractor.
- B. All installation work shall be scheduled and coordinated with other trades to expedite job progress.
- C. The installation shall match erection of slabs and walls such that no damage, cutting or patching will be required.
- D. All work shall be installed in accordance with current control industry practices.
- E. Only top quality workmanship will be permitted.
- F. Any work not properly executed shall be removed and replaced without extra expense to the Owner.
- G. Contractor Performance:
  - 1. The contractor shall uphold and advance the integrity, honor and dignity of the profession by:
    - a. using their knowledge and skill for the enhancement of human welfare;
    - b. being honest and impartial, and serving with fidelity the public, their employers and clients;
    - c. striving to increase the competence and prestige of the profession; and
  - 2. The contractor shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
  - 3. The contractor shall perform services only in the areas of their competence.
  - 4. The contractor shall issue public statements only in an objective and truthful manner.

5. The contractor shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
6. The contractor shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
7. The contractor shall consider the environmental impact in the performance of their professional duties.
8. The contractor shall associate only with reputable persons or organizations.

### 3.2 SENSORS AND GUARDS

- A. Temperature controls trades shall verify all wall mounted sensor locations with the General Contractor in order to avoid interference with wall mounted furnishings.
  1. Where interferences require moving the sensor more than two feet, consult with the Engineer for new location.

### 3.3 FREEZE PROTECTION THERMOSTATS

- A. Provide freeze stat as shown on drawings to stop the fan and close the outside damper upon sensing any one foot section below 40°F (adjustable).

### 3.4 ELECTRIC WIRING

- A. All control and interlock wiring shall be as specified in "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods. Provide diagrams and coordinate all work with the Division 26 contractor as required.

### 3.5 SERVICE AND WARRANTY

- A. The control system herein specified shall be free from defects and workmanship and material under normal use and service. After completion of the installation the controls contractor shall regulate and adjust all thermostats, control valves, damper motors and other equipment provided under this contract. If within twelve (12) months from the date of completion any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired free of charge in accordance with "Warranties" paragraph in Section 230500.
- B. The controls contractor shall after completion, provide any service incidental to the proper performance of the control system under guarantees outlined in Division 1 for the period of one year.
- C. When all devices are installed, a fully qualified technician shall set, adjust and calibrate all components.
  1. A letter certifying completion of the system shall be forwarded to the Engineer's office, prior to acceptance of project by Owner.

### 3.6 INSTRUCTION AND ADJUSTMENT

- A. On completion of the job the controls contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on operation of the control system and supply him with three (3) copies of the control operating and instruction manuals. He shall obtain from the owner's representative a signed receipt that he has received the instruction manuals and complete instructions on the operation of the system.
- B. Record Drawing: At completion of the job the controls contractor shall furnish two (2) copies of corrected wiring diagrams, one enclosed in laminated plastic and mounted on wall of the main mechanical room or as directed.
- C. Contractor Adjustments: At the completion of the job the controls contractor must submit to the Architect a letter stating that he has made final calibrations and adjustments to the system and that the owner's operating personnel have been instructed in its use.

### 3.7 SEQUENCE OF OPERATION

- A. Air Handlers AH-1A & AH-1B
  - 1. Run Conditions – Scheduled  
The unit shall run according to a user definable time schedule in the following modes:
    - a. Occupied Mode: The unit shall maintain
      - A 74° F (adj.) cooling set point.
      - A 74° F (adj.) heating set point.
    - b. Unoccupied Mode: The unit shall maintain
      - A 80° F (adj.) cooling set point.
      - A 60° F (adj.) heating set point.
  - 2. Zone Setpoint Adjust:  
The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
  - 3. Zone Occupied Override:  
A timed local override control shall allow an occupant to override the schedule and place the unit into occupied mode for an adjustable period of time. At the expiration of the time, control of the unit shall automatically return to the schedule.
  - 4. Return Air Smoke Detection:  
The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.
  - 5. Supply Fan:



The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

a. Alarms shall be provided as follows:

- Supply Fan Failure: Command on, but status off.
- Supply Fan in Hand: Command off, but status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

6. Cooling Stage:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

a. The cooling shall be enabled whenever:

- Outside air temperature is greater than 60° F (adj.).
- And the economizer is disabled.
- And the zone temperature is above cooling setpoint.
- And the supply fan status is on.
- And the heating is not active.

7. Heating Stage:

The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

a. The heating shall be enabled whenever:

- Outside air temperature is less than 60° F (adj.).
- And the zone temperature is below heating setpoint.
- And the supply fan status is on.
- And the cooling is not active.

8. Economizer:

The controller shall measure the zone temperature and modulate the economizer damper and return damper in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 5% (adj.) open whenever occupied to maintain building slightly positive pressure.

a. The economizer shall be enabled whenever:

- Outside air temperature is less than 65° F (adj.).
- And the outside air temperature is less than the return air temperature.
- And the supply fan status is on.

b. The economizer shall close whenever:

- Mixed air temperature drops below 40°F (adj.).
- Or on loss of supply fan status.

c. The return air damper shall close and relief air dampers shall open when economizer mode is enabled.

- d. The return air damper shall open and relief air dampers close when economizer mode is disabled.
9. Minimum Outside Air Ventilation – Carbon Dioxide (CO<sub>2</sub>) Control:  
When in the occupied mode, the controller shall measure the return air CO<sub>2</sub> levels and modulate the outside air dampers open on rising CO<sub>2</sub> concentrations, overriding normal damper operation to maintain a CO<sub>2</sub> setpoint of 750 ppm (adj.).
10. Prefilter Differential Pressure Monitor:  
The controller shall monitor the differential pressure across the prefilter.
  - a. Alarms shall be provided as follows:
    - Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).
11. Activity Room Roll Up Door Contact Sensor:  
The controller shall monitor the roll up door contact sensors.
  - a. The supply fan shall shutdown whenever:
    - Any roll up door contact sensors indicate the doors are open.
12. Mixed Air Temperature:  
The controller shall monitor the mixed air temperatures and use as required for economizer control..
  - a. The controller shall monitor the mixed air temperature and use as required for economizer control.
  - b. Alarms shall be provided as follows:
    - High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
    - Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).
13. Return Air Carbon Dioxide (CO<sub>2</sub>) Concentration Monitoring:  
The controller shall measure the return air CO<sub>2</sub> concentration.
14. Return Air Temperature:  
The controller shall monitor the return air temperature and use as required for economizer control.
  - a. Alarms shall be provided as follows:
    - High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
    - Low Return Air Temp: If the return air temperature is less than 45°F (adj.).
15. Supply Air Temperature:  
The controller shall measure the supply air temperature.
  - a. Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Roll Up Door Contact Sensors	x										x
Mixed Air Temp	x								x		x
Prefilter Differential Pressure	x								x		
Return Air Carbon Dioxide PPM	x								x		x
Return Air Temp	x								x		x
Supply Air Temp	x								x		x
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Mixed Air Dampers		x							x		x
Freezestat			x						x	x	x
Return Air Smoke Detector			x						x	x	x
Supply Fan Status			x						x		x
Zone Override			x						x		x
Cooling Stage 1				x					x		x
Heating Stage 1				x					x		x
Supply Fan Start/Stop				x					x		x
Cooling Setpoint					x				x		x
Economizer Zone Temp Setpoint					x				x		x
Heating Setpoint					x				x		x
Return Air Carbon Dioxide PPM Setpoint					x				x		x
Schedule								x			
Compressor Runtime Exceeded										x	
High Mixed Air Temp										x	
High Return Air Carbon Dioxide Concentration										x	
High Return Air Temp										x	
High Supply Air Temp										x	
High Zone Temp										x	
Low Mixed Air Temp										x	
Low Return Air Temp										x	
Low Supply Air Temp										x	
Low Zone Temp										x	

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Prefilter Change Required										x	x
Supply Fan Failure										x	
Supply Fan in Hand										x	
Supply Fan Runtime Exceeded										x	
<b>Totals</b>	<b>8</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>18</b>	<b>16</b>	<b>20</b>

B. Ground Mounted Roof Top Unit RTU-1

1. Run Conditions – Scheduled

The unit shall run according to a user definable time schedule in the following modes:

c. Occupied Mode: The unit shall maintain

- A 74° F (adj.) cooling set point.
- A 74° F (adj.) heating set point.

d. Unoccupied Mode: The unit shall maintain

- A 80° F (adj.) cooling set point.
- A 60° F (adj.) heating set point.

2. Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

3. Zone Occupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into occupied mode for an adjustable period of time. At the expiration of the time, control of the unit shall automatically return to the schedule.

4. Return Air Smoke Detection:

The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

5. Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

b. Alarms shall be provided as follows:

- Supply Fan Failure: Command on, but status off.
- Supply Fan in Hand: Command off, but status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

6. Cooling Stage:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

b. The cooling shall be enabled whenever:

- Outside air temperature is greater than 60° F (adj.).
- And the economizer is disabled.
- And the zone temperature is above cooling setpoint.
- And the supply fan status is on.
- And the heating is not active.

7. Heating Stage:

The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

b. The heating shall be enabled whenever:

- Outside air temperature is less than 60° F (adj.).
- And the zone temperature is below heating setpoint.
- And the supply fan status is on.
- And the cooling is not active.

8. Economizer:

The controller shall measure the zone temperature and modulate the economizer damper and return dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 21% (adj.) open whenever occupied.

e. The economizer shall be enabled whenever:

- Outside air temperature is less than 65° F (adj.).
- And the outside air temperature is less than the return air temperature.
- And the supply fan status is on.

f. The economizer shall close whenever:

- Mixed air temperature drops below 40°F (adj.).
- Or on loss of supply fan status.

g. The return air damper shall close and relief air dampers shall open when economizer mode is enabled.

h. The return air damper shall open and relief air dampers close when economizer mode is disabled.

9. Prefilter Differential Pressure Monitor:

The controller shall monitor the differential pressure across the prefilter.

b. Alarms shall be provided as follows:

- Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

10. Mixed Air Temperature:

The controller shall monitor the mixed air temperatures and use as required for economizer control..

- c. The controller shall monitor the mixed air temperature and use as required for economizer control.
- d. Alarms shall be provided as follows:
  - High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
  - Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

11. Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control.

- b. Alarms shall be provided as follows:
  - High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
  - Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

12. Supply Air Temperature:

The controller shall measure the supply air temperature.

- b. Alarms shall be provided as follows:
  - High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
  - Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Mixed Air Temp	x								x		x
Prefilter Differential Pressure	x								x		
Return Air Temp	x								x		x
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Mixed Air Dampers		x							x		x
Supply Fan VFD Speed		x							x		x
Freezestat			x						x	x	x
Return Air Smoke Detector			x						x	x	x
Supply Fan Status			x						x		x
Supply Fan VFD Fault			x						x		x
Zone Override			x						x		x
Cooling Stage 1				x					x		x
Heating Stage 1				x					x		x

Point Name	Hardware Points				Software Points						Show On Graphic
	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	
Supply Fan Start/Stop				x					x		x
Cooling Setpoint					x				x		x
Economizer Zone Temp Setpoint					x				x		x
Heating Setpoint					x				x		x
Schedule								x			
Compressor Runtime Exceeded										x	
High Mixed Air Temp										x	
High Return Air Temp										x	
High Zone Temp										x	
Low Mixed Air Temp										x	
Low Return Air Temp										x	
Low Zone Temp										x	
Prefilter Change Required										x	x
Supply Fan Failure										x	
Supply Fan in Hand										x	
Supply Fan Runtime Exceeded										x	
<b>Totals</b>	<b>5</b>	<b>2</b>	<b>5</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>17</b>	<b>13</b>	<b>18</b>

C. Ductless DX Cooling Only Mini Split DFC-1 & ACU-1

1. Run Conditions – Continuous:

The unit shall run continuous and shall maintain:

- a. A 74° F (adj.) cooling set point.

2. Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

3. Freeze Protection:

The unit shall shut down and generate alarm upon receiving a freezestat status.

4. Fan:

The fan shall run anytime the unit is commanded to run, unless shutdown on safeties.

5. Cooling:

The controller shall measure the zone temperature and cycle the compressor to maintain its setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime. The compressor shall run subject to its own internal safeties and controls.

6. Alarms:  
Compressor Runtime Exceeded: The compressor runtime exceeds a user definable limit (adj.).

D. Electric Unit Heater EH-1 thru EH-8

1. Run Conditions – Continuous:  
The unit shall run continuously and shall maintain a heating setpoint of 60°F (adj.).
2. Zone Setpoint Adjust:  
The occupant shall be able to adjust the zone temperature heating setpoints at the zone sensor.
3. Fan:  
The fan shall run anytime the zone temperature drops below heating setpoint, unless shutdown on safeties.

E. Exhaust Fan EF-1

1. Run Conditions – Interlocked:  
The fan(s) EF-1 shall be interlocked to run whenever RTU-1 runs unless shutdown on safeties.
2. Exhaust Air Damper:  
The exhaust air damper shall open anytime the unit runs and shall close anytime the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.

F. Exhaust Fan EF-2

1. Run Conditions – Scheduled:  
The unit shall be enabled according to a user definable time schedule in the following modes:
  - a. Occupied Mode: The unit shall maintain a zone temperature cooling setpoint of 78°F (adj.).
  - b. Unoccupied Mode (night setback): The unit shall maintain a zone temperature cooling setpoint of 85°F (adj.).
2. Fan:  
The fan shall run anytime the zone temperature rises above cooling setpoint, unless shutdown on safeties.
3. Exhaust Air Damper:  
The exhaust air damper shall open anytime the unit runs and shall close anytime the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.

END OF SECTION 230900



## SECTION 231123 - NATURAL GAS SYSTEM

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Pipe and Fittings.
- B. Gas Meter.
- C. Gas Pressure Regulator.

## 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500 - Basic Mechanical Requirements.

## 1.3 RELATED SECTIONS

- A. Section 230529- Basic Mechanical Materials and Methods: Valves, pipe hangers, supports and accessories.
- B. Section 230548 - Mechanical Seismic Control.
- C. Section 224450 - Plumbing Equipment: Gas supply and runout with gas cock or valve to water heater connection points.
- D. Section 237400 - Air Handling Systems: Gas supply and runout with gas cock or valve to packaged air handler connection points.

## 1.4 REFERENCES

- A. NFPA 54 (ANSI Z223.1) - National Fuel Gas Code.
- B. ANSI Z223.1a - Supplement to National Fuel Gas Code.

## 1.5 DEFINITIONS

- A. The following are references with definition acronyms used in this section:
  - 1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
  - 2. F.M. - Factory Mutual Engineering Division.

3. IRI - Industrial Risk Insurers AKA: F.I.A. Factory Insurance Association.
4. Jurisdictional Agencies:
  - a. Building Department.
  - b. Fire Department or Fire Prevention Bureau or Marshal.
  - c. Insurance Agency, Carrier, and/or Underwriter.
  - d. Engineer refers to the consulting Mechanical Engineer of record.

#### 1.6 SYSTEM DESCRIPTION

- A. Provide gas supply from gas meter outlet to all gas consuming equipment complete with piping, meters, valves, unions, dirt legs, hangers, supports, anchors, expansion compensators and regulators.

#### 1.7 QUALITY ASSURANCE

- A. Welding: Welders shall be certified in accordance with requirements in Section 230529.

#### 1.8 REGULATORY REQUIREMENTS

- A. Conform to Regulatory Requirements listed in Section 230500.
- B. Provide special inspections required in IBC Chapter 17.

#### 1.9 SUBMITTALS

- A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:
  1. Pipe, fittings, valves, hangers and supports.
  2. Regulators.
  3. Meters.
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:
  1. Regulators.
  2. Meters.
  3. Valves.
- C. Submit certified test reports, dated and signed by authorized person showing compliance of tests of the fuel gas systems, in accordance with the Contract Documents.

## 1.10 SEQUENCING/SCHEDULING

- A. Coordinate all work with all other trades and utility companies for elimination of interference, utilization of combined hanger support systems, timely routing and installation of systems, verifications of existing connector utilities, locations, depths, connection regulation, proper valving and junction structures or fittings. Location of meters, and remote readers as applicable and appropriate.

## 1.11 WARRANTIES

- A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.
- B. Provide 20 year full warranty on all cathodic protection and pipe wrapping against corrosion of piping due to electrolytic or active soil conditions.

## 1.12 GAS SERVICE

- A. Arrange with Utility Company to provide gas service to indicated location with shut-off at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. 231123 Contractor shall pay such costs and fees; obtain permits.

## PART 2 - PRODUCTS

## 2.1 PIPE AND FITTINGS

- A. Interior Exposed or Accessible:

- 1. Size 1/2" thru 1-1/2":

- Pipe: Schedule 40, ASTM A 53

- Fittings: Threaded malleable iron

- Joint Seal: Teflon

- Unions: Black malleable iron ground joint, bronze to iron seat, 150 lb. class, ANSI B2.1 and ASTM A 197.

- 2. Size 2" and over:

- Pipe: Schedule 40, ASTM A53, Type S Grade B

- Fittings: Butt weld ASTM A 234

- Unions: 150 lb. forged steel weld neck flange, ANSI B16.5 and ASTM A105.

- B. Interior, concealed, non-accessible spaces and return air plenums:

Use no unions, tubing fittings, right or left couplings, bushing, shut-off valves, compression coupling, or swing joints made by combinations of fittings.

## 2.2 GAS METER

- A. As provided by utility company.

## 2.3 GAS PRESSURE REGULATOR

- A. General: Provide single stage, steel jacketed, corrosion-resistant gas pressure regulators with atmospheric vent, elevation compensator; with threaded ends for 2" and smaller, flanged ends for 2-1/2" and larger; for inlet and outlet gas pressures, specific gravity, and volume flow required.
- B. Provide vent-limited or vented gas pressure regulators as required by appliance served. Vented regulators shall be piped to vent to outdoors per jurisdictional requirements.

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Welding, wiring, sleeves, plates and closures, foundations and pads, excavation and backfill, cutting and patching and installation of piping, valves, pipe hangers, supports, expansion compensators and identification shall be in accordance with Section 230529 - Basic Mechanical Materials and Methods.
- B. Provide all fuel gas piping from source to each connection point of all gas fired equipment items listed in "Related Work" paragraph in Part 1. Provide drip leg and gas cock or valve for each equipment item. Make final connections in compliance with equipment manufacturer's instructions. Flexible connections will not be allowed except where explicitly specified.

## 3.2 PIPING

- A. General:
  - 1. Install fuel gas distribution piping in accordance with jurisdiction codes and local Utility Company requirements and in conformity with standards listed in "References" paragraph in Part 1.
  - 2. Install "Tee" fitting with bottom outlet fitted with full size 6" long nipple and capped, at bottom of pipe risers or drops.
  - 3. Use dielectric unions where dissimilar metals are joined together.

4. Use Teflon joint seal on metal gas piping threads, make up with 3 threads showing.
  5. Remove cutting and threading burrs before assembling piping.
  6. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.
  7. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.
  8. Connections to all gas-fired equipment shall include a union downstream of the manual gas shut-off valve.
  9. For buried piping outside of building walls, piping shall rise out of ground 12" before penetrating building wall.
  10. Provide exterior gas piping and fittings with primed and painted surface. Coordinate color with Owner, Architect, and authority having jurisdiction.
- B. Buried Piping: Welded and wrapped with joints left exposed until testing has been accepted. Bury 24" below grade minimum.
- C. Wrapping:
1. Provide factory applied pipe wrap in accordance with standard of serving utility company. Hand wrap or machine wrap buried exterior gas piping with Scotchwrap 10 mil PVC tape using 50% overlap wrap minimum. Double wrap fittings and joints. Extend fitting wrapping not less than 6 inches past the end of the fitting onto the pipe section. Test pipe and fittings prior to wrapping fittings. Coat steel and iron pipe with Scotchwrap pipe primer before wrapping.
  2. Pipe wrapping shall conform to the following schedule:
- | Pipe Size         | Tape Width  | Scotchwrap No. |       |
|-------------------|-------------|----------------|-------|
|                   |             | Standard       | Cold  |
| 1/4 - 3/4 inch    | 1 inch      | 50             | 40    |
| 1 - 1-1/2 inch    | 2 or 4 inch | 50             | 40    |
| 2 inch and larger | 4 inch      | 50             | 40    |
| Color Backing     |             | Black          | Green |
3. During application of wrap, if the ambient temperature is 40 deg.F or less, use only Scotchwrap No. 40 tape. If ambient temperature is 41 deg.F or more, use only Scotchwrap No. 50.
- D. Buried Pipe Identification: Install bright colored continuously printed plastic ribbon tape of not less than 6 inches width and 4 mil thickness 6 to 8 inches below finished grade directly over buried pipe. Provide metalized tape over non-metallic pipe.
- E. Interior Concealed Piping: All pipe and fittings shall be welded. Do not install valves of any type in air plenums or concealed spaces.

## 3.3 HANGERS AND SUPPORT SYSTEMS (Interior)

- A. Provide pipe hangers, supports and accessories in accordance with Section 230529 - Basic Mechanical Materials and Methods.

## 3.4 VALVES

- A. Provide valves in accordance with Section 230529 - Basic Mechanical Materials and Methods.

## 3.5 GAS COCKS AND GAS VALVES

- A. Provide at supply runout connection for each gas-fired equipment item; and on risers and branches where indicated.
- B. Locate gas cocks and valves where easily accessible, and where they will be protected from possible damage.

## 3.6 GAS SERVICE

- A. Complete arrangements with Utility Company to provide gas service to indicated location with shut-off at terminus.
- B. Extend service pipe from Utility's terminus to inside building wall, under Utility's direction.
- C. Provide shut-off outside building where indicated, in adjustable gas service valve box, with cover set flush to finished grade.

## 3.7 GAS METER

- A. Be responsible to verify with utility company the size and thickness, reinforcing and location of all concrete pads, chain link enclosures, gate requirements, bar-hasp-padlock requirements, and size and type of traffic bollards-guards required.
- B. Provide concrete pad in accordance with Section 230529 - Basic Mechanical Materials and Methods.
- C. Provide enclosures, bumper protection or other accessories which may be required.
- D. Install gas meter in accordance with local Utility Company's installation instructions, and comply with requirements of jurisdictional codes.

## 3.8 GAS PRESSURE REGULATOR

- A. Install as indicated; comply with Utility requirements. Pipe atmospheric vent to outdoors (unless a vent-limited regulator is used), full size of outlet. Install gas shut-off valve upstream of each pressure regulating valve.

## 3.9 TESTS

- A. General: Test fuel supply lines with air under pressure before being covered. Use a calibrated, certified static gauge graduated to one pound per square inch.
- B. Testing shall be of the complete piping system, before covering, or of individually separable larger portions of the system. Only the last connection to the appliance may be tested under operating conditions. This connection will be tested with soap and brush under line pressures. This connection must remain exposed.
- C. Test Procedures: Use either of the following methods at the Contractor's option:
  - 1. 30 psig air pressure for a period of 24 hours with no drop in gauge pressure, indicating the line to be airtight.
  - 2. 100 psig air pressure, with joints tested with standard soap and brush inspection and maintain for 3 hours without drop in pressure.
- D. Retesting: Retest piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.
- E. Test Records: Record pressure and ambient temperature at start and end of test. Submit written results of test to the Architect/Engineer.

END OF SECTION 231123

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## SECTION 233300 - DUCTWORK AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Low pressure ductwork.
- B. Manufactured duct joints.
- C. Damper operator hardware.
- D. Volume control dampers.
- E. Fire dampers.
- F. Combination fire and smoke dampers.
- G. Combination fire, smoke, and control dampers.
- H. Smoke dampers.
- I. Gravity backdraft dampers.
- J. Motorized backdraft dampers.
- K. Insulated flexible round ductwork.
- L. Flexible duct fan connections.
- M. Access door hardware.
- N. Duct access doors.

## 1.2 PRODUCTS INSTALLED BUT NOT FURNISHED IN THIS SECTION

- A. Outside, return, and exhaust air dampers for supply fan/return fan systems per Section 230900.
- C. Sound attenuators per Section 230540.

## 1.3 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

- B. Section 230500 - Basic Mechanical Requirements.

#### 1.4 RELATED SECTIONS

- A. Section 230529 - Basic Mechanical Material and Methods.
- B. Section 230540 - Mechanical, Sound and Vibration Control.
- C. Section 230548 – Mechanical Seismic Control.
- D. Section 230593 - Testing, Adjusting and Balancing.
- E. Section 230700 - Mechanical Insulation.
- F. Section 230900 - Electronic Controls.

#### 1.5 REFERENCES AND CODE REQUIREMENTS

- A. ASHRAE - Handbook 2009 Fundamentals; Duct Design Chapter.
- B. ASHRAE - Handbook 2008 HVAC Systems and Equipment; Duct Construction Chapter.
- C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
- H. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- I. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.  
NFPA 92A - Smoke Control Systems.  
NFPA 92B - Smoke Management Systems.
- L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

- M. SCAQMD Rule 1168 – Adhesive and Sealant Applications
- N. SMACNA - HVAC Duct Construction Standards.
- O. SMACNA - HVAC Air Duct Leakage Test Manual
- P. SMACNA - Fibrous Glass Duct Construction Standards.
- Q. UL 33 - Heat Responsive Links for Fire-Protection Service.
- R. UL 181 - Factory-Made Air Ducts and Connectors.
- S. UL 555 - Fire Dampers and Ceiling Dampers.  
UL 555S - Leakage Rated Dampers for Smoke Control Systems.

#### 1.6 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Design and Construct to SMACNA 2 in. w.g. pressure class. Low pressure duct shall include: Supply duct downstream of VAV boxes, return duct, general/toilet exhaust ducts, fresh air duct, relief duct, smoke exhaust duct and combustion air duct, unless otherwise indicated on drawings.

#### 1.7 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

#### 1.8 SUBMITTALS

- A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:
  - 1. Shop fabricated assemblies including duct or plenum access doors.
  - 2. Duct fittings, particulars such as gauges, sizes, weld, and configuration prior to start of work for low pressure systems.
- B. Submit Product Data for the following items under provision of The General Conditions of the Contract:
  - 1. Combination fire and smoke dampers.
  - 2. Backdraft dampers.

- C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

- 1. Combination Fire and Smoke Dampers.

## 1.9 PROJECT CONDITIONS

- A. Do not fabricate or install any ductwork until Contractor has confirmed that the ductwork can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.
- B. Prepare 1/4" = 1'-0" scale shop drawings of all ductwork and plenums within confines of mechanical rooms for coordination with other trades and the Architectural and structural work.
- C. Provide any and all off-sets and fittings required to coordinate with field conditions. The lack of coordination will not constitute a change in contract price. The contract drawings are of a schematic nature only, exact duct routing and field coordination is the responsibility of the Contractor.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Nonmetallic air ducts and connectors shall conform to UL 181 Class 0 or Class 1.
- B. Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating each side in conformance with ASTM A90.
- C. Fasteners: Rivets, bolts, or sheet metal screws.
- D. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic, and comply with the chemical content requirements of SCAQMD Rule 1168.

### 2.2 LOW PRESSURE DUCTWORK

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures specified or as indicated on drawings.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

- C. Construct fittings with 45 degree wye or 90 degree wye with 45 degree entry.
- D. Round take-offs shall be plain spin collar fittings of 90 degrees unless indicated otherwise on drawings. Round spin collar fittings serving low-pressure duct run-outs to diffusers and grilles may include damper blade with two quadrants, fully retractable zinc alloy bearings, washers, and position handle with wing nut to lock damper position. Include 2-inch position handle standoff where used on externally insulated ducts.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- F. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of airflow.

## 2.3 DUCT SUPPORTS

- A. Hanger Rods: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- B. Hanger Straps for Galvanized Steel Duct: Galvanized steel.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## 2.4 MANUFACTURED DUCT JOINTS

- A. Manufacturer: Ductmate Industries, Inc., TDF, MEZ Industries, Hercules.
- B. Transverse duct joints of medium pressure ductwork shall be made with the Ductmate System components of standard catalog manufacture.

**2.5 DAMPER OPERATOR HARDWARE**

- A. Manufacturers: Ventfabrics Ventlok Regulators, Metropolitan Air.
- B. Other acceptable manufacturers offering equivalent product: Duro Dyne, Daniel.
- C. Regulators and End Bearings.  
  
Damper shaft length:  
12" or less - Ventlok #620 Regulator.  
12" to 20" - Ventlok #635 Regulator and #607 Bearings.  
Larger dampers - Ventlok #640 or #641 Regulator and #607 Bearings.
- D. Provide equivalent model elevated bases for insulated ducts.
- E. Provide remote damper control where any damper does not have permanent access. System to include a locking worm drive gear, 1/4" flexible steel shaft and a concealed ceiling cap of 1". Manufacturers: Young Regulator, Price, or approved equal.

**2.6 VOLUME CONTROL DAMPERS**

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.
- B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.
- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 6 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, polymer or sintered bronze bearings.
- E. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. Specification for low-pressure spin collar fittings with integral balancing dampers is found in paragraph 2.2.

**2.7 FIRE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)**  
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

- A. Acceptable manufacturers: Meet UL-555 requirements.

- B. Furnish and install, where plans show square or rectangular fire wall penetrations, fire dampers constructed and tested in accordance with the current edition of UL-555, Standard For Fire Dampers. Each fire damper shall be marked with a UL classified 1-1/2 hour fire protection rating and "for use in static systems only." In addition each fire damper shall include a 165°F fusible link. Fire dampers shall have damper blades out of air stream for minimum airflow restriction. Fire dampers shall include a factory fabricated steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with manufacturer's instructions shipped with the damper. Fire dampers shall be equivalent to Ruskin model IBD2 "B" Style.
- C. Where plans show round or oval fire wall penetrations, furnish and install fire dampers as described above except that fire damper shall have damper frame and blades completely out of air stream for minimum air flow restriction. Damper shall include a factory fabricated fully welded and sealed steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with these instructions. Fire dampers shall be equivalent to Ruskin model IBD2 "CR" or "CO" Style.
- D. Ducts connecting to sleeves shall be equal to or less than the sleeve thickness. Sleeve gauge requirements are listed in the SMACNA Fire, Smoke and Radiation Damper Installation Guide and outlined in NFPA 90A. If any other duct to sleeve connections are used, sleeve shall be 16 ga. minimum for dampers up 36"x24", and 14 ga. if damper width exceeds 36" or damper height exceeds 24".
- E. Where job conditions require vertical dampers larger than manufacturer's maximum UL tested sizes, contractor will provide and install fire rated mullions in accordance with fire damper manufacturer's instructions.
- F. Where duct gauges allow their use, contractor may, at his option, install square or rectangular fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Retaining angles shall be furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions and the dampers shall be installed in accordance with these instructions. Fire dampers shall be Ruskin model IBD20, IBD40, or IBD60 "B" Style. Where round or oval duct gauges allow their use, contractor may, at his option, install round or oval fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Installation shall be as described above. Sleeves shall be factory sealed airtight. Fire dampers shall be equivalent to Ruskin model IBD20, IBD40, or IBD60 Style "LR" or "LO."
- G. Contractor may, with engineer's approval, use certain models of dampers that afford ease of installation and labor savings such as dampers designed for grills, dampers with S-and-Drivemate breakaway connections, or dampers designed for metal stud wall applications. Install as described above per the manufacturer's UL installation instructions.

**2.8 SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)**

(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

- A. Acceptable manufacturers: Meet UL 555S requirements.
- B. Furnish and install at locations shown on plans, or as described in schedules, Ruskin model SD-60 or equivalent smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.
- C. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.
- D. Each smoke damper shall be equipped with a factory supplied and mounted 120 v electric actuator to close the smoke damper during test, smoke detection, power failure.

**2.9 CORRIDOR FIRE/SMOKE DAMPERS**

- A. Acceptable manufacturers: Meet UL requirements for a "Corridor Damper."
- B. Where tunnel corridor penetrations are square or rectangular, furnish and install at locations shown on the plans or as described in schedules, corridor dampers meeting or exceeding the following specification:
- C. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel and shall be low profile high performance type for lowest pressure drop. The blades shall be single skin galvanized steel 16 gauge minimum with three longitudinal grooves for reinforcement. Bearings shall be stainless steel turning in an extruded hole in frame. (Galvanized or synthetic bearings shall not be acceptable.) Blade edge seals shall be inflatable silicone coated fiberglass material to insure tight seal and low leakage. Seals shall be mechanically locked into blade edge (adhesive or clip fastened seals not acceptable) and shall withstand a minimum of 450°F. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.



- D. Each damper shall be listed as a fire damper and leakage (smoke) damper and classified by Underwriters Laboratories as a "Corridor Damper" for installation in tunnel corridors. They shall be rated for 1 hour fire resistance under UL555 and shall have a minimum leakage rating of Class II under UL555S for use in smoke control systems. Each damper shall bear a UL label designating the damper as "Corridor Damper."
- E. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators.
- F. Damper manufacturer shall provide factory assembled minimum 20 gauge steel sleeve. Damper shall be sealed to the sleeve with a 25/50 flame spread/smoke developed sealant material.
- G. Each corridor damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be automatic remote resettable after test, smoke detection or power failure conditions. After exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1 hour dampers shall be Ruskin model FSD36C or equivalent.
- H. Where tunnel corridors use round neck diffusers, furnish and install round combination fire/smoke dampers for ceiling penetration of tunnel corridors complete with integral surface mounted ceiling diffusers, Ruskin model DFSDR or equivalent. Operation shall be the same as described above.

2.10 FIRE/SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)  
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

- A. Acceptable manufacturers: Meet UL-555S requirements.
- B. Furnish and install at locations shown on plans, or as described in schedules, combination fire/smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

- C. Each combination fire/smoke damper shall be classified 1-1/2 hour for use in fire resistance ratings of less than 3 hours or 3 hour for use for fire resistance ratings of 3 hours or more. They shall be in accordance with UL standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.
- D. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of at least 17" long (contractor to verify maximum requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge for dampers above 84" wide. 12" or 22" single piece picture frame mounting angles shall be factory supplied and shipped on each damper/sleeve assembly. Factory shall supply sleeves to accommodate square, rectangular, round, or oval ducts.
- E. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be manually resettable after activation by heat and after exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1-1/2 hour dampers shall be Ruskin model FSD60 or equivalent and 3 hour dampers shall be Ruskin model FSD60-3 or equivalent.

2.11 GRAVITY BACKDRAFT DAMPERS (LOW VELOCITY COUNTERBALANCE TYPE)  
(< 2.0" w.c.)

- A. Acceptable Manufacturers: Air Balance, American Warming, Arrow United (Type 655), Louvers and Dampers Inc., Prefco, Ruskin (CBD4 or CBD6), C.E. Sparrow, Airstream, Greenheck, Pottorff.
- B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

- C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

## 2.12 INSULATED FLEXIBLE ROUND DUCTWORK

- A. Manufacturer: Flexmaster Type 5B - Insulated.
- B. Other acceptable manufacturers offering equivalent product subject to compliance with specified requirements: Genflex, Thermaflex, Wiremold, Cleve-Flex, H.K. Porter Co., Cal-Flex, Hart & Cooley, Hercules, Quietflex.
- C. Insulated low pressure flexible duct factory fabricated assembly consisting of a polyester coated fiberglass fabric mechanically interlocked by a galvanized steel spiral helix wrapped with minimum R=6 fiberglass insulation sheathed in a vapor barrier jacket. Vapor barrier permeance  $\leq 0.10$  perm, per ASTM E96.
- D. Composite assembly, including insulation and vapor barrier shall be UL Listed 181 for Class 1 Air Duct Material and comply with NFPA Standard 90A.
- E. Accessories: Spin collar fittings with adjustable damper including positive locking regulator damper hardware.

## 2.13 FLEXIBLE DUCT FAN CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.
- B. Indoor: UL listed fire-resistant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.
- C. Outdoor: UL listed hypalon coated woven glass fabric to NFPA 90A, minimum density 24 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

## 2.14 ACCESS DOOR HARDWARE

- A. Manufacturer: Ventfabrics Ventlok Series
- B. Other acceptable manufacturers offering equivalent product: Duro Dyne.

C. Latches, hinges and gasketing:

Doors less than 4 square feet - Series 100.

Doors 4 to 8 square feet - Series 200.

Larger doors and in medium pressure systems - Series 300.

2.15 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards as indicated.
- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- D. Access doors smaller than 12 inches square may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- F. Access doors with sheet metal screw fasteners are not acceptable.
- G. Provide observation window in all access doors installed at control dampers, fire dampers, smoke dampers, and combination fire/smoke dampers so damper blade position can be observed through the window.

PART 3 - EXECUTION

3.1 GENERAL SHEET METAL INSTALLATION

- A. Duct sizes fall within the limiting dimensions indicated on the Drawings. Provide sheet metal duct systems, connections, dampers, duct turns, housings, hinged sheet metal doors and necessary removable access doors for the complete supply, return, and exhaust systems. Install accessories in accordance with manufacturer's instructions.
- B. Wherever exposed ducts pass through walls, floors, or ceilings, a 2-inch flanged sheet-metal collar fitting close around ducts to be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Lock collar to duct.
- C. Wherever ducts penetrate floors or fire walls, install safing insulation to maintain fire wall integrity.

- D. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers.
- F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- G. Where Bellmouth fittings are specifically called for on Drawings, provide standard Bellmouth fittings per SMACNA Standards.
- H. On smoke management system ducts, conduct a leakage test, per Chapter 9 of the 2009 IBC, to 1.5 times the design pressure. Total leakage shall not exceed 5% of design flow.
- I. Wherever dampers are concealed under insulation, provide marker ribbon for identification. Hang ribbon below adjacent ductwork to allow view from any angle.
- J. Requirements for duct liner are located in Specification Section 230540 – Mechanical Sound and Vibration Control.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.

- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.3 SEALING OF DUCTWORK

- A. Seal all ductwork to Seal Class A per SMACNA HVAC Duct Construction Standards and as required by the International Energy Conservation Code. Additional sealing will be required if audible air leaks are observed. Where joints are not accessible for proper sealing, cut hand holes in duct and seal the joints from the inside.

### 3.4 DUCT LEAKAGE TESTING

- A. Conduct a complete duct leakage test of all supply and return air duct as outlined in the most current edition of the SMACNA Air Duct Leakage Test Manual.
- B. Total leakage of each duct system not to exceed recommendations in SMACNA Air Duct Leakage Test Manual per Leakage Classifications defined above. If leakage rate exceeds maximum allowed, reseal ductwork until measured system leakage rate is less than the maximum allowable leakage rate.
- C. Perform a leakage test on all field erected air handler casings from the outdoor/return air dampers through to the point the medium pressure duct connects to the discharge opening at the end of the air handler. Leakage shall be limited to 1% of design flow. Test casing to 2" wc positive pressure, and extrapolate values out to 6" wc positive pressure. Provide all necessary blank-offs.

### 3.5 MANUFACTURED DUCT JOINTS

- A. The installation of the manufactured duct joints shall be in accordance with the manufacturer's printed instruction and installation manuals. Apply multiple thicknesses of folded butyl gasket material at each corner of rectangular duct joints to assure air tightness.

## 3.6 DUCTWORK APPLICATION SCHEDULE

## A. AIR SYSTEM MATERIAL

Low Pressure Supply (Heating Systems)	Galvanized Steel
Low Pressure Supply (System with cooling coils)	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Low Pressure Flex Duct	Insulated Flexible Round Duct
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

## 3.7 DAMPER OPERATOR HARDWARE

- A. Install per manufacturer's instructions and recommendations. Coordinate any ceiling control locations prior to installation.
- B. Coordinate length of flexible shaft on site.

## 3.8 VOLUME CONTROL DAMPERS

- A. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.

## 3.9 FIRE DAMPERS, SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

- A. Provide fire dampers, combination fire and smoke dampers or smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per manufacturer's instructions.
- B. Demonstrate re-setting of fire/smoke dampers and/or smoke dampers to authorities having jurisdiction and Owner's representative.

## 3.10 GRAVITY BACKDRAFT DAMPERS (LOW PRESSURE SYSTEMS)

- A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside of building and where indicated.
- B. Provide counter-balanced gravity backdraft dampers in return air duct sections from CRAC units to ceiling plenums to prevent air bypass from raised floor to ceiling space when CRAC unit fan is "off".

## 3.11 MOTORIZED BACKDRAFT DAMPERS

- A. Provide motorized backdraft dampers where shown on drawings.

## 3.12 INSULATED FLEXIBLE ROUND DUCTWORK

- A. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum length of flexible duct.
- B. Install flexible ducts in a fully extended condition, free of sags and kinks, using only the minimum length required to make the connection. Bends shall be made with not less than one duct diameter centerline radius. Provide Flexmaster FlexRight radiused supports as necessary.
- C. Where horizontal flex duct sags more than ½ inch per foot, suspend flexible duct on 35-inch centers with a minimum one inch wide flat bending material.
- D. Where "lift-out" ceilings occur, install with volume damper in flex duct at connection to main duct.
- E. Make all connections to metal ducts, diffusers, and troffer boots with draw bands or metal clamps. Use only continuous lengths of flexible duct, no joints are allowed between two lengths of flexible ducts.

## 3.13 FLEXIBLE DUCT FAN CONNECTIONS

- A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- B. At least 1-inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to duct work. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

## 3.14 DUCT ACCESS DOORS

- A. Provide duct access doors for inspection, maintenance and cleaning at all automatic dampers, flow station, humidifiers, fire and smoke dampers and duct turning vanes and before and after all booster coils.
- B. Provide minimum 8 x 8 inch size for hand access, 24 x 24 inch size for shoulder access, unless indicated otherwise on drawings.

END OF SECTION 233300



## SECTION 233400 - AIR HANDLING FANS

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Cabinet Fans
- B. Centrifugal Fans
- C. Power Roof Ventilators
- D. Exhaust Fans (Ceiling Type)

## 1.2 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.
  - 1. Section 230500 - Basic Mechanical Requirements.
  - 2. Section 230529 - Basic Mechanical Materials and Methods.
  - 3. Section 230540 - Mechanical Sound and Vibration Control.
  - 4. Section 230548 - Mechanical Seismic Control.
  - 5. Section 230593 - Testing, Adjusting and Balancing.

## 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified fans with characteristics, sizes, and capacities required, whose specified fan has been in satisfactory use in similar service for not less than 3 years.

## 1.4 SUBMITTALS

- A. Submit shop drawings and product data for the following items under provisions of the General Conditions of the Contract:
  - 1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details for each fan.
  - 2. Product Data: Submit manufacturer's technical product data for all fans showing dimensions, weights, capacities, ratings, fan performance curves with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials. Provide multiple-speed performance curves for fans with variable speed drives.

- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

- 1. All fans.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.
- C. Store fans in clean dry place and protect from weather and construction traffic.
- D. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

#### 1.6 EXTRA STOCK

- A. Provide one spare set of belts for each belt-driven fan.

### PART 2 - PRODUCTS

#### 2.1 CABINET FANS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide cabinet fan of one of the following: Loren Cook, Greenheck, Twin City, Trane, New York Blower, ACME, Peerless, Barry, Penn, Soler and Palau.
- B. Furnish and install cabinet fans of size and capacity shown on drawings.
- C. Cabinet shall be constructed of steel with removable panels for access to all internal parts.
- D. Fan shall be double width, double inlet multi-blade centrifugal type with V-belt drive and adjustable speed sheave.
- E. Fans shall be statically and dynamically balanced and shall run on permanently lubricated bearings.
- F. Motor shall be provided per requirements of "Motors" in Section 230529.

## 2.2 CENTRIFUGAL FANS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide centrifugal fan of one of the following: Twin City, Trane, New York Blower, Pace, ACME, Cook, Barry, Soler and Palau.
- B. Type: The fans to be backward inclined type completely assembled with fan, fan scroll, motor, belt, drive, belt guard and motor mount, capacity and arrangement as shown on the Drawings, and certified performance tests by Air Moving and Conditioning Association (AMCA) to be submitted with the shop drawing.
- C. Housing: To be constructed of steel sheet and parts to be bonderized and then coated with baked primer-finisher. The fan scroll to be attached to the side plates by means of continuous lock seam or welded seam construction.
- D. Bearings: The bearings to be of the ball bearing type especially constructed for quiet operation.
- E. Motor and Drive: To be belt driven with adjustable motor sheave. Motor nameplate horsepower shall exceed brake horsepower by a minimum of five percent. Belts to be of the oil resistant type. Motor to be especially designed for quiet operation and in accordance with "Motors" in Section 230529. Provide variable frequency drives where indicated, in accordance with Section 230810.

## 2.3 EXHAUST FANS (CEILING TYPE)

- A. Acceptable Manufacturer: Subject to compliance with requirements, provide ceiling type exhaust fan of one of the following: Penn Co. (Zephyr Model), ILG, Pace, Cook, Jenn-Air, Greenheck, ACME, Carnes, Twin City Fan, Broan, Soler and Palau.
- B. Type: Shall be of the centrifugal fan, integral grille and housing type, all completely self-contained.
- C. Capacity: Capacity and model number of the units shall be as shown on drawings, and shall be certified by AMCA.
- D. Motor and Drive: Fan shall be of the direct drive type, and maximum fan motor speed shall be 1150 RPM. Motor shall be of the permanently lubricated ball bearing type, and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service. Direct drive fans to include solid state speed controllers.
- E. Housing: Shall be constructed of heavy gauge steel, and shall be completely insulated internally with acoustical insulation material to deaden sound.
- F. Backdraft Damper: Each fan shall be equipped with a nonmetallic backdraft damper constructed of neoprene and shall be shatterproof under all conditions.

- G. U.L. Label: Each fan shall be approved by the Underwriters' Laboratories, Inc. and shall carry the U.L. Label.
- H. Intake Grille: Shall be constructed of steel frame and woven steel grille with a minimum free area of 85%. Intake grille shall have a white, factory baked enamel finish.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION OF FANS

- A. Install fans where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.
- B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.
- C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.
- D. Do not operate fans for any other purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.
- E. Support: Install floor-mounted fans on 4" high reinforced concrete pad, 6" larger on each side than unit base in accordance with Section 230529.
- F. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 230540.
- G. Seismic Restraint: Provide seismic restraints in accordance with Section 230548.
- H. 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 with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.
- I. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

3.2 FIELD QUALITY CONTROL

- A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.3 EXTRA BELTS

- A. Deliver one spare set of belts for each belt-driven fan unit, obtain receipt from Owner that belts have been received.

END OF SECTION 233400

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## SECTION 233713 - AIR INLETS AND OUTLETS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers.
- C. Grilles.
- D. Louvers.
- E. Gravity roof hoods.

## 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500- Basic Mechanical Requirements.

## 1.3 RELATED SECTIONS

- A. Section 230529 - Basic Mechanical Materials and Methods: Painting of ductwork visible behind outlets and inlets.
- B. Section 230593 - Testing, Adjusting and Balancing.
- C. Section 233300 - Ductwork and Accessories.

## 1.4 REFERENCES

- A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- C. ARI 890-91 - Rating of Air Diffusers.
- D. ASHRAE 70 - Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. SMACNA - HVAC Duct Construction Standard.

- F. ASTM C 636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

## 1.5 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70 and ARI 890.
- B. Test and rate performance of louvers in accordance with AMCA 500.

## 1.6 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.

## 1.7 SUBMITTALS

- A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:
  - 1. Shop fabricated louvers.
  - 2. Shop fabricated roof hoods.
- B. Submit Product Data for the following items under provision of The General Conditions of the Contract:
  - 1. Diffusers.
  - 2. Registers.
  - 3. Grilles.
  - 4. Louvers.
- C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
  - 1. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

## PART 2 - PRODUCTS

### 2.1 CEILING DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tempo, Air Diffusion Products, Tuttle & Bailey, TurboX, Price, Hart & Cooley.



## 2.2 CEILING REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tuttle & Bailey, Price, Hart & Cooley.

## 2.3 CEILING SLOT DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Anemostat, Tempmaster, Tempo. (No Substitutions Allowed).

## 2.4 CEILING LINEAR EXHAUST AND RETURN GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Tuttle & Bailey, Price.

## 2.5 WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Metal-Aire, Barber-Colman, Anemostat, Krueger, Tuttle & Bailey, Air Concepts, Price.

## 2.6 LINEAR WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Price, Tuttle & Bailey.

## 2.7 LINEAR SUPPLY REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

- A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Price, Tuttle & Bailey.

## 2.8 LOUVERS

- A. Acceptable Manufacturers: Dowco, Airstream, Louvers and Dampers, Inc., Ruskin, Krueger, Air Balance, American Warming and Ventilating, Arrow, C. E. Sparrow, Greenheck, Cesco, Pottorff, Air-Rite.
- B. Provide 6 inch deep louvers with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.
- C. Fabricate of 16 gauge galvanized steel or 12 gauge extruded aluminum, welded assembly, with factory baked enamel finish, custom color to be selected by Architect.
- D. Furnish with interior angle flange for installation.

## 2.9 GRAVITY ROOF HOODS

- A. Acceptable Manufacturers: Acme, Louvers and Dampers, Inc., Penn Ventilator, Greenheck, Ruskin, Cook, Carnes.
- B. Fabricate air inlet or exhaust hoods in accordance with SMACNA Low Pressure Duct Construction Standards.
- C. Fabricate of galvanized steel, minimum 16 gauge base and 20 gauge hood, or aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory baked enamel finish.
- D. Provide minimum 12 inch high insulated curb base.
- E. Make hood outlet area minimum of twice throat area.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Install ceiling mounted items in accordance with ASTM C 636.
  - 1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
  - 2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
  - 3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.
- F. Install diffusers to ductwork with air tight connection.

- G. Install duct connections to fire rated UL Listed and Labeled diffusers and return grilles in strict accordance with instructions furnished by manufacturer.

END OF SECTION 233713

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## SECTION 234100 - AIR CLEANING

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Disposable panel filters.

## 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 230500 - Basic Mechanical Requirements

## 1.3 RELATED SECTIONS

- A. Section 235700 - Heat Transfer.
- B. Section 237400 - Air Handling Systems.
- C. Section 237410 - Air Handling Unit With Coils.

## 1.4 REFERENCES

- A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.
- B. ANSI/UL 900 - Test Performance of Air Filter Units.
- C. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- D. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods.

## 1.5 QUALITY ASSURANCE

- A. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2, as approved by local authorities.
- B. Provide all filters as product of one manufacturer.
- C. Assemble filter components to form filter banks from products of one manufacturer.

## 1.6 SUBMITTALS

- A. Submit Shop Drawings and Product Data under provisions of The General Conditions of the Contract on filter media, filter performance data, filter assembly and filter frames.

## 1.7 EXTRA STOCK

- A. Provide one extra set(s) of disposable panel filters.

## PART 2 - PRODUCTS

## 2.1 DISPOSABLE PANEL FILTERS

- A. Acceptable Manufacturers: Cambridge, Continental, Camfil Farr, American Air Filter, ULOK Fiberbond, Flanders.
- B. Media: 2 inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive, nominal size 24 x 24 inches.
- C. Rating: 500 FPM face velocity, 0.15 inch WG initial resistance, 0.50 inches WG recommended final resistance.
- D. Casing: Cardboard frame with perforated metal retainer.
- E. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.

END OF SECTION 234100

## SECTION 235100 - BREECHINGS, CHIMNEYS, STACKS, AND FLUES

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Type B Flue Vents.
- B. Positive Pressure Chimney and Manifold System.

## 1.2 RELATED WORK

- A. Requirements: Provide Breechings, Chimneys, Stacks and Flues in accordance with the Contract Documents.
- B. Section 224450 - Plumbing Equipment.
- C. Section 230500 - Basic Mechanical Requirements.
- D. Section 230529 - Basic Mechanical Materials and Methods.
- E. Section 230548 – Mechanical Seismic Control.

## 1.3 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
  - ANSI/NFPA 37 - Installation and Use of Stationary Combustion Engines and Gas Turbines.
  - ANSI/NFPA 211 - Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.
  - ANSI/UL 441 - Standard for Gas Vents.

## 1.4 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of prefabricated breeching and smokepipe, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

## 1.5 SUBMITTALS

- A. Submit Shop Drawings for the following items under provisions of the General Conditions of the Contract:
  - 1. Positive Pressure Chimney and Manifold System.
- B. Submit Product Data for the following items under provisions of the General Conditions of the Contract:
  - 1. Type B Flue Vents.
  - 2. Positive Pressure Chimney and Manifold System.
- C. Submit a flue system analysis performed for the fuel-fired equipment that will be provided by the contractor. Flue sizes shall be modified as necessary to accommodate the brand/model of fuel fired equipment being provided as part of this project and to accommodate the routing of the flue indicated on the contractor's shop drawings.

## PART 2 - PRODUCTS

## 2.1 TYPE B FLUE VENTS

- A. Acceptable Manufacturers: Selkirk Metalbestos, Simpson Dura-Vent, Ameri-Vent, American Metal Products Co., United McGill, Metal-Fab, Protech Systems, Metal Vent, Heat-FAB.
- B. General: Provide double wall gas vents, UL-listed for Type B, consisting of double wall metal construction pipe sections and fittings and accessories required for complete installation.
- C. Material: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel.
- D. Accessories: Provide manufacturer's standard accessory items including draft hood connectors, tees, caps, elbows, increasers, adaptors, support plates, thimbles, storm collars, roof flashings and vent tops as indicated and required for complete installation.

## 2.2 POSITIVE PRESSURE CHIMNEY AND MANIFOLD SYSTEM

- A. Acceptable Manufacturers: Selkirk Metalbestos, Schebler, Amerivent, AMPCO, Metal-Fab, Chiminee Lining, Metal Vent, Heat-Fab, United McGill, Van Packer, Jeremias Inc.
- B. General: Provide double wall metal chimney, U.L. Listed for use with building heating equipment burning gas, solid or liquid fuels as described in NFPA 211, Section 2-3.1 and Appendix A.



- C. Material: Double wall metal chimney with outer jacket of aluminum coated steel with minimum one inch air space between the walls and inner gas-carrying pipe of Type AL 29-4c stainless steel.
- D. Accessories: Provide manufacturer's standard accessory items including flanged boiler kits, clamp flanges, elbows, increasers, tees, wyes, drain sections, wall supports, wall guides, floor guides, plate supports, roof supports, ventilated roof thimbles, flashings, storm collars, exit cones, open stack top rings and stack caps as indicated and required for complete installation.
- E. Seals: For flue gas temperatures up to 600 degrees F, any RTV Silicone Sealant. For flue gas temperatures over 600 degrees F, Sauereisen #33 ceramic joint cement or its equivalent. All joints to be gas and liquid tight.

### PART 3 - EXECUTION

#### 3.1 TYPE B FLUE VENTS

- A. Install gas vents in accordance with manufacturer's installation instructions. Maintain UL-Listed minimum clearances from combustibles. Assemble pipe and accessories as indicated for complete installation.
- B. The gas vent system shall be so engineered and constructed as to develop a positive flow adequate to exhaust all flue gases to outside atmosphere, without condensation within the vent or spillage at any appliance draft hood.
- C. All parts of vent system shall be of Underwriters' Laboratories, Inc. listed double wall gas vent piping, and such piping shall be continuous from the appliance outlets into vent top or housing.
- D. The gas vent piping shall be installed in full compliance with the terms of its listing, with the Manufacturer's installation instructions, and with jurisdictional Building Code representing good practice for such installations.
- E. It shall be the responsibility of the Contractor to provide adequate accessibility, head room, and chase dimensions so that all vent connectors and vertical vents can be correctly sized, spaced and supported.

#### 3.2 POSITIVE PRESSURE CHIMNEY AND MANIFOLD SYSTEM

- A. Install in accordance with Manufacturers installation instructions. Maintain UL-Listed minimum clearances from combustibles as described in NFPA 211, Section 2-3.1 and Appendix A. Assemble manifold, stack and accessories as indicated for complete installation.
- B. Seal inner pipe joints during field assembly with any RTV Silicone Sealant to assure positive internal pressure requirements.

- C. Terminate chimney pipe extending above roof surfaces as required by local code.
- D. Provide a minimum of one base coat and one finish coat of heat and corrosion resistant primer and paint protection on all exposed metal parts.

END OF SECTION 235100

## SECTION 235700 - HEAT TRANSFER

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

- B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements  
Section 230529 - Basic Mechanical Materials and Methods  
Section 230540 - Mechanical Sound and Vibration Control  
Section 230700 - Mechanical Insulation  
Section 236400 - Refrigeration  
Section 233400 - Air Handling Fans  
Section 237400 - Air Handling Systems  
Section 237410 - Air Handling Unit with Coils  
Section 230900 - Electronic Controls  
Section 230593 - Testing, Adjusting and Balancing

## 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to providing the following:
1. Electric Cabinet Heaters and Unit Heaters
  2. All contactors, relays, terminal boxes, thermostats and other electrical appurtenances for electric heat in accordance with "ELECTRIC WIRING" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

## 1.3 QUALITY ASSURANCE

- A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

## 1.4 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

## 1.5 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
  - 1. Electric Heating Equipment
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500:
  - 1. Electric Heating Equipment

## PART 2 - PRODUCTS

## 2.1 ELECTRIC CABINET HEATERS AND UNIT HEATERS

- A. Acceptable Manufacturers: Chromalox, Indeeco, Modine, Electromode, Sterling, Raywall, Markel, QMark.
- B. Provide electric cabinet heaters and unit heaters of size and capacity as shown on Drawings.
- C. Unit Cabinet: Shall be 14 gauge steel, enameled cabinet, color as selected by Architect, adjustable discharge louvers.
- D. Motor and Blower Fans: Direct drive, blow-through design, two-speed motors and switch, resilient mounted. Motor and blower to be easily accessible for servicing. Bearings to be factory lubricated.
- E. Electric Heating Elements: Fin-tube with helical fins with overheat protection. Unit to be furnished with thermostat for remote mounting as shown on drawings, tamperproof. Provide all contactors, relays, etc., as required. Entire unit to be U.L. approved.
- F. Units to be provided with a summer-winter switch to allow operation without heat when desired. Operation as follows: Fan to be cycled by remote thermostat to maintain space temperature. Provide delay switch to keep fan from operating on call for heat until heating elements have warmed up.

## PART 3 - EXECUTION

## 3.1 UNIT HEATERS (HORIZONTAL BLOW)

- A. Unless noted otherwise, mount high as possible to give greatest headroom possible. Piping shall be as shown on the plans.

- B. Protect the entire unit with a cover during construction.
- C. Manufacturers data is to be observed before installation.

END OF SECTION 235700

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## SECTION 236400 - REFRIGERATION

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Air Cooled Condensing Units
- B. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units
- C. Refrigerant Piping Materials and Products

## 1.2 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.
- B. Related work specified in other Sections:
  - Section 230500 - Basic Mechanical Requirements
  - Section 230529 - Basic Mechanical Materials And Methods
  - Section 230540 - Mechanical Sound and Vibration Control
  - Section 230548 - Mechanical Seismic Control
  - Section 230593 - Testing, Adjusting and Balancing
  - Section 230700 - Mechanical Insulation

## 1.3 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
  - 1. Air Conditioning and Refrigeration Institute (ARI):
    - Standards for the following:
      - # 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment
      - # 270 - Sound Rating of Outdoor Unitary Equipment
      - # 410-72 - Plate Fin Type Refrigerant Coils
      - # 450 - Water Cooled Condensers
      - # 460 - Remote Mechanical-Draft Air Cooled Condensers
      - # 520 - Positive Displacement Condensing Units
      - # 550/590 - Water Chilling Packages using the Vapor Compression Cycle
      - # 575 - Method of Measuring Machinery Sound within an Equipment Space

## 2. American National Standards Institute (ANSI):

ANSI B9.1 "Safety Code for Mechanical Refrigeration." (Also known as ANSI/ASHRAE 15).

ANSI B31.5 "Refrigeration Piping," and extend applicable lower pressure limits to pressures below 15 psig.

## 1.4 QUALITY ASSURANCE

- A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.
- B. The firm installing the refrigeration piping shall have at least 3 years of successful installation experience on projects with refrigeration piping system work similar to that required for this project.
- C. Brazing Qualifications: Certify operators, brazing procedures and brazers in accordance with ANSI B31.5 for shop and job-site brazing of refrigerant piping work.

## 1.5 WARRANTY

- A. All refrigerant compressors in this specification section shall be provided with a four year extended warranty for parts and labor in addition to the standard one year warranty required in Section 230500, for a total of 5 years of warranty coverage.

## 1.6 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
  - 1. Condensing Units
  - 2. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units
  - 3. Refrigerant Specialties
- B. Certificates: Before proceeding with refrigerant piping work, submit to the Architect/Engineer/Construction Manager/General Contractor two copies of Certification that brazing procedures, brazers and operators will be in accordance with ANSI B31.5.
- C. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.
  - 1. Condensing Units



2. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units
3. Refrigerant Specialties

## PART 2 - PRODUCTS

## 2.1 AIR COOLED CONDENSING UNITS (5 TONS OR LESS)

- A. Acceptable Manufacturers: Carrier, Trane, York, McQuay, Sanyo, Mitsubishi, AAON.
- B. Furnish and install factory assembled condensing units of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.
- C. Units shall be of the packaged air cooled type as shown on the Drawings and consist of a reciprocating or rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.
- D. The unit shall contain sufficient refrigerant R-134a, or R-410 for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.
- E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.
- F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.
- G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.
- H. Provide the following accessories:
  1. Start capacitor and relay.
  2. Indoor fan relay.
  3. Liquid line filter drier.
  4. Low ambient head pressure control.
  5. Low voltage control transformer.
  6. 7-Day Programmable thermostat with subbase.
  7. Device to prevent damage to compressor caused by short cycling.
  8. Crankcase heater.
  9. 12" tall curb or snow stand.

## 2.2 AIR COOLED CONDENSING UNITS

- A. Acceptable Manufacturers: Carrier, Trane, York, McQuay, Sanyo.
- B. Furnish and install factory assembled condensing units of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.
- C. Units shall be of the packaged air cooled type as shown on the Drawings and consist of a reciprocating or rotary compressor, or multiples thereof, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME Code.
- D. Refrigerant shall be R-134a or R410.
- E. Each compressor shall be of the reciprocating serviceable hermetic type, and shall have an automatically reversible oil pump, operating oil charge, suction and discharge shutoff valves and shall be factory mounted on spring isolators.
- F. Compressor motor shall be cooled by suction gas passing around the motor windings and shall be thermally protected.
- G. Each compressor shall be equipped with an insert type crankcase heater of proper size to control oil dilution during shutdown.
- H. Compressor shall unload in response to suction pressure for partial load operation. Compressor shall be located in a section separated from condenser fans and coil.
- I. Multiple compressor units shall have step-start fans and coils. Compressor motor(s) shall have part-winding start.
- J. Condenser coil shall be nonferrous construction. Coil shall have aluminum plate fins, mechanically bonded to seamless copper tubes. Coil shall be circuited for subcooling.
- K. Unit shall be furnished with direct-driven, propeller-type condenser fans arranged for vertical discharge. Condenser fan motors shall have inherent protection, and shall be of the permanently lubricated type, resiliently mounted. Each Fan shall have a safety guard. Controls shall be included for cycling fan(s) for intermediate season operation.
- L. Controls shall be factory wired and located in a separate enclosure. Safety devices shall consist of high and low pressure switches and compressor overload devices. Unit wiring shall incorporate a positive acting timer to prevent short cycling of compressor if power is interrupted. Timer shall prevent compressor from restarting for approximately 5 minutes after shutoff.
- M. Each unit shall have a transformer to provide control circuit voltage.
- N. Casing shall make unit fully weatherproof for outdoor installation. Casing shall be galvalneal steel, zinc phosphatized and finished with baked enamel.

- O. Openings shall be provided for power and refrigerant connections. Panel shall be removable to provide access for servicing.
- P. Only one power supply connection shall be required for each unit.
- Q. Provide the following accessories:
  - 1. Electric unloaders.
  - 2. Pressure operated unloaders.
  - 3. Remote control center and switch base for thermostatic control of unit from conditioned space.
  - 4. Low ambient head pressure control.
  - 5. Hot gas by-pass.

2.3 CASSETTE-STYLE COOLING-ONLY DUCTLESS DX FAN COIL SPLIT SYSTEMS WITH AIR COOLED CONDENSING UNITS

- A. Acceptable Manufacturer: Carrier, Trane, York, Mitsubishi.
- B. Furnish and install factory assembled cooling-only split systems of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.
- C. Condensing units shall be of the packaged air cooled type as shown on the Drawings and consist of a rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.
- D. The condensing unit shall contain sufficient refrigerant (R134, R410A or R407) for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.
- E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.
- F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.
- G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.
- H. Unit to be housed in a fully weatherproof housing made of galvaneal steel, zinc phosphatized, with a baked enamel finish.

- I. Condensing unit must be capable of serving DX fan coil located 22 vertical feet below the condenser.
- J. Fan coil to be of size and capacity indicated on the drawings. Fan coil to mount on vertical wall surface and have a maximum height of 14”.
- K. Fan coil shall be complete with DX cooling coil, condensate pan and drain, direct drive fan, fan motor, filter, piping connectors, microprocessor control system, and integral thermostat. Include integral wall mounting bracket and mounting hardware.
- L. Fan coil cabinet to be fully insulated for improved acoustical and thermal performance.
- M. Fan coil to be configured with return air drawn in at top of front vertical face, and supply air discharged at bottom of front vertical face. Discharge to include manually adjustable horizontal and vertical deflection blades, as well as automatic motor driven vertical air sweep with on/off switch.
- N. Fan coil unit to include a remote control that allows users to turn unit on/off, change setpoints, and change from fan-only to cooling mode.
- O. Fan coil to connect to condensing unit for electrical power as necessary.
- P. Provide the following accessories:
  - 1. Start capacitor and relay.
  - 2. Indoor fan relay.
  - 3. Liquid line filter drier.
  - 4. Low ambient kit (0°F).
  - 5. Low voltage control transformer.
  - 6. Device to prevent damage to compressor caused by short cycling.
  - 7. Crankcase heater.
  - 8. 14” high roof curb or 4” high concrete if slab on grade.
  - 9. Factory installed starter and disconnect.

## 2.4 REFRIGERANT PIPING MATERIALS AND PRODUCTS

- A. General:
  - 1. 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 materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigeration piping system on maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigeration piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

## B. Basic Pipe, Tube and Fittings:

1. Provide pipe, tube and fittings in accordance with the following:

Tube Size 4-1/8" and Smaller: Copper tube.

Wall Thickness: Type ACR, hard drawn temper.

Fittings: Wrought-copper, solder-joints, ANSI B16.22.

Joints: Brazed or soldered.

## C. Refrigeration Valves:

1. Globe and Check Valves:

- a. Acceptable Manufacturers: Subject to compliance with requirements, provide globe and check valves of one of the following:

Henry Valve Co.

Parker Hannifin Corp., Refrigeration & Air-Conditioning Div.

Sporlan Valve Co.

- b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg.F (149 deg.C) temperature rating, 500 psi working pressure.
- c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg.F (121 deg.C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

- a. Acceptable Manufacturers: Subject to compliance with requirements, provide solenoid valves of one of the following:

Alco Controls Div., Emerson Electric Co.

Automatic Switch Co.

Sporland Valve Co.

- b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 115 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg.F (121 deg.C) temperature rating, 400 psi working pressure.

## D. Refrigeration Accessories:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:  
  
Alco Controls Div., Emerson Electric Co.  
Henry Valve Co.  
Parker-Hannifin Corp., Refrigeration & Air-Conditioning Div.  
Sporlan Valve Co.  
Toxalert
2. Refrigerant Strainers: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL listed, 350 psi working pressure.
3. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200 deg.F (93 deg.C) temperature rating, 500 psi working pressure.
4. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.
5. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
6. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL listed.

## PART 3 - EXECUTION

## 3.1 REFRIGERATION EQUIPMENT INSTALLATION

- A. General: Comply with manufacturer's recommended installation instructions.
- B. Provide sound and vibration isolation in accordance with Section 230540 - Mechanical Sound and Vibration Control.
- C. Equipment manufacturer to provide labor to assemble, test, charge, start-up, calibrate, and instruct Owner's personnel in operation and maintenance.

## 3.2 REFRIGERATION SYSTEM INSTALLATION

## A. Refrigerant Piping:

1. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing 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. Comply with ANSI B31 Code for Pressure Piping.
2. Piping to be kept clean and dry with factory installed caps in place until time of installation. Keep the entire system clean and dry during the installation. Piping to be straight and free of kinks, ripples, or restrictions of any kind. Bending the pipe will not be permitted. Fittings required to be of the long radius pattern except when used for oil traps.
3. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.
4. Pitch refrigerant piping 1" in 15 feet in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.
5. Refrigeration system connections shall be of the sweat copper type properly cleaned and silver brazed with Sil-Fos or Easy-Flor solders using Handy and Harmon flux. Circulate nitrogen through tubes being soldered to eliminate the formation of copper oxide during the brazing operation.
6. Evacuation and leak test shall be made after refrigerant piping system is completed. The Contractor shall draw a vacuum on the entire system with a vacuum pump, the vacuum shall hold for 12 hours at 25 inches hg. of vacuum. The Contractor shall then break the vacuum with clean dry refrigerant, he shall then make a test with halide detector, after which he shall then draw another vacuum down to 25 in. and again break the vacuum with new clean dry refrigerant. The system shall then be fully charged with refrigerant and tested with halide detector at all joints.
7. Solder copper tube-and-fitting joints where indicated using silver-lead solder, ASTM B32, Grade 96 TS, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
8. Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal. Bleed dry nitrogen through refrigerant piping during brazing operations.
9. Provide pipe hangers and supports in accordance with Section 230529 - Basic Mechanical Materials and Methods.

## B. Refrigerant Valves:

1. Provide refrigerant type hand valves where indicated on the Drawings and wherever required for routine servicing. Install in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.
2. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards. Wire in accordance with "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

## C. Refrigerant Accessories:

1. Liquid indicators, strainers and filter-drier: Furnish and install in each refrigerant circuit and in accessible location for service.
2. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.
3. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

## D. Equipment Connections:

1. General: Connect refrigerant piping to mechanical equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.
2. Provide flexible connections in suction and discharge lines at compressor and install valves where necessary for proper service and maintenance.
3. The oil level in the compressors to be checked or removed to achieve the correct level. The oil level to be rechecked after extended operation and adjusted accordingly.
4. Install refrigeration equipment on vibration isolation mountings in accordance with Section 230540 - Mechanical Sound and Vibration Control.

## E. Dehydration and Charging System:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg.F (2 deg.C) is indicated on vacuum dehydration indicator.
3. Provide manufacturer's recommended refrigerant charge to system to obtain optimum operating conditions.

END OF SECTION 236400



## SECTION 237400 - AIR HANDLING SYSTEMS

## PART 1 - GENERAL

## 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Related work specified in other Sections:
  - Section 230500 - Basic Mechanical Requirements
  - Section 230529 - Basic Mechanical Materials and Methods
  - Section 230540 - Mechanical Sound and Vibration Control
  - Section 230548 - Mechanical Seismic Control
  - Section 230700 - Mechanical Insulation
  - Section 236400 - Refrigeration
  - Section 230900 - Electronic Controls
  - Section 230593 - Testing, Adjusting and Balancing

## 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to providing the following:
  - 1. Package HVAC Units

## 1.3 QUALITY ASSURANCE

- A. Quality control shall be in accordance with Section 230500 - Basic Requirements.

## 1.4 WARRANTY

- A. All refrigerant compressors in this specification section shall be provided with a four-year extended warranty for parts and labor in addition to the standard one-year warranty required in Section 230500 for a total of 5 years of warranty coverage.

## 1.5 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
  - 1. Packaged HVAC Units

- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

- 1. Packaged HVAC Units

## 1.6 EXTRA STOCK

- A. Provide one complete extra set of filters for each air handling unit.
- B. Provide one spare set of belts for each belt-driven air handling unit.

## PART 2 - PRODUCTS

### 2.1 PACKAGED HVAC UNITS (SINGLE ZONE)

- A. Accepted Manufacturers: Trane, Carrier, York, Lennox, McQuay, AAON.
- B. Provide packaged rooftop HVAC units of size and capacity shown on Drawings.
- C. Units shall be AGA approved specifically for outdoor installation, completely weatherproof, mounted on a common curb type base.
- D. Units to be complete with insulated steel casing, baked enamel finish, roof curb, hermetic compressors, aluminized or stainless steel heat exchanger, evaporator, blower, and air cooled condenser.
- E. Units shall have automatically resetting electric spark ignition system to prevent pilot outage under all climatic conditions. Spark ignitor only energized during pilot outage. If gas service is interrupted for an extended period of time, units may be restarted at thermostat within building.
- F. Refrigeration cycle controls shall include compressor contactors, condenser and evaporator fan contactors, 24-volt transformers, low and high pressure cut-outs, liquid line solenoid valves for system pumpdown, and compressor protection cut-out with reset. Reset relay provided to prevent unit cycling on overloads. If operating conditions trip any safety controls, unit must be reset at thermostat.
- G. Units shall be equipped with automatic gas valve, combination fan and limit controls, pressure regulator, manual pilot valve, and main shut-off valve. Automatically resetting pilot safety relay provided.
- H. Drain Pans: Shall be provided for evaporator and condenser sections. Evaporator section drain pan internally sealed and insulated.

- I. Thermostat: Provide a 24-volt programmable thermostat with 7 day night setback for each unit. Thermostat provides manual or automatic fan operation and system operation control of "heat", "cool", and fan "on", "auto" "off" positions.
- J. Low Ambient Operation: Provide low ambient control to 0°F. with time delay timer.
- K. Units to be equipped with weatherproof outside air intake with manual damper set for 20% outside air.
- L. Units to be equipped with "economizer" cycle with motorized outside, return, and exhaust air dampers, automatically controlled and pre-wired at the factory.
- M. The following options shall be provided on units:
  - 1. Fused unit disconnect switch
  - 2. 2 steps of compressor unloading
  - 3. Hot gas bypass
  - 4. Low leak outside air dampers (max. 10 cfm/sf @ 4" s.p.)
  - 5. High efficiency motors (90% +)
  - 6. Extended grease lines
  - 7. Hinged access doors with cam lock handles
  - 8. 115 volt/1 ph convenience outlet
  - 9. Four (4) year extended warranty in addition to one (1) year standard warranty, for a total of five (5) years of warranty.
  - 10. Two-stage gas valve
  - 11. 100% modulating exhaust/return fans
  - 12. Factory mounted smoke detector wired and mounted (5 ton and larger)
  - 13. Coil guards
  - 14. Brown out protection

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF AIR HANDLING EQUIPMENT

- A. Install air handling equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.
- B. Coordinate with other work, including ductwork, roof structure, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.
- C. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.
- D. Install units on vibration isolators or isolation bases, in accordance with Section 230540 - Mechanical Sound and Vibration Control.

### 3.2 ELECTRICAL CONNECTIONS

- A. Ensure air handling equipment is wired properly, with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

### 3.3 PACKAGED HVAC UNITS

- A. Install units on full perimeter support curbs where indicated per manufacturer's recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

### 3.5 FILTERS AND BELTS

- A. Install extra set of new filters at completion of air handling system work, and prior to testing, adjusting and balancing work. Obtain receipt from Owner that new filters have been installed.
- B. Deliver one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION 237400

## SECTION 237410 - AIR HANDLING UNIT WITH COILS

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. Custom air handling units.

## 1.2 RELATED WORK

- A. Requirements: Provide air handling unit with coils in accordance with the Contract Documents.
- B. Section 230500 - Basic Mechanical Requirements
- C. Section 230529 - Basic Mechanical Materials and Methods
- D. Section 230540 - Mechanical Sound and Vibration Control
- E. Section 230548 - Mechanical Seismic Control
- F. Section 230593 - Testing, Adjusting and Balancing
- G. Section 230810 - Variable Frequency Drives
- H. Section 230900 - Electronic Controls
- I. Section 234100 - Air Cleaning

## 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards: Comply with the following:
  - 1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 300 and 301 for sound ratings.
  - 2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models. Test and rate coils in accordance with ARI 410 – "Standards for Forced Circulation Air-Cooling and Air-Heating Coils".

3. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
  4. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards. Units with factory wiring shall be factory UL or ETL approved and labeled.
  5. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.
  6. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
- C. The following shall be used as selection criteria and shall be as specified: Airflow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, water pressure drops.

#### 1.4 SUBMITTALS

- A. Submit shop drawings and product data for the following items under provisions of The General Conditions of the Contract:
1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.
  2. Product Data: Submit manufacturer's technical product data showing dimensions, weights, capacities, ratings, detailed fan performance curves with operating point clearly indicated, motor ratings and electrical characteristics, sound power levels (inlet, outlet, and radiated), coil ratings, filter data, wiring diagrams, gauges and finishes of materials.
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:
1. Air Handling Unit

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver air handling units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers. Deliver air handling units with all openings covered with plywood and fiber-reinforced plastic sheeting to protect the units while in transit.
- B. Handle air handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

- C. Store air handling units in clean place and protect from weather and construction traffic.
- D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

## 1.6 EXTRA STOCK

Provide one complete extra set of filters for each air handling unit.

- A. Provide one spare set of belts for each belt-driven air handling unit.

## PART 2 - PRODUCTS

### 2.1 CUSTOM AIR HANDLING UNITS

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

- 1. Tentrol
- 2. Governair
- 3. Haakon
- 4. Mammoth
- 5. York
- 6. Racan
- 7. Energy Labs
- 8. AAON
- 9. Scott Springfield Manufacturing
- 10. Unitech
- 11. Annex Air

- B. Manufactured Units:

- 1. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, dampers, plenums, filters, drip pans, and mixing dampers. Provide factory-fabricated and factory-tested air-handling units of sizes and capacities as scheduled, and as specified herein.

## C. Casing:

1. Walls and roof of each unit shall have a support framework constructed of steel to which all exterior and interior panels are mechanically fastened. All walls shall be constructed of minimum 2-inch thick "double wall" acoustical thermal panels. Exterior wall panels shall be a minimum of 16 gauge G90 galvanized steel. The inner wall shall be a minimum of 22 gauge, solid G90 galvanized steel. The inner wall where downstream of final filters shall be a minimum of 22 gauge, solid G90 galvanized steel. The insulation shall be minimum 2 inch 3.0 or 4.5 lb/cu ft. density fiberglass. All permanently joined flanged panel surfaces shall be sealed with an individual strip of tape sealer and caulked with a high grade silicone sealant. Wall (and roof) seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit. All panel seams on outdoor units shall be sealed weather tight.
2. All insulation edges shall be protected with metal lagging.
3. Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 1.5 times the working pressure.
4. Units shall ship as one single piece whenever feasible. If multiple sections are required, the units shall be engineered for simple demount and field assembly. Mating frames of each section shall be fabricated with a flanged perimeter which is predrilled with assembly clearance bolting holes and is continuously gasketed. Demount gasket supplied with the unit shall be a high quality weather resistant closed cell neoprene sponge rubber. Assembly lugs, fabricated from structural steel with appropriate assembly clearance holes shall be welded to the base frame. All gasket and necessary assembly hardware shall ship with the unit sections, boxed separately, and clearly marked.
5. The AHU framework and casing construction shall be fabricated in such a manner as to comply with the following requirements:
  - a. Provide an airtight unit that will not leak greater than 1% of the specified airflow at the rated static pressures.
  - b. Should it become necessary to remove casing panels to facilitate removal, replacement or repair of internal equipment components such as fan wheels, shafts, motors or coils, the unit must be able to be disassembled and supported without the use of external or supplemental bracing. If this is not possible, then access doors must be provided of sufficient size to allow for removal of any components without structural degradation of the unit.

## D. Base Construction:

1. Base shall be constructed from a minimum 2" X 5" X 10 gauge galvanized steel tubes, channels, or I-beams fitted with cross members to support all interior components. Frame to be continuously welded at all joints. Units less than or equal to 20 ft. long shall have a minimum 5 inch base, and units greater than 20 ft. shall have a minimum of 6 inch base. Base shall be provided with lifting lugs, minimum four (4) per unit section.



2. A 12 gauge G90 galvanized steel or powder coated checker plate floor shall be installed on the base. Floor shall be flat, reinforced from below, with all seams continuously sealed or welded. The floor shall be insulated with minimum 3 inch fiberglass insulation and sheeted with a 20 gauge galvanized exterior steel liner. Provide safety pipe railing on all floor openings larger than 3 sq.ft.
3. Provide auxiliary drains in fan sections downstream of cooling coils and humidifiers, and in mixing sections. Drain pans shall be 3" deep fabricated of 16 gauge, 304 stainless steel with 1-1/4" MPT connections mounted below the bottom of the drain pan and the 20 gauge subfloor of the unit. Drain pan shall be sloped to the outlet in the pan floor so as to prevent any standing water to accumulate in the drain pan.
4. All drain connections on floor mounted air handling units shall terminate at the side of the unit.
5. Maximum base deflection shall be 1/4" on 240" unsupported span.
6. Units shall be designed to be supported by a housekeeping pad.

E. Access Doors:

1. Access doors shall be manufactured from 16 gauge G90 galvanized steel. The doors shall be double wall construction with 20 gauge solid metal liner on the inside. Corners of the doors shall be continuously welded for rigidity. Minimum two inch 3.0 or 4.5 lb/cu ft. density insulation shall be sandwiched between the 16 gauge outer layer and the 20 gauge inner layer.
2. Two metal latches operable from either side of door shall be provided. Door opening shall be fully gasketed with continuous neoprene/EPDM rubber bulb type gasket rated for a constant exposure temperature range of -20°F to 160°F. All doors shall swing open against the AHU component section pressure except on outdoor units and unless leakage rate specified can be achieved otherwise. Doors shall have door tie backs to secure an open position. Door frames shall be made from 16 gauge galvanized steel or extruded aluminum with the outside of the door flush with the unit. Minimum door opening size shall be 24 in. x 60 in. (where unit height permits) unless otherwise noted on drawings. Provide 10" x 10" wire - reinforced glass window in each access door.

F. Fans - Supply and Return:

1. Wall mounted, direct driven plenum fans (horizontal or vertical) shall be installed with perimeter gasketed isolation.
2. Fans shall be direct drive radial centrifugal fans with free running impeller. Fans shall be compact, optimized and construction made of galvanized sheet steel with backward curved 7-blade high efficiency impeller, protected by an epoxy powder coating.
3. To reduce vibration, the impeller shall be balanced with hub to an admissible vibration severity of less than 2.8 mm/s in conformity with DIN ISO 14694 and proof shall be supplied for each individual impeller. Tests shall be made according to DIN ISO 1940 Part 1, quality of balancing G2.5/6.3.
4. The single inlet shall be mounted onto constant speed direct drive motor, equipped with an air flow optimized inlet cone from galvanized sheet steel.

5. Fans shall be completely certified as per ISO 5801 and in accordance to AMCA standards.
6. All fans shall be tested in accordance with AMCA Standard 210-70 Test Code for Air Moving Devices.
7. Backward inclined fans shall bear the AMCA sticker. Backward inclined wheels over 22 inches diameter shall have double thickness airfoil shaped fan blades.
8. Fan housing shall be constructed of steel, adequately braced with structural steel for rigidity. Plug fans shall be encased by a protective steel screen. Plug fan inlets shall be protected by an OSHA-approved inlet screen.
9. Fan shafts are to be solid, ground and polished, carbon steel, SAE 1045 materials, machined to close tolerances, keyed to the fan wheel. Coat the fan shaft with a rust inhibitor after machining. Hollow shafts will not be acceptable.
10. Fan bearings shall be in self aligning pillow block, grease lubricated, extra heavy duty antifriction ball or spherical roller type, selected for an AFBMA L-50 average life of 200,000 hours at the maximum RPM of the fan Class. Bearings are to be mounted on the fan structural bracing. On units with casings less than 54" high, provide extended lubrication lines to permit lubrication for both bearings to be performed from the access door side of the air handling unit.
11. Fan motors shall be in accordance with Section 230529.
12. Drive sheaves are to be machined cast iron. Provide an adjustable motor sheave on motors of 10 HP and less. Sheave selections and belt lengths are to be in accordance with the drive manufacturer's recommendations based on the specific motor nameplate HP including a 1.2 service factor for fans served by VFD's and a 1.5 service factor for constant volume fans.
13. An "I-Beam" shall be factory installed at the roof, inside the AHU casing, above the motor for any motor 15 HP or greater. This "I-Beam" shall serve as a permanent device from which the motor can be lifted from its mounting position by cable or chain and then easily moved to the access door for removal from the AHU.

G. Variable Frequency Drive (VFD):

1. Provide VFD as scheduled on drawings and in accordance with Section 230810.

H. Electrical:

1. Starters, Electrical Devices, and Wiring: Electrical devices and connections shall comply with Division 26.

I. Coils:

1. Coils shall be fully enclosed within casing and mounted on galvanized steel angle iron racks manufactured to allow coils to slide out individually. Removable coil access panels shall be provided to remove coils through casing wall.
2. Provide drain pans for all cooling coils except indirect cooling coils. Drain pans shall be 16 gauge, 304 stainless steel. Stacked coils shall have intermediate drain pans interconnected with 1 inch copper drain lines.

3. Coils shall be designed with respective circuits to match the design requirements. All coils shall have a distributor per circuit connection. Coils shall be circuited for counter-flow heat transfer to provide maximum mean effective temperature difference for maximum heat transfer rates.
4. Primary surface shall be round seamless (3/8" O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.
5. Casing shall be constructed of continuous stainless steel.
6. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 60" and shall not exceed 500 FPM face velocity.
7. All coils shall be rated in accordance with AHRI standard 410.
8. Refrigerant coils shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration. Provide copper tubing headers with connections extended through unit casing. Dehydrate entire assembly, charge with dry nitrogen, and seal for shipment.

J. Filters:

1. Provide filter sections as scheduled on drawings and in accordance with Section 234100.

K. Finish:

1. Unit shall be powder coated or finished painted with two component etch bond primer and finish painted with alkyd enamel. All uncoated steel shall be painted with red oxide primer. All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bond to metal. Bright spangled galvanized finish is acceptable in lieu of painted finish. Outdoor units shall be finish coated with polyurethane paint.

L. Louvers:

1. Louvers and frames for outdoor units shall be extruded aluminum, 4" deep, blades on a fixed 45° angle with a galvanized steel birdscreen.

M. Hoods:

1. Galvanized steel outside air and exhaust air hoods for outdoor units shall have a birdscreen and shall be finished to match the color of the units.

## N. Lights:

1. Marine lights with protective metal cage, glass or plastic globe, and compact fluorescent bulb shall be installed in all accessible sections on the wall across from the access doors for units less than 144" wide. For units greater than or equal to 144" wide, provide two lights or a single 4-foot fluorescent light with an acrylic diffuser and a continuous neoprene gasket in the center of each section. One switch for all the lights with an indicator light and a duplex outlet shall be installed on the exterior of the unit. Electrical power shall be 120/1/60.

## O. Dampers:

1. Dampers shall be Ruskin CD60 (galvanized steel airfoil blades, 4000 fpm max. velocity for 48" blade, 2.0 CFM/SF leakage at 1.0" w.c., max. section 60"x72") or Engineer accepted equal.
2. Position damper parallel blades so that return air and outside air streams are directed toward each other to promote better mixing of the air.
3. Damper actuators to be supplied by the ATC contractor. Specified torque requirements for each damper assembly shall be coordinated with the ATC contractor to ensure a sufficient quantity and size of actuators is used to provide a complete shut-off of the dampers.

## P. Electrical Service:

1. In addition to the 120/1/60 single point connection for lights and outlets, the unit shall have factory installed conduit and wiring to a single point exterior to the AHU casing for each motor. All wiring and components shall comply with the current National Electrical Code and Division 26.
2. Provide motor starters, disconnects, transformers and all required accessories complying with Division 26 unless these are specified to be by Division 26 or unless a remotely located VFD is to be used.
3. Units in which the supply and/or return fan is controlled by an external variable frequency drive shall have a separate 120/1/60 circuit for lights and outlets.

## Q. Power and Safety Control

1. The power and control center shall be integral to the unit housing and rated equivalent to NEMA 3R.
2. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have. A separate access door shall be provided with an approved locking device.
3. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with VFDs, fuses, relays, phase protection for compressorized units, terminals for main ON/OFF and step-down transformer. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for ON/OFF servicing.
4. An electrical pipe chase for power and control feeding shall be provided next to the control panel.

5. Any power or control wiring that is field installed shall not be accepted under any circumstances. The Short Circuit Current Rating (SCCR) is 5 kA rms symmetrical, 600V Maximum or as noted on schedule.

## 2.2 BURNERS

### A. Indirect Gas Fired Furnace

1. Furnish and install where shown on plans Gas-fired Duct Furnace Heat Module(s).
2. The module shall be a Recognized Component by Intertek Testing Services (ITS / ETL). All modules will have a minimum thermal efficiency of 80%.
3. The module shall employ a tubular heat exchanger and a draft inducer assembly to provide for positive venting of flue gases. Burner assemblies shall employ in-shot type burners constructed of aluminized steel body and sintered metal flame holder with integral carryover plenum.
4. The ignition system will include a 6000 V Igniter and flame rod detection. Ceramic hot surface ignition systems are unacceptable.
5. Gas-fired duct furnace(s) provided shall employ a tubular heat exchanger constructed of 18-gauge minimum, type 409 stainless steel, and 1 3/4" to 2 1/4" diameter having a minimum wall thickness of 0.047". Tubes shall be produced to ASTM A249 standards for heat exchanger application. Tubes shall employ integral formed-dimple restrictors to eliminate noise associated with expansion and contraction of internal baffles during heating cycles, and to provide for unobstructed drainage of condensate that occurs in the tubes during cooling operation. Drainage shall be configured so that burners and burner surfaces are not exposed to condensate during cooling system operation.
6. Full Modulation control shall be provided. On a call for heat and subsequent safe burner light OFF, the burner modulation shall be minimum 5:1 as noted on the schedule. Stepped modulation is not acceptable. Controls shall include an ignition control with alarm capable contact and one hour auto reset on lockout, roll out switch, high limit switch and a proving switch of loss of the induced draft fan. Additionally, on modulating and 2-stage systems all timing and switching functions shall be controlled through an electronic timer relay control. Staging controller available for 0 to 10VDC or 4 to 20mA input from building management control.
7. Burners will use Natural Gas (with gas pressure min 7" –max 14"wc) unless otherwise specified. Gas train compartment shall be provided with 1" PVC drain.

## 2.3 AIR TEMPERATURE CONTROL PACKAGE

- A. The unit shall be delivered with factory installed control system. Under no circumstances shall control be provided by other than the manufacturer of the equipment. Field installed control package by the ATC will not be acceptable.

- B. The control system shall consist of a microprocessor with LCD display, 7 day time clock, 20 day holiday schedule, occupied/unoccupied mode switch, warm up mode, cool down mode, hi-lo limit discharge control, fan status, temperature and humidity sensors when applicable, scroll buttons to change settings as required and alarm history.
- C. Supply air temperature and humidity sensors shall be provided by Annexair and field mounted in the supply duct and wired by others. Optional - Space temperature and humidity wall mounted sensors shall be field wired and installed by others.
- D. Refer to the Sequence of Operation and control schematic for detailed description and options.
- E. Communication Interface Card: The microprocessor shall be capable of communicating with the following protocol language: Select one of the following: Bacnet MS/TP RS-485.

## 2.4 ADDITIONAL ACCESSORIES AND UNIT FEATURES

- A. Dirty filter switch
- B. Door interlocking switch (for fan section)
- C. Magnehelic gauges (Dwyer 2000 model)
- D. Condensate overflow switch (for drain pans)
- E. OA Air Flow Monitoring Package – IAQ-TEK
  - 1. The airflow measuring station shall consist of a special probe, a transducer and a display. The probe will be designed to be accurate in turbulent airflow and will be a standard design to fit all ducts. Only the number of probes will change based on the surface area. Probes can be washed down if required. The high accuracy transducer shall be mounted inside a NEMA 4 enclosure where temperature is controlled and shall also include an auto-zero function to prevent drifting. The display will indicate airflow, temperature and alarms. It will also serve as the interface to configure the system via an internal Set-up Wizard. This Set-up Wizard will include start-up, commissioning and diagnostics functions without the use of a laptop computer or other tools. All calculations, and management operations will be done within the display unit. The accuracy shall be +/- 5% of reading between 200 and 965 ft/min and +/- 10% of reading between 75 and 200 ft/min. as per Tek-Air series IAQ-Tek.
- F. Fan Airflow Monitoring Station Package
  - 1. The unit shall be delivered with factory installed airflow measuring system. The airflow measuring system, consisting of a piezometer ring and transducer, shall be installed on the fan. The package consists of an inlet port on the fan inlet cone connected with flexible tubing to the transducer.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Install air-handling units level and plumb, in accordance with manufacturer's written instructions and recognized industry practices. Maintain manufacturer's recommended clearances.
  - 1. Unless otherwise noted on the drawings or in Part 2, support floor-mounted units on concrete equipment bases 4" high and 4" larger than equipment base on each side, in accordance with Section 230529. Secure units to anchor bolts installed in concrete equipment base. Provide seismic restraint in accordance with Section 230548.
  - 2. Unless otherwise noted on the drawings or in Part 2, support roof-mounted units on factory-fabricated insulated galvanized steel roof curbs nominal 12" high. Construct with integral slope for mounting on sloped roof. Secure units to roof curb. Provide seismic restraint in accordance with Section 230548.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance. Coordinate installation with the work of other trades.

## 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
  - 1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
  - 2. Connect condensate drain pans using 1-1/4-inch minimum, Type L copper tubing. Extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- B. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- C. Electrical Connections: The following requirements apply:
  - 1. Electrical power wiring is specified in Division 26.
  - 2. Temperature control wiring and interlock wiring is specified in Section 230900 and 230529.
  - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:
  - 1. Inspect the field assembly of components and installation of air-handling units including piping, ductwork, and electrical connections.
  - 2. Prepare a written report on findings and make recommended corrective actions.

### 3.4 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.
- B. Adjust damper linkages for proper damper operation.
- C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.
- D. Comb coil fins.

### 3.5 COMMISSIONING

- A. Final Checks before Start-Up: Perform the following operations and checks before start-up:
  - 1. Remove shipping blocking and bracing.
  - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  - 3. Perform cleaning and adjusting specified in this Section.
  - 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  - 6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
  - 7. Comb coil fins for parallel orientation.
  - 8. Install clean filters.
  - 9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
  - 10. Disable automatic temperature control operators.



- B. Starting procedures for air-handling units:
  - 1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    - a. Replace fan and/or motor sheaves and belts as required to achieve design conditions.
  - 2. Measure and record motor electrical values for voltage and amperage.
  - 3. Verify and adjust sump fill/drain valves to confirm adequacy of installation at full load conditions.
- C. Shut unit down and reconnect automatic temperature control operators.
- D. Refer to Section 230593 "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

### 3.6 DEMONSTRATION

- A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:
  - 1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
  - 2. Familiarization with contents of Operating and Maintenance Manuals.
- B. Schedule training with at least 7 days advance notice.

END OF SECTION 237410

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**SECTION 26 0500****ELECTRICAL GENERAL PROVISIONS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

<u>ITEM</u>	<u>SECTION</u>
1. Electrical General Provisions	26 0500
2. Mechanical and Electrical Coordination	26 0501
3. Electrical Connections for Equipment	26 0507
4. Conductors and Cables	26 0519
5. Grounding	26 0526
6. Supporting Devices	26 0529
7. Conduit Raceway	26 0532
8. Electrical Boxes and Fittings	26 0533
9. Electrical Seismic Control	26 0548
10. Electrical Identification	26 0553
11. Protective Device Study	26 0573
12. Occupancy Sensors	26 0923
13. Lighting Control Equipment	26 0943
14. Switchgear and Switchboards	26 2413
15. Panelboards	26 2416
16. Service Entrance	26 2713
17. Wiring Devices	26 2726
18. Overcurrent Protective Devices	26 2815
19. Motor and Circuit Disconnects	26 2816
20. Surge Protective Devices (SPD)	26 4313
21. Interior and Exterior Building Lighting	26 5100
22. Telephone Systems (Raceways)	27 1501
23. Audiovisual Systems	27 4100
24. Access Control System	28 2205
25. Fire Alarm and Detection System	28 3111
26. Fire Sprinkler Monitoring System	28 3112

- B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and

systems required as a portion of this work.

- C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

### 1.3 DEFINITION OF TERMS

- A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:
  - 1. "Provide": Means furnish, install and connect, unless otherwise indicated.
  - 2. "Furnish": Means purchase and deliver to project site.
  - 3. "Install": Means to physically install the items in-place.
  - 4. "Connect": Means make final electrical connections for a complete operating piece of equipment.

### 1.4 RELATED SECTIONS:

- A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
- B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.
- C. Earthwork:
  - 1. Provide trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, buried cable, in-grade pull boxes, manholes, lighting pole foundations, etc. See Division 31, Sitework, and other portions of Divisions 26, 27 and 28, for material and installation requirements.
- D. Concrete Work:
  - 1. Provide forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, light pole foundations, pull box slabs, vaults, equipment pads, etc. See Division 3, Concrete for material and installation requirements.
- E. Miscellaneous Metal Work:
  - 1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.
- F. Miscellaneous Lumber and Framing Work:
  - 1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.
- G. Moisture Protection:
  - 1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.
- H. Access panels and doors:

1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.
- I. Painting:
  1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

**1.5 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:**

- A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:
  1. Electric motors.
  2. Package mechanical equipment: fans, fan coil units, pumps, boilers, duplex compressors, etc.
  3. Flow switches and valve monitors.
  4. Motorized dampers.
  5. Fire and smoke dampers
  6. Duct mounted smoke detectors.
  7. Elevator/Escalator Controllers.
  8. Irrigation controllers.
  9. Door hold-open/release devices.
  10. Motorized projection screens.
  11. Wheel chair lifts.
  12. Roll down doors.
  13. Electric hardware.
  14. Laboratory equipment including hoods, cold rooms, autoclaves, drying ovens, glassware washers and dryers, refrigerators, freezers, etc.
  15. Shop equipment including saw dust collectors, saws, lathes, grinders, welders, planers, presses, etc.
  16. Temperature control panels.
  17. Variable frequency controllers.
  18. Chiller starters.
  19. Motorized Chalkboards/Markerboards/Whiteboards.
  20. Display cases.
  21. Water coolers.
  22. Kitchen equipment including ovens, fryers, mixers, disposers, dishwashers, etc.
  23. Paint spray booths.
  24. Fire sprinkler alarm bells.
  25. Electric heat trace cable for domestic and industrial hot water piping systems.
  26. Electric heat trace cable for guttering, drain lines, etc.
  27. Anti-sweat heaters, fan coils, etc. for walk-in coolers and freezers.
  28. Hand dryers, hair dryers.
  29. Dock levelers.
  30. Systems/Open Office Furniture

**1.6 ITEMS FURNISHED UNDER ANOTHER DIVISION, BUT INSTALLED AND CONNECTED UNDER THIS DIVISION:**

- A. Items furnished under other Divisions, but turned over to Division 26 for installation and final connection include, but are not necessarily limited to, the following:
1. Wall mounted control stations for motorized roll-up doors/grills.
  2. Wall mounted control stations for motorized projection screens.
  3. Wall mounted control stations for handicap lift.
  4. Lighting fixtures for paint spray booths.
  5. Lighting fixtures, receptacles, and switches for fume hoods.
  6. Lighting fixtures for kitchen hoods.
  7. Lighting fixtures for walk-in freezers and coolers.

**1.7 WORK NOT INCLUDED IN THIS DIVISION:**

- A. Items of work provided under another contract include, but are not necessarily limited to, the following:
1. Telephone cables and electronic equipment.
  2. Data system cables, fittings, coverplates and electronic equipment.
  3. Control wires for irrigation control valves.
  4. Energy management/temperature control system; both line and low voltage including conductors and conduit.
  5. Television monitors and projection equipment.
  6. Security system equipment, cables, fittings, and coverplates.
  7. CCTV cabling and electronic equipment.
  8. MATV cabling and electronic equipment

**1.8 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:**

- A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

**1.9 QUALITY ASSURANCE:**

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.
- B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:
1. National Electric Code (NEC).
  2. International Building Code (IBC).
  3. International Fire Code (IFC).
  4. International Mechanical Code (IMC).

- C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.
- |    |       |  |
|----|-------|--|
| 1. | UL    | Underwriters' Laboratories                     |
| 2. | ASTM  | American Society for Testing Materials         |
| 3. | CBN   | Certified Ballast Manufacturers                |
| 4. | IPCEA | Insulated Power Cable Engineers Association    |
| 5. | NEMA  | National Electrical Manufacturer's Association |
| 6. | ANSI  | American National Standards Institute          |
| 7. | ETL   | Electrical Testing Laboratories                |
- D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract Documents that may be in excess of the aforementioned requirements, and not contrary to same.
- F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.
- G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.
- H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

#### **1.10 CONSTRUCTION CHANGE ORDER PROPOSALS**

- A. In the event that a submission of a change order is issued by the contractor, the following information will be required to be submitted by the contractor, prior to any consideration by the owner/architect.
- a. Where project manager or project engineer work is required, the labor cost shall not exceed 2% of the electrical portion of the change order.
  - b. All equipment, including conduit and wire, shall be itemized, identifying unit costs and quantities of equipment. Distributor quotes shall accompany all change order requests. The distributor quotes shall include costs for all equipment including conduit and wire. Lot pricing for equipment is not acceptable.
  - c. The general contractor shall review and confirm that the quantity and costs of materials submitted appear reasonable for the scope proposed.
  - d. Labor units shall not exceed base NECA 1 standards. No adjustment factors shall be approved.
  - e. Any research and labeling time, shall be the responsibility of the electrical contractor and shall not be included in the change order request.
  - f. Any costs associated with the purchase of tools or transportation shall be fully itemized for review by architect/owner.

- g. Overtime rates shall only be approved where additional manpower cannot achieve the same result.
- h. Change order form shall follow the following format:
  - i. PCO number
  - ii. Detailed description of work being performed
  - iii. Location on project where work is performed
  - iv. Chosen NECA column
  - v. Identified material:
    - 1. QTY
    - 2. Unit cost
    - 3. Mark up
    - 4. Material total
  - vi. Identified labor:
    - 1. QTY
    - 2. Unit cost
    - 3. Composite labor rate
    - 4. Labor total

**1.11 SUBMITTALS:****A. SHOP DRAWINGS AND PRODUCT DATA:**

- 1. After the Contract is awarded but prior to manufacture or installation of any equipment, prepare complete Shop Drawings and Brochures for materials and equipment as required by each section of the specification. Submit 8 complete sets for review. All sets of shop drawing material shall be bound. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to ensure proper clearance for installation of equipment. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents. A minimum period of two weeks, exclusive of transmittal time, will be required each time Shop Drawing and/or Brochure is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data. If the shop drawings are rejected twice, the contractor shall reimburse the engineer the sum of \$1,200.00 for the third review and any additional reviews required.
- 2. Shop drawings requiring the use of electronic documents (floor plans, Lighting plans, fire alarm plans, etc.) shall be requested via a request for information (RFI) through the general contractor. Electronic documents will be provided to the Architect for distribution. No direct vendor requests will be accepted.
- 3. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.
- 4. Certifications shall be written or in the form of rubber stamp impressions as follows:
  - a. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)



Signed\_\_\_\_\_.

Position\_\_\_\_\_Date\_\_\_\_\_.

5. Observe the following rules when submitting the Shop Drawings and Brochures.
- a. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be returned for resubmittal.
  - b. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsman skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.
  - c. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs that describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.
6. ELECTRONIC SUBMITTAL REQUIREMENTS:
- a. Provide submittals in Portable Document Format (PDF).
  - b. Documents must be electronically bookmarked and keyword searchable using Adobe Acrobat (<http://www.adobe.com/acrobat>) or Bluebeam Revu (<http://www.bluebeam.com>) for each relevant section. For example, include electronic bookmarks separating "Light Fixtures" from "Panelboards".
  - c. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents is NOT acceptable and will NOT be reviewed.
  - d. Provide only completed cutsheets for all fixture and equipment types. Blank cutsheets submitted with a schedule are NOT acceptable and will NOT be reviewed.
  - e. A maximum of one submittal per specification section is allowed. It is NOT acceptable to provide a product by product submittal. Single product by product submittals will NOT be reviewed.

**1.12 OPERATION AND MAINTENANCE MANUALS:**

- A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.
- B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The

binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones WLJ36544B). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.

- C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).
- D. Include the following information where applicable.
  - 1. Identifying name and mark number.
  - 2. Certified outline Drawings and Shop Drawings.
  - 3. Parts lists.
  - 4. Performance curves and data.
  - 5. Wiring diagrams.
  - 6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
  - 7. Manufacturer's recommended operating and maintenance instructions.
  - 8. Vendor's name and address for each item.
- E. The engineer shall review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of \$1,200.00 for each review afterwards.

#### **1.13 RECORD DRAWINGS:**

- A. Maintain, on a daily basis, a complete set of "Record Drawings", reflecting an accurate record of work in accordance with the following:
  - 1. Show the complete routing and location of all feeders rated 100 amps and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.)
  - 2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.).
  - 3. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.
- B. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes. The "Record Drawings" for daily recording shall consist of a set of blue line prints of the Contract Drawings.
- C. Upon completion of the work, purchase a complete set of electronic drawings. Transfer all "Record" information from the blue line prints to the drawings via the current CAD program that it was written. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings. The

Contractor shall make two complete copies of the drawings electronically and forward this to the Engineer.

- D. Certify the "Record Drawings" for correctness by placing and signing the following certifications of the first sheet of the drawings:

"CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)

By: \_\_\_\_\_ Date: \_\_\_\_\_

(Name of Electrical Contractor)

By: \_\_\_\_\_ Date: \_\_\_\_\_

**1.14 GUARANTEE:**

- A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional charge, replace any work or materials that develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

**PART 2 – PRODUCTS**

**2.1 GENERAL:**

- A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

**2.2 MANUFACTURERS:**

- A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.
- B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.
- C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.
- D. No materials or apparatus may be substituted after the bid opening except where the

equipment specified has been discontinued.

- E. Provide only equipment specified in the Contract Documents or approved by addendum.

### **2.3 SPARE PARTS:**

- A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION:**

- A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.
- B. Provide equipment enclosures appropriate to the environment to which they are installed. For example, provide NEMA 3R for exterior enclosures and NEMA 1 for interior enclosures unless otherwise noted.
- C. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.
- D. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.
- E. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.
- F. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.
- G. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

### **3.2 CLEAN:**

- A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.
- B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

**3.3 POWER OUTAGES:**

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the Owner. Include all costs for overtime work in bid.
- B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.
- C. Keep all outages to an absolute minimum.

**3.4 STORAGE AND PROTECTION OF MATERIALS:**

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

**3.5 EXCAVATING FOR ELECTRICAL WORK:**

- A. General: Locate and protect existing utilities and other underground work in manner that will ensure that no damage or service interruption will result from excavating and backfilling. Perform excavation in a manner that protects walls, footings, and other structural members from being disturbed or damaged in any way. Burial depths must comply with NEC Section 300-5 (or State of Utah requirement, whichever is more stringent), unless noted otherwise on drawings.
- B. Protect persons from injury at excavations, by barricades, warnings and illumination.
- C. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.
- D. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or sub-bases.
- E. Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum. See other sections of specification for additional requirements for excavating.
- F. Store excavated material (temporarily) near excavation, in a manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip line).
- G. Retain excavated material that complies with requirements for backfill material. Dispose of excavated material that is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material. Remove unused material from project site, and dispose of in lawful manner.

**3.6 BACKFILL MATERIALS:**

- A. For buried conduit or cable (other than below slab-on-grade, or concrete encased) - 2" thickness of well graded sand on all side of conduit or cable.
- B. For trench backfill to within 6" of final grade - soil material suitable for compacting to required densities.
- C. For top 6" of excavation - Top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven

hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
  2. Paved Areas, Other than Roadways (90 percent for cohesive soils, 95 percent for cohesionless soils).
- E. Subsidence: Where subsidence is measurable or observable at electrical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.7 CONCRETE BASES:**

- A. Unless otherwise noted, provide 4" high reinforced concrete bases for all floor mounted or floor standing electrical equipment, including generators, transformers, switchgear, battery racks, motor control centers, etc. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Notwithstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 404.8.
- B. Concrete bases shall be provided under Divisions 26, 27 and 28. Coordinate size and location of all bases and furnish all required anchor bolts, sleeves, reinforcing and templates as required to obtain a proper installation.
- C. Provide and locate properly sized concrete pads for power company furnished pad mounted transformers in accordance with power company clearance requirements. Where the serving utility is Rocky Mountain Power, the electrical contractor shall conform to the requirements of Electrical Service Requirements, Section 6.4.

### **3.8 ROOF PENETRATIONS:**

- A. Where raceways penetrate roofing or similar structural area, provide appropriate roof jack coordinate with the roofing contractor and the Architect in order to match the vent with the roof construction. The jack shall be sized to fit tightly to raceway for weather-tight seal, and with flange extending a minimum of 9" under roofing in all sides or as required by the roof type of construction. Completely seal opening between inside diameter of roof flashing and outside diameter of penetrating raceways. Coordinate all work with work required under roofing section of specifications.

### **3.9 FIRE PENETRATION SEALS:**

- A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling that it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide 3M CID cast-in device for floor slabs. Where applicable, provide 3M fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

**3.10 PROJECT FINALIZATION AND START-UP:**

- A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.
- B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.
- C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:
  - 1. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.
  - 2. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM

(List systems included)

FACTORY REPRESENTATIVE

(List name and address of Factory Representative)

---

Owner's Representative

---

Contractor

- D. Send copy of acceptance to Architect/Engineer.

**3.11 FINAL REVIEW:**

- A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

**END OF SECTION 26 0500**

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**SECTION 26 0501****MECHANICAL AND ELECTRICAL COORDINATION****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Vertical Transportation, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

**1.2 CONTRACTOR RESPONSIBILITIES**

- A. Electrical Contractor shall verify electrical service provided prior to ordering any electrical equipment serving mechanical equipment, and Electrical Contractor shall have the final responsibility for properly coordinating the electrical work, including the exact location of the electrical connection(s).
  - 1. Circuit breakers, disconnects, starters, fuses, conduit sizes, wire sizes, VFDs, etc. have been coordinated by Engineers and sized according to the mechanical systems "Basis of Design". Coordinate with Division 23 Contractor for any changes arising from substituted equipment or changes to the basis of design in any way. Coordinate all requirements of multi-motor VFD control (including fanwall units) and ensure all provisions accordingly. Prepare documentation showing changes in the electrical characteristics of each piece of equipment that has changed and submit for acceptance. All costs arising from said changes shall be the responsibility of Division 23.
- B. Obtain submittals of all mechanical equipment from Division 21 through 23 contractor(s).
  - 1. Notify engineer of any modifications between contract documents and submittals. It shall be the contractor's responsibility to ensure compliance with the documents.
- C. Electrical contractor shall be responsible for coordinating all their own blockouts and coordinating their space of a shared blockout.
- D. Coordinate all interfaces between Mechanical and Electrical/Communications/Security Divisions before submitting any equipment for review or beginning installation.

**1.3 ABBREVIATIONS**

- A. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who provides equipment and motor.
- B. TC: Temperature Controls = Division 23 09 00 Contractor who provides control.
- C. EC: Electrical Contractor = Divisions 26 through 28 Contractor who provides power/data.
- D. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

**1.4 RESPONSIBILITY SCHEDULE**

- A. Responsibility: Unless otherwise indicated, all equipment, motors, and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnishe d Under	Set In Place Under	Power Wiring Under	Control Wiring Under
AHU Interior Marine Lights (Note 8)	MC	MC	MC	MC
AHU Light Switch	EC	EC	EC	EC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4)				
-Separate	MC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Variable Frequency Drives				
-Separate	EC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4)				
-Separate	MC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	TC	TC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	MC or TC	TC	TC
Equipment in Temperature Control Panels	TC	TC	EC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	EC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	EC	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	EC	EC	FA
Room Smoke Detectors Including Relays for Fan Control (Note 3)	MC	MC		MC
Smoke Management Controls (Note 7)	MC	MC	EC	TC
CO Sensors	FA	FA	EC	FA
Control Air Compressor	TC	TC	EC	TC
Refrigerated Air Dryer	TC	TC	EC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA
Smoke Control Dampers (for smoke management system) (Note 7)	MC	MC	EC	FA/TC
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC

## B. Responsibility Schedule Notes:

- If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC.

2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.
  3. Pre-action system alarm and trouble initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be monitored under Division 28.
  4. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.
  5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.
  6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
    - a. Division 26 and 28 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.
    - b. Fire alarm system shall override automated building control system during smoke exhaust mode.
    - c. TC wiring required only when damper also serves HVAC system.
  7. FA wires from the fire alarm control panel necessary for the initiation and monitoring of the Smoke Management System Control Panel. TC wires to components and smoke control fans and dampers utilized in the control and monitoring of the Automated Building Control System.
  8. Division 26 shall provide power to junction box on the exterior of the AHU.
- C. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trades requiring such power. Electrical contractor shall review Division 21 through 23 drawings and coordinate with said contractors to confirm power needs.
1. Sufficient power for this purpose shall be furnished as "spare" dedicated circuit capacity in Division 26's panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trades requiring the power.
    - a. Such equipment is hereby defined as:
    - b. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings (Division 22 work).
    - c. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor's engineered system design drawings.
    - d. Pre-action system alarm and trouble initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.

- e. Division 21 shall provide pre-action control panel and interconnection between pre-action panel and location of pre-action valve(s).
- f. Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).
- g. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
- h. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor's control submittal drawings.
- i. Condensate pumps. Provide power from associated unit or from nearby panelboard.
- j. BAS or Control System Gateways. Provide power from nearest panelboard and single data cable from nearest telecommunications room.

## 1.5 GENERAL REQUIREMENTS

### A. Special Requirements:

- 1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

### B. Building Management System Controls:

- 1. Provide 120V circuit and single data cable to each building management control panel. Coordinate exact locations with controls contractor. See Specification 27-1500 / 27-1501.
- 2. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23.
- 3. Any additional power requirements shall be the responsibility of the Division 23 Contractor requiring same, and shall be provided at no additional cost to the owner.

## 1.6 CEILING AND CHASE CAVITY PRECEDENCE

- A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.
  - 1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
  - 2. Condensate piping.
  - 3. Hydronic main piping (8" and larger).
  - 4. Plumbing vent piping.
  - 5. Supply, return and exhaust ductwork.
  - 6. Cable tray systems.
  - 7. Electrical conduit 4" diameter or greater.

8. Hydronic branch and mains (greater than 2", but less than 8").
  9. Domestic water piping.
  10. Fire sprinkler mains and leaders.
  11. Hydronic branch piping (2" and less).
  12. Domestic hot and cold-water branches.
  13. Electrical branch conduits.
  14. Pneumatic control piping.
  15. Fire sprinkler branch piping and sprinkler runouts.
- B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2").
- C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).
- D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.
- E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.
- F. Provide access doors for all electrical and communications equipment which require access for adjustment or servicing and which are in otherwise inaccessible locations. All access door locations must be approved by the architect prior to installation and be in as inconspicuous location as possible.
1. For equipment located in "accessible locations" such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. "Normal maintenance" includes, but is not limited to: replacement of drivers, fuses, etc.

#### **1.7 BLOCKOUT USAGE**

- A. Electrical and Mechanical Contractors shall review the contract documents and advise if additional blockouts are necessary for the execution of work. Electrical and Mechanical Contractors shall coordinate and hold meetings with other contractors who will occupy the blockouts to ensure sufficient space is allocated for their scope of work. It is not acceptable to delay this meeting until conduit/piping/tray is being installed. Change orders are not acceptable due to a lack of contractor coordination prior to commencing rough in.

#### **PART 2 PRODUCTS (NOT USED)**

#### **PART 3 EXECUTION (NOT USED)**

**END OF SECTION 26 0501**

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**SECTION 260507****ELECTRICAL CONNECTIONS FOR EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-23 section making reference to electrical connections.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.
- B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.
- C. Refer to Division-23 section for control system wiring; not work of this section.
- D. Refer to sections of other Divisions for specific individual equipment power requirements.

**1.3 QUALITY ASSURANCE:**

- A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.
- B. UL LABELS: Provide electrical connection products and materials that have been UL-listed and labeled.

**PART 2 - PRODUCTS****2.1 GENERAL:**

- A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 26 0532, Conduit Raceways; Section 26 2726 Wiring Devices; and Section 26 0519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:
  - 1. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.
  - 2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).
  - 3. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

**PART 3 - EXECUTION****3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:**

- A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
- C. Coordinate installation of electrical connections for equipment with equipment installation work.
- D. Verify all electrical loads (voltage, phase, horse power, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings to Architect before proceeding with rough-work. In summary it is not in the Electrical Engineers scope to review the shop drawings from other trades/divisions.
- E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.
- F. Refer to basic materials and methods Section 26 0553 Electrical Identification, Conductors, for identification of electrical power supply conductor terminations.

**END OF SECTION 26 0507**



**SECTION 26 0519****CONDUCTORS AND CABLES (600V AND BELOW)****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.
- B. Types of conductors and cables in this section include the following:
  - 1. Copper Conductors (600V)
- C. Applications for conductors and cables required for project include:
  - 1. Power Distribution
  - 2. Feeders
  - 3. Branch Circuits

**1.3 RECORDS SUBMITTAL:**

- A. Submit record in triplicate of megohmmeter readings to Architect/Engineer. Please see paragraphs 3.2A AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW for testing requirements.

**1.4 QUALITY ASSURANCE:**

- A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables that have been UL-listed and labeled.
- B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.
- C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

**1.5 SUBMITTALS:**

- A. FIELD TEST DATA:
  - 1. Submit megohmmeter test data for circuits under 600 volts.

**PART 2 - PRODUCTS****2.1 COPPER CONDUCTORS (600V):**

- A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's installation requirements and NEC standards. Provide conductors in accordance with the following:

1. Service Entrance Conductors – Copper conductor; see drawings for insulation type.
  2. Distribution and Panelboard Feeders; and Other Conductors, #2 AWG and Larger – Copper conductor; see drawings for insulation type.
  3. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG. Provide solid conductors for #10 AWG and smaller. Provide stranded conductors for #8 AWG and larger.
- B. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
- C. Provide neutral and ground wire as specified elsewhere in documents.
- D. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

- A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.
- B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop that pull wires can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.
- D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.
- E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.
- F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.
- G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.
- H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and that is listed by UL.
- I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not

contain splices.

- J. Support all cables in pullholes, concrete trenches, and similar locations by cable racks and secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator. In manholes, pullholes, concrete trenches, and similar locations, wrap strips of fire-proofing tape (approx. 1/16 inch thick by 3 inches wide) tightly around each cable spirally in half-lapped wrapping or in two butt-joined wrappings with the second wrapping covering the joints in the first. Apply tape with the coated side toward the cable, and extend tape one inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure sensitive glass cloth tape. Provide fireproofing tape of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick weighing not less than 2.5 pounds per square yard. Provide tape that is noncorrosive to cable sheath, self-extinguishing, and that will not support combustion. Construct tape of materials that do not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
- K. Follow manufacturer's instructions for splicing and cable terminations.

### **3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:**

- A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits, Megger all circuits of 100 amp and greater rating. Correct malfunctions. Record all test data and provide written test report.
- B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

### **3.3 IDENTIFICATION OF FEEDERS:** Refer to Section 26 0553 for requirements.

**END OF SECTION 26 0519**

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**SECTION 26 0526****GROUNDING****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Provide grounding as specified herein, and as indicated on drawings.
- B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.
- C. Unless otherwise indicated, ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.
- D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.
- E. Types of grounding in this section include the following:
  - 1. Underground Metal Water Piping
  - 2. Metal Building Frames
  - 3. Grounding Electrodes
  - 4. Grounding Rods
  - 5. Separately Derived Systems
  - 6. Service Equipment
  - 7. Enclosures
  - 8. Systems
  - 9. Equipment
  - 10. Other items indicated on drawings
- F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products that have been UL listed and labeled.
- B. Resistance from the service entrance ground bus, through the grounding electrode to earth, shall not exceed 5 ohms.

**1.4 SUBMITTALS:**

- A. Submit the name of test agency to be used for testing specified in this section. Submit results of tests specified in this section. Also include test results in Operation and Maintenance Manuals as specified.

**PART 2 – PRODUCTS****2.1 MATERIALS AND COMPONENTS:**

- A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.
- B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.
- C. GROUND RODS: Steel with copper welded exterior, 3/4" dia. x 10' long. Weaver or Cadweld.
- D. GROUND WELL BOXES FOR GROUND RODS: Precast concrete box 9-1/2" W. x 16" L. X 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "GROUND ROD".
- E. CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND): #2/0 AWG bare copper conductor.
- F. INSULATED GROUNDING BUSHINGS: Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners, OZ-Gedney BLG, or Thomas & Betts #TIGB series.
- G. CONNECTIONS TO PIPE: For cable to pipe, OZ-Gedney G-100B series or Thomas & Betts #390X series, or Burndy type GAR.
- H. CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES: For splicing and/or connecting conductors, use exothermic welds or high pressure compression type connectors. Provide exothermic weld kits manufactured by Cadweld or Thermoweld. If high compression type connectors are used for cable-to-cable, or cable-to-steel, or cable-to-ground rod connections, provide Thomas & Betts #53000 series, or Burndy Hyground series.
- I. BONDING JUMPERS: OZ-Gedney Type BJ, or Thomas & Betts #3840 series, or Burndy type GG and type B braid.
- J. MAIN BUILDING REFERENCE GROUND BUS: Provide one 18" L. X 2" H X 1/4" thick copper bus bar (or size noted on drawings). Mount on walls in locations shown, on insulating stand offs, 18" AFF. Furnish complete with lugs for connecting grounding system cables. All holes shall be drilled and tapped for single hole lugs. Provide 6 spare lugs and 6 lug spaces.
- K. INTERSYSTEM BONDING TERMINAL: Provide one 12" L. x 2" H x 1/4" thick copper bus bar. Mount on wall adjacent to Main Electrical Service Equipment on insulating standoffs, 18" A.F.F. Furnish complete with lugs for connecting systems grounding cables. All holes shall be drilled for 2 hole compression lugs. Provide 6 spare lugs. Connect to equipment grounding bus in Main Electrical Service Equipment with No. 4 AWG copper conductor.

**PART 3 - EXECUTION****3.1 INSTALLATION OF GROUNDING SYSTEMS:**

- A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.
- B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.

- C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All non-metallic raceways shall include copper grounding conductor sized in accordance with NEC. Include copper grounding conductor in all raceway installed in suspended slabs.
- D. Provide service entrance grounding by means of ground rods (quantity of two, driven exterior to building), by means of bonding to water main, and by means of bonding to building structural steel. In addition, provide a grounding electrode for not less than 30 lineal feet in concrete footing or foundation that is in direct contact with earth. Size electrode in accordance with NEC, but in no case, smaller than No. 4 AWG bare copper. Support electrode so as to be below finished grade near the bottom of the trench, and approximately three inches from the bottom or sides of the concrete. Locate a point of connection for inspection.
- E. Provide grounding conductors for dimming systems in accordance with manufacturer's requirement.

### 3.2 GROUNDING ELECTRODES:

- A. Concrete Encased Grounding Electrode (UFER Ground): Provide a #2/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings that are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Extend electrode through a horizontal length of 30 feet minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils. At point of emergence from concrete, run electrode through a protective non-metallic sleeve and extend to the main building reference ground bus.
- B. Supplementary Grounding Electrode (Ground Ring, Grid, and Driven Rods): Provide driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod(s) with structural steel and adjacent rods with minimum #4 AWG bare copper conductor. Locate ground rod a minimum of 10 feet from any electrode of another electrical system or from adjacent ground rod(s).
- C. Separately Derived Electrical System Grounding Electrode: Ground each separately derived system per requirements in NEC Section 250-26 unless indicated otherwise.
- D. GROUNDING ELECTRODE CONDUCTOR: Provide grounding electrode conductor sized per NEC table 250-94 or as indicated.
- E. POWER SYSTEM GROUNDING: Connect the following items using NEC sized copper grounding conductors to lugs on the Main Building Ground Bus Service Ground Bus.
  - 1. Grounding electrode conductor from concrete encased electrode, and from ground rods, and from service entrance ground bus.
  - 2. Conductor from main incoming cold water piping system.
  - 3. Conductor from building structural steel.
  - 4. Ground for separately derived systems.
- F. Run main grounding conductors exposed or in metallic conduit if protection or concealment is required.
- G. EQUIPMENT BONDING/GROUNDING: Provide a NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:
  - 1. Non-metallic conduits and ducts.
  - 2. Distribution feeders.
  - 3. Motor and equipment branch circuits.
  - 4. Device and lighting branch circuits.

- 5. Provide grounding bushings and bonding jumpers for all conduit terminating in reducing washers, concentric, eccentric or oversized knockouts at panelboards, cabinets and gutters.
- H. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system.
- I. Provide bonding wire in all flexible conduit.

### **3.3 TESTING:**

- A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.
- B. Include typewritten records of measured resistance values in the Operation and Maintenance Manual.
- C. Use independent testing agency for all testing.
- D. Use test equipment expressly designed for the purpose intended. Submit name of testing agency for review and approval, in writing, to the Engineer prior to the performance of any testing.

**END OF SECTION 26 0526**



**SECTION 26 0529****SUPPORTING DEVICES****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.
- B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components that are UL-listed and labeled.

**PART 2 - PRODUCTS****2.1 MANUFACTURED SUPPORTING DEVICES:**

- A. GENERAL:
  - 1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

**PART 3 - EXECUTION****3.1 INSTALLATION OF SUPPORTING DEVICES:**

- A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.
- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts, moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or

raceway.

**D. RACEWAYS:**

1. Support raceways that are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90° degree bend. Support raceway (as it is installed) in accordance with the following:

<u>NUMBER OF RUNS</u>	<u>3/4" TO 1-1/4" Ø</u>	<u>1-1/2" &amp; LARGER Ø</u>
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use "tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.

**E. FLOOR MOUNTED EQUIPMENT:**

1. Provide rigid attachment of all floor mounted equipment to the floor slab or structural system. Provide 5/8" bolts or expansion anchors at each 90 degree corner and at intervals not to exceed 48" on center along entire perimeter of the equipment. Provide rigid attachment for all floor mounted switchboards, panelboards, power and control equipment, motor control centers, dimmer cabinets, transformers (provide neoprene vibrations isolators at anchor points), oil switches, battery packs and racks, and similar equipment furnished under Division 26, 27 and 28.

**F. WIREWAYS, BUS DUCTS AND CABLE TRAYS:**

1. Provide vertical and lateral support systems for all wireways, busway, and cable trays that are supported from overhead structure. See Sections 260536 and 262500 for additional requirements.

**END OF SECTION 26 0529**

**SECTION 26 0532****CONDUIT RACEWAY****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the following:
  - 1. Electrical Metallic Tubing
  - 2. Flexible Metal Conduit
  - 3. Intermediate Metal Conduit
  - 4. Liquid-tight Flexible Metal Conduit
  - 5. Rigid Metal Conduit
  - 6. Rigid Non-metallic Conduit

**1.3 QUALITY ASSURANCE:**

- A. MANUFACTURERS: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.
- C. SUBMITTALS: Not required.
  - a. Submit manufacturer's data on MC-PCS Power & Control/Signal Cable.

**PART 2 – PRODUCTS****2.1 METAL CONDUIT AND TUBING:**

- A. GENERAL:
  - 1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".
- B. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.
- C. INTERMEDIATE STEEL CONDUIT (IMC): FS WW-C-581.
- D. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSI C80.1 and NEMA Std. Pub. No. RN 1.
- E. ALUMINUM CONDUIT: Not acceptable.
- F. MC CABLE: Not acceptable.
- G. RIGID AND INTERMEDIATE STEEL CONDUIT FITTINGS:

1. Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.
- H. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.
- I. EMT FITTINGS:
  1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.
- J. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;
  1. Zinc-coated steel.
- K. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.
- L. LIQUID TIGHT FLEXIBLE METAL CONDUIT:
  1. Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- M. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G.
- N. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

## **2.2 NON-METALLIC CONDUIT AND DUCTS:**

- A. GENERAL:
  1. Provide non-metallic conduit, ducts and fittings of types, sizes and weights as indicated; with minimum trade size of 3/4".
- B. UNDERGROUND PVC PLASTIC UTILITIES DUCT:
  1. Minimum requirements shall be schedule 40 for encased burial in concrete and for Type II for direct burial.
- C. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS:
- D. ANSI/NEMA TC 9, match to duct type and material.
- E. HDPE CONDUIT: Not acceptable.

## **2.3 CONDUIT; TUBING; AND DUCT ACCESSORIES:**

- A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, that mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

## **2.4 SEALING BUSHINGS:**

- A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

## **2.5 CABLE SUPPORTS:**

- A. Provide OZ cable supports for vertical risers, type as required by application.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION OF ELECTRICAL RACEWAYS:**

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in

accordance with the following:

1. SERVICE ENTRANCE CONDUCTORS, AND CONDUCTORS OVER 600 VOLTS:
  - a. Install in rigid metal conduit (RMC), or intermediate metal conduit (IMC); except where buried below grade, install in non-metallic conduit or duct, individually encased in concrete. See duct banks.
2. FEEDERS UNDER 600 VOLTS:
  - a. Install feeders to panels and motor control centers and individual equipment feeders rated 100 amps and greater, in rigid metal conduit (RMC), or intermediate metal conduit (IMC), or Electrical Metallic Tubing (EMT); except where buried below grade, install in non-metallic conduit or duct. Encase feeders 1-1/4" and larger, individually in concrete where installed below grade. See duct banks.
3. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:
  - a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic duct. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT. Encase non-metallic duct 1-1/4" and larger in concrete. See duct banks.
- B. Provide 1000 feet of 3/4" conduit with 3 #12 conductors and 1000 feet of 3/4" conduit with 3 #10 conductors. Provide all supports, fittings, boxes, terminations, etc. as required for installation. Install only as directed by engineer. Credit back all unused material and labor to the Owner.
- C. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- D. Install raceway in accordance with the following:
  1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.
  2. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.
  3. Provide a minimum of 1 1/2" from nearest surface of the roof decking to raceway.
  4. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
  5. Provide neutral and ground wire as specified elsewhere in documents.

6. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.
- E. Comply with NEC for requirements for installation of pull boxes in long runs.
- F. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandrel and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.
- G. Replace all crushed, wrinkled or deformed raceway before installing conductors.
- H. Do not use flame type devices as a heat application to bend PVC conduit. Use a heating device that supplies uniform heat over the entire area without scorching the conduit.
- I. Provide rigid metal conduit (RMC) for all bends greater than 22 degrees in buried conduit. Provide protective coating for RMC bend as specified herein.
- J. Where raceways penetrate building, area ways, manholes or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 feet on the exterior side of the floor or wall measured from interior face. Provide OZ, Type FSK, WSK or CSMI sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering walls or slabs below grade. Provide segmented type CSB internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway.
- K. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.
- L. Install spare 3/4" conduits (capped) from each branch panelboard into the ceiling and floor space. Run five into the ceiling space and five into the floor space. Where the floor is not accessible run six conduits into the ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.
- M. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.
- N. Provide OZ cable supports in all vertical risers in accordance with NEC 300-19; type as required by application.
- O. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.
- P. Raceway installation below grade:
  1. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
  2. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
- Q. Raceway installation below slab-on-grade, or below grade:
  1. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. All raceway shall be located a minimum of 8" below bottom of slab. Install RMC (with protective coating) for raceways passing vertically through slab-on-grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.
  2. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.

3. Mark all buried conduits that do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
  4. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
- R. Raceway installation in suspended slabs:
1. Install conduit as close to the middle of concrete slab as practicable without disturbing reinforcement. Do not install conduits of diameter greater than 1/3 of the slab thickness. Space conduits not less than 3 diameters on center (except at stub up locations). Provide OZ expansion fittings at all expansion joints. All raceways shall be installed with concrete tight fittings. Include copper ground conductor in all raceways installed in suspended slabs.
- S. Raceway installation in hazardous locations:
1. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.
  2. Engage at least five full threads on all fittings. Provide inspection fittings with explosion proof drains to prevent water accumulation in conduit runs. Install seal-offs for arcing or high temperature equipment, at housing with splices or taps and where conduits enter or leave the hazardous area. Provide seal-offs of the appropriate type for vertical or horizontal installation. Ground all metallic parts.
- T. DUCTBANKS:
1. Provide ductbank construction as indicated using 3000 psi at 28 day strength concrete. Use Type II low alkali per ASTM C150. Use ASTM C-33 aggregate gradation with maximum size of 3/4". Use W/C ratio of 0.50. Install #4 reinforcing bar per ASTM 615 grade 50 in each corner of ductbank. Provide minimum 4" concrete cover on all sides of exterior conduits. Provide polypropylene pull rope in all spare duct.
- U. Electrical Identification: Refer to Section 260553 for requirements.

**END OF SECTION 26 0532**

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**SECTION 26 0533****ELECTRICAL BOXES AND FITTINGS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of electrical box and electrical fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
  - 1. Outlet Boxes
  - 2. Junction Boxes
  - 3. Pull Boxes
  - 4. Floor Boxes
  - 5. Conduit Bodies
  - 6. Bushings
  - 7. Locknuts
  - 8. Knockout Closures
  - 9. Miscellaneous Boxes and Fittings

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings that have been UL-listed and labeled.

**1.4 SUBMITTALS:**

- A. Submit manufacturer's data including specifications, installation instruction and general recommendations for each type of floor box used on project.

**PART 2 - PRODUCTS****2.1 FABRICATED MATERIALS:**

- A. INTERIOR OUTLET BOXES:
  - 1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x2-1/8".
  - 2. Provide an 'FS' box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

**B. INTERIOR OUTLET BOX ACCESSORIES:**

1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, that are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications.

**C. WEATHERPROOF OUTLET BOXES:**

1. Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

**D. JUNCTION AND PULL BOXES:**

1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

**E. FLOOR BOXES:**

1. Single Service Floor Box: Provide leveling and fully adjustable floor service receptacle outlets and fittings of types and ratings indicated; and with finish as selected by Architect. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; provide epoxy-coated stamped steel boxes or cast iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall be available in one, two or three gang configurations. Boxes shall comply with UL Standard UL514A.
2. Multi-Service Floor Box: Provide leveling and fully adjustable multi compartment floor box; there shall be multiple independent wiring compartments; the floor box shall permit tunneling from end power compartment to end power compartment. Floor box shall accommodate a minimum of two duplex receptacles and two mounting plates for telecommunication devices. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; with finish as selected by Architect. Provide epoxy-coated stamped steel boxes or cast-iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall comply with UL Standards UL514A and/or UL514C.
3. Manufacturer: subject to compliance with requirements, provide floor boxes of one of the following:
  - a. Bell Electric/Square D Co.
  - b. Crouse-Hinds Co.
  - c. Harvey Hubbell, Inc.
  - d. Thomas & Betts.
  - e. Wiremold

**F. CONDUIT BODIES:**

1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

**G. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:**

1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

**PART 3 - EXECUTION****3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:****A. GENERAL:**

1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
4. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.
7. Fasten boxes rigidly to substrates or structural surfaces, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them. Set boxes on opposite sides of fire resistant walls with minimum of 24" separation.
8. Provide a minimum of 1 ½" from the nearest surface of the roof decking to the installed boxes.
9. Provide electrical connections for installed boxes.

**END OF SECTION 26 0533**

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**SECTION 26 0548****ELECTRICAL SEISMIC CONTROL****PART 1 – GENERAL****1.1 WORK INCLUDED:**

- A. Anchorage and seismic restraint systems for all Division 26 isolated and non-isolated equipment, cable tray, and conduit systems.
- B. Anchorage and seismic restrain systems for electrical components shall include but not be limited to the following:
  - 1. Pad Mounted Equipment
  - 2. Conduit
  - 3. Cable Tray
  - 4. Bus Duct
  - 5. Light Fixtures

**1.2 RELATED WORK:**

- A. Requirements: Provide Electrical Seismic Control in accordance with the Contract Documents.
- B. Section 260500 – Electrical General Provisions

**1.3 REFERENCES:**

- A. International Building Code, Current Edition in use by Jurisdictional Authority.
- B. NFPA Bulletin 90A, Current Edition.
- C. UL Standard 181.
- D. ASCE 7-10

**1.4 SYSTEM DESCRIPTION**

- A. The Division 26 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:
  - 1. Short period design spectral response acceleration coefficient  $SDS=0.70$ .
  - 2. One second period design spectral response acceleration coefficient  $SD1=0.28$ .
  - 3. Site Class B.
  - 4. Seismic Design Category D.
  - 5. Importance Factor ( $I_p$ ) = 1.0
- B. Seismic Restraint Exceptions
  - 1. The following components are exempt from the requirements of this section

**1.5 QUALITY ASSURANCE:**

- A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for electrical equipment. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division

26 equipment and systems shall be provided by a single firm.

- B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the electrical equipment that have been submitted, reviewed and accepted by the Architect/Engineer for this project.
- C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.
- D. The Division 26 Contractor shall require all equipment suppliers furnish equipment that meets the seismic code, with bases/skids/curb designed to receive seismic bracing and/or anchorage. All isolated and non-isolated electrical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

#### **1.6 SUBMITTALS:**

- A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 26 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.
- B. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:
  - 1. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Paragraph 1.1 above, and as detailed on drawings.
  - 2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
  - 3. Details for all seismic bracing.
  - 4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
  - 5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
  - 6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
  - 7. Include confirmation that all calculations are based on the design criteria listed in Paragraph 1.4.A of this Section.
  - 8. Certificate of Compliance.
- C. Where equipment is exempt per this specification provide a written certificate of compliance for each of the systems noted in paragraph 1.1 with the professional seal of engineer who has reviewed the electrical system.

#### **PART 2 – PRODUCTS:**

##### **2.1 RESTRAINT EQUIPMENT AND SYSTEMS:**

- A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:
  - 1. Mason Industries, Inc.
  - 2. Korfund
  - 3. Amber/Booth Company

4. Vibration Mountings and Control Company
  5. Kinetics
  6. International Seismic Application Technology
  7. Tolco
- B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment.

## 2.2 SNUBBERS:

- A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.
- B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.
- C. Snubbers shall be Mason Industries Z -1011 or accepted equivalent.

## PART 3 – EXECUTION

### 3.1 DESIGN AND INSTALLATION:

- A. General:
1. All electrical components shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials, and equipment for protection against seismic disturbances as specified herein. The following electrical components are exempt from seismic restraint requirements.
    - a. Electrical components in Seismic Design Category A or B (see section 1.4)
    - b. Electrical components in Seismic Design Category C provided that the component importance factor,  $I_p$ , is equal to 1.0 (see section 1.4).
    - c. Electrical components in Seismic Design Categories D, E, or F where all of the following apply:
      - i. The component importance factor,  $I_p$ , is equal to 1.0;
      - ii. The component is positively attached to the structure;
      - iii. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and either
        1. The component weighs 400 lb (1,780 N) or less and has a center of mass located 4 ft (1.22 m) or less above the adjacent floor level; or
        2. The component weighs 20 lb (89 N) or less or, in the case of a distributed system, 5 lb/ft (73 N/m) or less.
  2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.

3. Attachments and supports for electrical equipment shall meet the following provisions:
  - a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).
  - b. Friction clips shall not be used for anchorage attachment.
  - c. Expansion anchors shall not be used for electrical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.
  - d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.
  - e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.
  - f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as 2Fp. The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.
  - g. Seismic supports shall be constructed so that support engagement is maintained.
- B. Pad Mounted Equipment
  1. Spring Isolated Equipment:
    - a. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.
  2. Non-Isolated Equipment:
    - a. The section 260548 (Electrical Seismic Control) Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment i.e. switchboards, transformers, generators, etc. to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.4 of this specification section.
- C. Conduit, Conduit Racks/Trapeze Assemblies, Cable Tray and Bus Duct:
  1. Seismic braces for be omitted when the distance from the supporting structure to the raceway support point is 12" or less. Where rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod.
  2. Seismic braces may be omitted where the total weight of the assembly is less than 10 lb/ft.
  3. Seismic braces for individual conduit may be omitted for conduit less than 2.5 inch trade size.
  4. A rigid conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.



5. Unbraced conduit attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
  6. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
  7. Provide large enough pipe sleeves through wall or floors to allow for anticipated differential movements.
  8. For spaces, where the Importance Factor ( $I_p$ ) is equal to 1.5, all electrical components that are attached to structures that could displace relative to one another and for isolated structures where components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements.
- D. Light Fixtures
1. Light fixtures, lighted signs, and ceiling fans not connected to ducts or piping, which are supported by chains or otherwise suspended from the structure, are not required to satisfy the seismic force and relative displacement requirements provided they meet all of the following criteria:
    - a. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for the design.
    - b. Seismic interaction effects shall not cause an effect so that the failure of the non-essential component causes a failure of an essential component.
    - c. The connection to the structure shall allow a 360° range of motion in the horizontal plane.
    - d. The component is less than 20 lbs and has flexible connections and an importance factor ( $I_p$ ) equal to 0.

**END OF SECTION 26 0548**

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**SECTION 26 0553****ELECTRICAL IDENTIFICATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Requirements of the following Division 26 Sections apply to this section:
  - 1. "Basic Electrical Requirements".
  - 2. "Basic Electrical Materials and Methods".

**1.2 SUMMARY**

- A. This section includes identification of electrical materials, equipment and installations. It includes requirements for electrical identification components including but not limited to the following:
  - 1. Buried electrical line warnings.
  - 2. Identification labels for raceways, cables and conductors.
  - 3. Operational instruction signs.
  - 4. Warning and caution signs.
  - 5. Equipment labels and signs.
  - 6. Arc-flash hazard labels
- B. Related Sections: The following sections contain requirements that relate to this section:
- C. Division 9 Section "Painting" for related identification requirements.
- D. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

**1.3 QUALITY ASSURANCE**

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code"

**1.4 SUBMITTALS:**

- A. PRODUCT DATA: Submit manufacturer's data on each type of electrical identification products.
- B. SAMPLES: Submit one sample of each component of the electrical identification system as follows:
  - 1. Wire/cable tape marker.
  - 2. Tags
  - 3. Engraved, plastic laminate labels.
  - 4. Arc-flash hazard labels.

**PART 2 – PRODUCTS****2.1 MANUFACTURERS**

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

1. American Labelmark Co.
2. Calpico, Inc.
3. Cole-Flex Corp.
4. Emed Co., Inc.
5. George-Ingraham Corp.
6. Ideal Industries, Inc.
7. Kraftbilt
8. LEM Products, Inc.
9. Markal Corp
10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H Brady, Co.

## **2.2 ELECTRICAL IDENTIFICATION PRODUCTS**

- A. Colored Conduit Systems for raceway identification:
  1. Factory-painted conduit and/or factory-painted couplings and fittings
- B. Colored paint for raceway identification:
  1. Use Kwal Paint colors as specified in Part 3 – Execution.
- C. Color Adhesive Marking Tape for Raceways, Wires and Cables:
  1. Self-adhesive vinyl tape not less than 3 mills thick by 1" to 2" in width.
- D. Underground Line Detectable Marking Tape:
  1. Permanent, bright colored, continuous-printed, acid- and alkali-resistant plastic tape specifically compounded for direct-burial service. Not less than 6" wide by 4 mills thick.
  2. With metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
  3. Printed legend indicative of general type of underground line below.
- E. Wire/Cable Designation Tape Markers:
  1. Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letters.
- F. Brass or Aluminum Tags:
  1. Metal tags with stamped legend, punched for fastener.
  2. Dimensions: 2" X 2" 19 gage.
- G. Engraved, Plastic Laminated Labels, Signs and Instruction Plates:
  1. Engraving stock plastic laminate, 1/16" minimum thickness for signs up to 20 sq. in. or 8" in length; 1/8 " thick for larger sizes. Engraved legend in 1/4" high white letters on black face and punched for mechanical fasteners.
- H. Arc-flash Hazard Labels:
  1. ANSI Z535.4 Safety Label.
  2. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
  3. Dimensions: 5" x 3.5"

4. Information contained: Arc-flash boundary; Voltage; Flash Hazard Category; Incident Energy (arc rating); checkboxes for the required Personal Protective Equipment (PPE) and the date that the calculations were performed.
- I. Equipment Labels:
  1. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
  2. Dimensions: minimum 5" x 2"
  3. Conductor-Identification-Means Labels:
    - a. Information contained: the method utilized for identifying ungrounded conductors within switchboards, distribution panels and branch circuit panels.
  4. Available-Fault-Current Labels:
    - a. Information contained: maximum available fault current at the respective piece of equipment, and date of calculation of fault current.
  5. Source-of-Supply Labels:
    - a. Information contained: indicate the device or equipment where the power supply originates.
- J. Baked Enamel Warning and Caution Signs for Interior Use:
  1. Preprinted aluminum signs, punched for fasteners, with colors legend and size appropriate to location.
- K. Fasteners for Plastic-Laminated and Metal Signs:
  1. Self-tapping stainless steel screws or # 10/32 stainless steel machine screws with nuts, flat and lock washers.
- L. Cable Ties:
  1. Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18" minimum width, 50-lb. Minimum tensile strength, and suitable for a temperature range from minus 40° F. to 185° F. Provide ties for specified colors when used for color coding.
- M. Colored Support Wires:
  1. When electrical equipment/wiring is supported by wires within the ceiling cavity, these wires shall be independent of the ceiling support assembly and shall be distinguishable by painting entire length in bright yellow.

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- A. Lettering and Graphics:
  1. Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as approved in submittals and as required by code.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work:
  1. Where identification is to be applied to surfaces that require a finish, install identification after completion of finish work.
- D. Conduit Identification:

1. Identify Raceways of Certain Systems with Color Coding. Acceptable means of color identification are as follows:
  - a. Colored adhesive marking tape.
  - b. Field-painted colored bands.
  - c. Factory-painted conduit.
  - d. Color exposed or accessible raceways of the following systems for identification. Make each color band 2 inches wide, completely encircling conduit. Apply bands at changes in direction, at penetrations of walls and floors, and at 20-foot maximum intervals in straight runs. Apply the following colors:
    - i. Fire Alarm System: Red
    - ii. Sound/IC: Blue
    - iii. Telephone: Yellow
    - iv. Data: Green
    - v. MATV: Black
    - vi. Security: Orange
2. Identify Junction, Pull and Connection Boxes.
  - a. Code-required caution sign for boxes shall be pressured-sensitive, self-adhesive label indication system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers on outside of cover with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.
3. Label and paint the covers of the systems junction boxes as follows:

<u>SYSTEM</u>	<u>COLOR (ALL COLORS ARE KWAL PAINT)</u>	
Fire Alarm	Red Alert	AC118R
Sound/IC	Neon Blue	7076A
Telephone	Competition Yellow	7225A
Data	Java Green	AC098N
MATV	Flat Black	
Security	Fiesta Orange	AC107Y

E. Underground Electrical Line Identification.

1. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground line detectable marking tape, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
2. Install detectable marking tape for all underground wiring, both direct-buried and in raceway.
3. Provide red marker dye applied to concrete encased ductbank.

F. Conductor Color Coding.

1. Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

<u>CONDUCTOR</u>	<u>208Y / 120V System</u>	<u>480Y / 277V System</u>
Phase A	Black	Brown

Phase B	Red	Orange
Phase C	Blue	Yellow
Shared/Single Neutral	White	Gray
Neutral A (dedicated)	White w/Black Stripe	Gray w/Black Stripe
Neutral B (dedicated)	White w/Red Stripe	Gray w/Orange Stipe
Neutral C (dedicated)	White w/Blue Stripe	Gray w/Yellow Stipe
Equipment Ground	Green	Green
Isolated Ground	Green w/Yellow Strip	Green w/Yellow Stripe

2. Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.
3. Use conductors with color factory applied the entire length of the conductors except as follows:
  - a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
  - b. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
  - c. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. Power Circuit Identification.

1. Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb monofilament line or one-piece self-locking nylon cable ties.
2. Tag or label conductors as follows:
  - a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicting source and circuit numbers.
  - b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/ signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- H. Apply warning, caution and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items. Warning and caution signs shall be furnished and installed on, but not be limited to the following equipment and locations:
    - a. Entrances to rooms and other guarded locations that contain exposed live parts 600 volts or less; signs shall forbid unqualified personnel to enter.
    - b. Switch and Overcurrent device enclosures with splices, taps and feed-through conductors. Provide warning label on the enclosures that identifies the nearest disconnecting means for any feed-through conductors.
    - c. Entrances to buildings, vaults, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts: DANGER-HIGH VOLTAGE-KEEP OUT.
    - d. Metal-enclosed switchgear, unit substations, transformers, enclosures, pull boxes, connection boxes and similar equipment operating at over 600 volts shall have appropriate caution signs and warning labels.
    - e. Indoor and Outdoor substations operating over 600 volts. Provide warning signs, instructional signs and single-line diagrams in accordance with NEC 225.70.
- I. Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- J. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/4"-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required) white lettering in black field. White lettering in red field for Emergency Power Systems. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
    - a. Each service disconnect, to identify it as a service disconnect.
    - b. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit served from.
    - c. Switches in fusible panelboards shall be labeled. Main switches shall be identified.
    - d. Access doors and panels for concealed electrical items.
    - e. Electrical switchgear and switchboards.
    - f. Motor control centers.
    - g. Motor starters, including circuit origination, HP, heater size, FLA, and mechanical equipment designation.



- h. Disconnect switches.
  - i. Pushbutton stations.
  - j. Power transfer equipment.
  - k. Contactors.
  - l. Dimmers.
  - m. Control devices.
  - n. Transformers.
  - o. Power generating units, to include transfer switches.
  - p. Telephone switching equipment.
  - q. Clock/program master equipment.
  - r. Call system master station.
  - s. TV/audio monitoring master station.
  - t. Fire alarm master station or control panel.
  - u. Busduct – Label all cable tap boxes, bus plug-in units, etc. with plastic laminate labels designating load served.
  - v. Variable frequency drives.
  - w. Lighting Control Equipment.
  - x. Uninterruptable Power Supply.
- K. Post Conductor-Identification-Means labels at locations of switchboards, distribution panels and branch circuit panels. The labels shall identify the color-coding used on ungrounded conductors for each voltage system used on the premises.
- L. Apply Available-Fault-Current labels at the service entrance equipment.
- M. Apply Source-of-Supply labels on the exterior covers of equipment (except in single- or two-family dwellings) as follows:
- 1. Each switchboard supplied by a feeder.
  - 2. Each branch circuit panelboard supplied by a feeder.
  - 3. Each disconnect switch serving elevators, escalators, moving walks, chairlifts, platform lifts and dumbwaiters.
  - 4. Each dry type transformer (or primary-side disconnect switch at transformer). If the primary-side disconnect is remote from the transformer, both the remote disconnect and the transformer shall be labeled, and the transformer label shall also indicate the location of the disconnect.
  - 5. Each feeder disconnect, branch circuit disconnect, panelboard or switchboard in a remote building or structure.
  - 6. Each on-site emergency power source, with sign placed at service entrance equipment to comply with NEC 700.
- N. The label shall identify the device or equipment where the power supply originates, and the system voltage and phase. For example: Feeder Power Supply for Panel “XX” Originates at Panel “XX” (or Switchboard “XX”, Transformer “XX”, Switch “XX”, etc.); 120/208 volts, 3-phase (or 120/240, 277/480, etc.).
- O. Install Arc-flash hazard labels on the following equipment:
- 1. Each piece of service entrance equipment.
  - 2. Each power distribution switchboard or panel.
  - 3. Each individually mounted circuit breaker.
  - 4. Each branch circuit panelboard.
  - 5. Each motor control center.

- 6. Each individually mounted motor starter.
- 7. Each meter socket enclosure.
- P. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.
- Q. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- R. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics: Example; "208V 30A".
- S. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit that the device is connected to: Example; "CKT A-1"
- T. Label circuit breaker feeding fire alarm panel "Fire Alarm Circuit". Using plastic laminate label, white lettering on a red background.

**END OF SECTION 26 0553**

**SECTION 26 0573****PROTECTIVE DEVICE STUDY****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification sections, apply to work of this section.

**1.2 DESCRIPTION OF WORK:**

- A. Studies in this section include the following:
  - 1. Fault current protective device and equipment evaluation
  - 2. Protective device coordination study
  - 3. Arc-flash hazard analysis and study

**1.3 QUALITY ASSURANCE:**

- A. Provide protective device and arc-flash hazard studies performed by qualified engineers of the equipment manufacturer or an approved consultant. Studies must bear the professional engineer's stamp of the engineer in responsible charge of the protective device studies. Perform all work in accordance with latest IEEE and ANSI standards.

**1.4 SUBMITTALS:**

- A. Provide submittals in Portable Document Format (PDF), electronically bookmarked and keyword searchable.
- B. Preliminary Submittal: Submit partial study that includes the calculated values for short circuit current availability and arc flash levels for each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, automatic transfer switch, and branch circuit panelboard. This data shall be submitted prior to, or at the same time as, submitting the entire electrical gear package. Contractor shall utilize construction drawings to estimate approximate feeder lengths for this preliminary submittal. Submitted data shall include equipment/panel designations, feeder conductor sizes, feeder lengths, and calculated short circuit values and arc flash levels. Include the utility transformer ratings and transformer impedances used for the preparation of the short circuit calculations.
- C. Construction Period Submittal: During the construction period but prior to application of utility power to the electrical distribution system, submit an indexed copy of the complete protective device study based on actual field values. Include the following:
  - 1. Introductory section with basic formulas, pertinent data, and rationale employed in the study.
  - 2. One-line diagram for that portion of the system included in the study.
  - 3. Calculations section showing tabulated calculations.
  - 4. Results, recommendations, settings, etc.
- D. Provide one revision to study based on engineering review comments for the completed study to allow for minor modifications to adjustable circuit breakers to minimize arc flash levels.

**PART 2 – STUDIES****2.1 FAULT CURRENT PROTECTIVE DEVICE & EQUIPMENT EVALUATION**

- A. Perform fault current analysis with the aid of a computer and appropriate software.

Include as input data the maximum available short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

**B. Coordination Criteria:**

1. All overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second.
2. Coordination shall not be required as follows:
  - a. Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exist on the transformer secondary.
  - b. Between overcurrent protective devices of the same size (ampere rating) in series.
- C. Calculate fault current close and latch duty values and interrupting duty values on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, branch circuit panel and other significant locations throughout the system. Include symmetrical fault currents, and X/R ratios in the fault current tabulations. For each fault location, list the total duty on the bus, as well as the individual contribution from each connected branch, with its respective X/R ratio. Calculate ground fault currents at each bus. Incorporate major motor contributions in determining momentary and interrupting ratings of protection devices.
- D. Perform an evaluation to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses, by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Apply appropriate multiplying factors based on system X/R ratios and protective device rating standards. Report problem areas or inadequacies in the equipment due to short circuit currents prior to release for fabrication of switchgear, switchboards and/or appliance panelboard.

## **2.2 PROTECTIVE DEVICE COORDINATION STUDY**

- A. Perform a protective device coordination study including the necessary calculations and logic decisions required to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. Perform the studies in accordance with the latest applicable IEEE and ANSI standards.
- B. Include all medium and low voltage classes of equipment in the coordination study from the building or plant service protective devices down to and including the largest rated device in the low voltage motor control centers and panelboards. Include the phase and ground overcurrent protection as well as settings of all other adjustable protective devices.
- C. Develop time-current characteristics of the specified protective devices on log-log paper. Include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. Indicate on plots the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. Adhere to all restrictions of the National Electrical Code. Maintain proper coordination intervals and separation of characteristic curves.
- D. Provide coordination plots for phase and ground protective devices on a system basis.

Provide a sufficient number of separate curves to clearly indicate the coordination achieved.

- E. Provide the selection and settings of the protective devices in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Provide a tabulation of the recommended power fuse selection for medium voltage fuses where applied in the system. Promptly report any discrepancies, problem areas, or inadequacies prior to release for fabrication of switchgear, switchboards and/or appliance panels.

## **2.3 ARC-FLASH HAZARD ANALYSIS AND STUDY**

- A. Perform an arc-flash hazard analysis and study. Include the necessary calculations required to determine the level of Personal Protection Equipment (PPE) that a worker must use, the Arc Flash Boundary in inches, and the incident energy at each location. This information shall be calculated and determined for each piece of service entrance equipment, each power distribution switchboard or panel, each separately-mounted circuit breaker, each motor control center, each individually mounted motor starter, and for each branch circuit panelboard.
- B. Perform the analysis and study in accordance with IEEE 1584.
- C. Furnish and install a label at each piece of service equipment, each power distribution switchboard or panel, each separately mounted circuit breaker, each motor control center, each individually mounted motor starter, and each branch circuit panel board. The label shall be an ANSI approved Arc Flash Warning Label that warns and instructs workers of the arc flash hazard, voltage, arc flash boundary, and required PPE (Personal Protective Equipment).

## **2.4 ANALYSIS/REPORT**

- A. Include the following in the report.
  - 1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system that is included within the scope of the study.
  - 2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same. Include formulas and description of methods used.
  - 3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
  - 4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
  - 5. Recommended size for power fuses and recommended settings for ground fault relays and for all adjustable trip relays, circuit breakers, etc.
  - 6. Tabulation of arc-flash calculations for each location and tabulation of arc-flash hazard, voltage, boundary and required PPE for each equipment item listed in the arc-flash analysis.

## **2.5 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT**

- A. Provide the services of a qualified field engineer employed by the equipment manufacturer, and necessary tools and equipment to test, calibrate and adjust the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Protective Device Study.

## **2.6 TYPEWRITTEN DEVICE SETTING TABULATION:**

- A. Provide type written tabulation that includes all settings for each protective relay, ground fault relay and circuit breaker solid-state trip devices. Enclose the table in a protective

plastic sleeve and affix to the main service entrance equipment.

**END OF SECTION 26 0573**

**SECTION 26 0923****OCCUPANCY SENSORS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of occupancy sensor work is indicated by drawings and schedules.
- B. Types of occupancy sensors in this section include the following:
  - 1. Ultrasonic Ceiling Sensors
  - 2. Passive Infrared Ceiling and Wall Mount Sensors
  - 3. Control Pack
  - 4. Passive Infrared Wall Switch
  - 5. Dual Technology Wall Switch
  - 6. Dual Technology Wall Switch with Dimming and Daylight Control.
  - 7. Ultrasonic Wall Switch
  - 8. Ultrasonic Ceiling Sensor with Daylight Control
  - 9. Dimming Ballast Ambient Light Controller
  - 10. Dual Technology Ceiling Sensor w/ Control Pack

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC and NEMA standards as applicable to construction and installation of occupancy sensors. Provide occupancy sensors that have been UL listed and labeled.
- B. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, motor loads and any other passive infrared or microwave systems.

**1.4 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on occupancy sensors, control modules, wiring diagrams, interconnection diagrams and any related accessories.
- B. Submit scaled drawings with lighting fixtures shown clearly marked by manufacturer showing proper product, location and orientation of each sensor.

**PART 2 - PRODUCTS****2.1 MANUFACTURER:** The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors and related relays shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable.

- A. **ULTRASONIC (MICROPHONICS) CEILING SENSORS:** Where units are indicated, provide a sensor that meets the following minimum requirements:
  - 1. The sensor shall be Class 2, low voltage device capable of mounting to a wall or ceiling as required for optimum coverage.

2. Sensor shall incorporate one transmitter for each receiver oriented in the same direction.
  3. Sensor shall be capable of being networked with additional units to achieve adequate coverage.
  4. Sensor shall utilize a dry contact relay for control of lighting relay.
  5. Sensor shall have adjustable sensitivity from 0% to 100% for coverage pattern.
  6. Sensor shall have time out adjustment from 15 seconds to 32 minutes. Timer shall use a timer chip and be linear in adjustment.
  7. Sensitivity and timer controls shall be accessible on the front of the sensor, but recessed to inhibit tampering.
  8. Sensor shall incorporate an accessible, but recessed, ON override device.
  9. Sensor shall be easily mounted to a suspended ceiling tile without using large holes, or to a standard 4 x 4 box.
  10. Sensor shall be available with more than one pair of transmitters/receivers to achieve coverage required.
  11. Sensor shall incorporate a real time motion indicator visible from the front of the unit.
  12. Transmitters/receivers shall be protected from damage.
  13. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-ATU Series
    - b. Sensor Switch-CM Series
    - c. Wattstopper-WT Series
    - d. Mytech – Omni- US Series
    - e. Lithonia – LMTO Series
    - f. Greengate OMC-U Series
    - g. Leviton – OSC UOW Series
- B. PASSIVE INFRARED CEILING AND WALL MOUNT SENSORS: Where units are indicated, provide a sensor that meets the following minimum requirements:
1. The sensor shall be Class 2, low voltage device capable of mounting to a wall or ceiling as required for optimum coverage.
  2. Sensor shall utilize a dual element pyroelectric detector and a multi-segmented lens to achieve adequate coverage.
  3. Sensor shall be capable of being networked with additional units to achieve adequate coverage.
  4. Sensor shall utilize a dry contact relay for control of lighting relay.
  5. Sensor shall have time out adjustment from 8 seconds to 32 minutes. Timer shall be linear in adjustment.
  6. Sensor shall incorporate a motion indicator behind the lens array.
  7. Ceiling mount sensor shall have a 360 degree field of view with a 34 foot diameter coverage pattern when mounted at a height of twelve feet.
  8. Ceiling mount sensor shall protrude no more than 1.5 inches when surface mounted. Sensor shall be capable of recessed mounting without impairing field of view.
  9. Wall mount sensor shall have a 117 degree field of view and cover up 1600 square feet when mounted at a height of eight feet.
  10. Wall mount sensor shall have three adjustment positions for range control.



11. Subject to compliance with the above requirements, provide models of one of the following:
  - a. Hubbell-ATP Series
  - b. Sensor Switch-CM Series
  - c. Wattstopper-CX Series
  - d. Mytech-Omni-IR/LO-IR Series
  - e. Lithonia - LIRO Series
  - f. Greengate OMC-P Series
  - g. Leviton – OSWWV/IOW Series
- C. PASSIVE INFRARED WALL SWITCH: Where units are indicated provide a sensor that meets the following minimum requirements:
  1. Sensor shall utilize a dual element pyroelectric detector behind a lens to detect the motion of infrared energy emitted by the human.
  2. Lens shall be of the multi-element type that divides the field of view into forty zones of detection.
  3. Sensor shall fit a single gang switch box and utilize a decorator cover plate.
  4. Sensor shall not protrude more than 0.75 inches from switch box.
  5. Sensor shall operate at 120VAC and 277VAC.
  6. Sensor shall have a time-out delay, adjustable from 1 minute to 30 minutes.
  7. Sensor shall have an Automatic/OFF switch on front of unit.
  8. Sensor shall incorporate a daylight control. The adjustable ambient light control shall be adjustable from 20 to 420 foot-candles.
  9. Sensor shall have a 170 degree field of view. Detection beam shall be horizontal.
  10. Sensor shall use a dry contact relay to control the lighting load.
  11. Sensor shall be rated for 0 to 600 watts at 120VAC and 277VAC and adapt automatically to the operating voltage.
  12. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-WS Series
    - b. Sensor Switch-WSD-P Series
    - c. Wattstopper-WS Series
    - d. Mytech-LP Series
    - e. Lithonia - LIRW Series
    - f. Greengate OSW-P Series
    - g. Leviton – ODS 10 – ID Series
- D. ULTRASONIC (MICROPHONICS) WALL SWITCH: Where units are indicated provide a sensor that meets the following minimum requirements:
  1. Sensor shall utilize active ultrasonics to detect motion.
  2. Sensor shall have two ultrasonic transmitters and one receiver.
  3. Sensor shall incorporate an inrush current limiter circuit to protect the relay contacts.
  4. Sensor shall utilize a dry relay contact for control of the lighting load.
  5. Sensor shall have a time out adjustment from 8 seconds to 32 minutes. Timer shall be linear and controlled by a timer chip.
  6. Sensor shall have automatic sensitivity adjustment and be microprocessor controlled.

7. Sensor shall have automatic gain setback to reduce the sensitivity after the sensor has turned off the lighting to prevent false tripping.
  8. Sensor shall have transmitter control adjustments to prevent false tripping from hallway traffic.
  9. Sensor shall have a 180 degree field of view, coverage up to 800 square feet, and shall detect six inches of hand movement towards the sensor at a distance of 22 feet. Sensor shall detect body motion towards the sensor at a distance of 32 feet.
  10. Sensor shall operate at 120VAC and 277VAC.
  11. Sensor shall be rated for 40 to 740 watts at 120VAC and 90 to 1400 watts at 277VAC.
  12. Sensor shall be automatic on and shall have an automatic to off override switch on the unit. Switch shall be an air gap switch to disconnect power to the lighting load.
  13. Sensor shall have a real time motion indicator on the front of the unit.
  14. Sensor shall mount to a single or double gang switch box.
  15. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-ATU 1277 Series
    - b. Sensorswitch-WSD-PDT-P Series
    - c. Mytech LH-US Series
    - d. Greengate OSW-U Series
    - e. Leviton – OSSMT-MD Series
- E. DUAL TECHNOLOGY WALL SWITCH: Where units are indicated provide a sensor that meets the following minimum requirements:
1. Sensor shall utilize PIR (Passive Infrared) to turn on the lights and then PIR or US (Ultrasonic) technologies to keep lights on.
  2. Sensor shall incorporate an inrush current limiter circuit to protect the relay contacts.
  3. Sensor shall utilize single or dual dry relay contacts for control of the lighting loads. Contractor shall verify requirements in coordination with the drawings.
  4. Sensor shall have a self-adjusting time delay, selectable 5, 15 and 30 minutes.
  5. Sensor shall have automatic sensitivity adjustment and be microprocessor controlled.
  6. Sensor shall have light level sensing 0 to 200 footcandles.
  7. Sensor shall have a 180 degree field of view, coverage up to 800 square feet and shall detect 6 inches of hand movement towards the sensor up to 300 square feet; and body motion towards the sensor up to 1000 square feet.
  8. Sensor shall be rated for 0 to 800 watts at 120VAC and 0 to 1200 watts at 277VAC.
  9. Sensor shall be automatic on and shall have an automatic to off override switch on the unit. Switch shall be equipped with an air gap switch to disconnect power to the lighting load.
  10. Sensor shall have real time motion indicator on the front of the unit.
  11. Sensor shall mount to a single gang switch box.
  12. Subject to compliance with the above requirements. Provide models of one of the following:
    - a. Greengate ONW-D

F. DUAL TECHNOLOGY WALL SWITCH WITH DIMMING AND DAY-LIGHT CONTROL: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Dual technology sensors shall have one of its two technologies, not require motion to detect occupancy.
2. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period.
3. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 15 minutes.
4. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated.
5. Sensor shall be capable of switching both 120 VAC and 277 VAC.
6. Sensor shall recess into single gang switch box and fit standard GFI opening.
7. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
8. Line and load wire connections shall be interchangeable.
9. Wall switch sensor shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point.
10. Sensor shall be capable of both auto-on and manual operation.
11. Combination photocell/dimming sensors set point and deadband shall be automatically calibrated through the sensors microprocessor by initiating the automatic set point programming procedure. Min and max dim settings as well as set point may be manually entered.
12. Subject to compliance with the above requirements, provide models of one of the following:

a. Sensor-switch – N5X-PDT-D Series

G. ULTRASONIC (MICROPHONICS) CEILING SENSOR WITH DAYLIGHT CONTROL: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Sensor shall meet all requirements of Ultrasonic Ceiling Sensors.
2. Sensor shall incorporate a daylight control photocell to control the lighting based on available ambient light and occupancy.
3. Photocell shall be adjustable from 2 to 300 footcandles.
4. Photocell shall have an adjustable dead band control from 10% to 400% to set the difference between lights on level and lights off level.
5. Adjustments shall be accessible on front of sensor.
6. Photocell control shall have a bi-colored LED on front of sensor to aid in adjusting lighting on/off levels.

7. Photocell control shall have an adjustable time delay from 2 seconds to 4 minutes to prevent lights from cycling during temporary interruptions of ambient light.
  8. Switching priority shall be given to the occupancy sensor function when the space is vacant to turn the lighting off.
  9. Daylight control shall override the sensor when the space is occupied to turn the lighting off if there is sufficient ambient light available and on when ambient light level drops.
  10. Daylight control shall not be dependent on the sensor cycling the lighting off before photocell control will operate.
  11. Daylight control sensor shall be able to be networked with other sensors.
  12. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-ATU/CRP Series
    - b. Sensor Switch-CM9-P Series
    - c. Wattstopper-DT Series
    - d. Mytech-Omni US –RP Series
    - e. Leviton – OSC UOW Series
- H. DIMMING BALLAST AMBIENT LIGHT CONTROLLER: Where units are indicated, provide a sensor that meets the following minimum requirements:
1. Ambient light controller shall wire directly to the low voltage control circuit of the ballast.
  2. Control shall be by a photocell that senses available daylight and adjusts the light output to maintain a preset light level.
  3. Photocell control shall be adjustable.
  4. Ambient light controller shall be capable of controlling up to 48 ballasts.
  5. Ambient light controller shall not require a power source other than that supplied by the ballast.
  6. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Sensor Switch-CM-ALC Series
    - b. Wattstopper-WD Series
    - c. Mytech DLC-7 Series
- I. DUAL TECHNOLOGY CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:
1. Sensor shall incorporate ultrasonic (microphonics) and infrared technologies in a single unit.
  2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
  3. Sensor shall use internal microprocessor for motion signal analysis and automatic self-adjustment.
  4. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
  5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time out from 8 minutes to 100 minutes.
  6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.

7. Sensor's microprocessor shall automatically extend timer by 1 hour in response to recognition to false off condition. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.
  8. Sensor's microprocessor shall automatically reduce either PIR or ultrasonic sensitivity in response to false on condition.
  9. Sensor microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
  10. Sensor microprocessor algorithm shall incorporate automatic adaptation to continuous airflow.
  11. For airflow that is so intense as to mask motion, sensor shall flash indicator LED code to indicate excessive airflow.
  12. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar.
  13. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on while normally occupied and off when normally unoccupied.
  14. Sensor shall have selection settings for the following dual technology schemes:
    - a. High Sensitivity and High Confidence (miser mode)
  15. Sensor shall be available with either 180 degrees or 360 degrees coverage pattern.
  16. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
  17. Sensor shall have a variety of mask inserts for PIR coverage rejection to prevent false tripping.
  18. Transducers shall be protected from tampering.
  19. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
  20. Sensor shall have adjustable sensitivity from 0% to 100% for both ultrasonic and infrared.
  21. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.
  22. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
  23. Sensor shall provide internal operating status and settings confirmation via LED motion lamp indicator.
  24. Sensor shall have two (if 180 degree) or three (if 360 degree) real time LED motion indicators visible from the front of the unit: Red = infrared; green = ultrasonic.
  25. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-ATD Series
    - b. Sensor Switch-CM-PDT Series
    - c. Wattstopper-DT Series
    - d. Mytech-Omni-DT Series
    - e. Lithonia - LMTO Series
    - f. Leviton – OSC UOW Series
    - g. Greengate OMC – DT Series
- J. PASSIVE INFRARED CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Sensor shall incorporate infrared sensing technology.
  2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
  3. Sensor shall use internal microprocessor for signal analysis and automatic self-adjustment.
  4. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
  5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time-out from 8 minutes to 100 minutes.
  6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.
  7. Sensor microprocessor shall automatically extend timer by 1 hour in response to recognition of false off condition.
  8. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.
  9. Sensor's microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
  10. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on.
  11. Sensor shall be available with a 360 degree coverage pattern. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
  12. Sensor shall have mask inserts for PIR coverage rejection.
  13. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
  14. Sensor shall have adjustable sensitivity from 0% to 100% for infrared sensor.
  15. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.
  16. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
  17. Sensor shall have one real time LED motion indicator visible from the front of the unit: Red = infrared.
  18. Subject to compliance with the above requirements, provide models of one of the following:
    - a. Hubbell-ATP Series
    - b. Sensor Switch-CM-9 Series
    - c. Wattstopper-WPIR CX Series
    - d. Mytech-Omni-IR
    - e. Lithonia - LIRO Series
    - f. Greengate OMC-P Series
    - g. Leviton – OSC IOW Series
- K. 24 VDC POWER/CONTROL PACK: Where units are indicated, provide a power/control pack that meets the following minimum requirements:
1. Control module shall consist of a DC power supply and a dry contact relay for switching a lighting load.
  2. Control module shall be available in versions to accept 120, and 277 VAC line voltages.

3. Output shall be 24VDC nominal, and shall be inherently safe, low voltage, limited power output (Class 2).
4. Output shall supply 100mA current, in addition to current consumed internally to operate internal relay.
5. Relay shall utilize normally open, silver alloy dry contacts, and shall be rated for a 20A ballast load at 120V and 277V.
6. Relay function shall not require more than 5 mA control current to operate.
7. Control module shall have line voltage wiring, consisting of input voltage and relay contact connections, exiting from one end, and low voltage DC connections, consisting of ground, power, and control wires, exiting from the other end.
8. Control module shall be sized to fit inside a standard 4" x 4" junction box.
9. Control module shall be equipped with a 1/2" EMT threaded male fitting on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.
10. Control module shall be equipable with accessory 1/2" EMT threaded male fitting on the low voltage end, such that it may be mounted to the inside of a ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.
11. Slave module shall be available for switching additional circuits. Slave module has same construction and specifications as control module except without power supply function.
12. Subject to compliance with the above requirements, provide models of one of the following:
  - a. Hubbell-CU Series
  - b. Sensor Switch-PP-20 Series
  - c. Wattstopper-BEP Series
  - d. Mytech-MP Series
  - e. Lithonia - LPCS Series
  - f. Greengate SP20-MV Series
  - g. Leviton – OSC/OSA Series

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:**

- A. Install occupancy lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.
- B. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.
- C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Contractor shall be on site as required, to adjust lighting control units for proper operation.
- E. Mount the switchpack in a standard 4" junction box. Mount sensor to a standard 4" junction boxes. Refer to manufacturer supplied mounting instructions.
- F. Provide 5 spare sensors for each type used on project.

**3.2 FIELD QUALITY CONTROL:**

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.
- B. System start-up: Provide a factory authorized technician to verify the installation and test the system.
- C. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. Contractor shall visit the job site 3 months after the owner has taken occupancy and adjust any units not operating properly, otherwise remove and replace with new units.

**3.3 PRODUCT SUPPORT AND SERVICES:**

- A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
  - 1. The sensors have been fully installed in accordance with manufacturer's installation instructions.
  - 2. Low voltage wiring for overrides and sensors is completed.
  - 3. Accurate 'as-built' load schedules have been prepared.
  - 4. Proper notification of the impending start-up has been provided to the owner's representative.
  - 5. Programming of all switches, sensors, power packs, relays, etc. shall be completed by factory authorized technician, prior to final and training.
- B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.
- C. Functional Testing:
  - 1. The owner shall hire a third party that will conduct and certify the functional testing.
  - 2. Lighting controls devices shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working conditions in accordance with the construction documents, manufacturer's instructions and code requirements. The following shall be performed:
    - a. Certify that sensors have been located, aimed and calibrated per manufacturer recommendations.
    - b. Status indicator operates properly.
    - c. Fixtures that are controlled by auto-on controls turn on to permitted level.
    - d. Fixtures that are controlled by manual on controls operate when manually activated.
    - e. Fixtures do not turn on incorrectly due to HVAC or movement outside the controlled area.
    - f. Confirm that occupancy sensors turn off after space is vacated and do not turn on unless space is occupied.



- g. Simulate unoccupied conditions and confirm that vacancy sensors only turn on manually and turn off after space is vacated.

- 3. The party responsible for the functional testing shall provide documentation that the installed lighting controls meet or exceed all performance criteria and shall not be directly involved in the design or construction of the project.

### **3.4 WARRANTY:**

- A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

### **3.5 AS-BUILT DRAWINGS:**

- A. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
- B. Provide a CD to the owner containing the information specified below. The CD shall include all information required to allow the Owner to change the schedules themselves. The CD shall contain a minimum of following:
  - 1. CAD drawing files of 'as-built' lighting control components and point to point connections.
  - 2. General configuration programming.
  - 3. Job specific configuration programming to include schedule.
  - 4. Tutorial file on complete programming of lighting control system.

### **3.6 TRAINING**

- A. Provide four (4) hours of video taped training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

### **3.7 MANUFACTURER AUTHORIZED PERSONNEL TRAINING:**

- A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating lighting control system equipment.

**END OF SECTION 26 0923**

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**SECTION 26 0943 - LIGHTING CONTROL EQUIPMENT****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK**

- A. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, lighting control panels, control stations and other user interface devices, wiring and ancillary equipment.
- B. Types of lighting control equipment specified in this section, includes the following:
  - 1. Low voltage relay control panels
  - 2. Wall stations
  - 3. Occupancy sensors
  - 4. Daylight photosensor
- C. Requirements are indicated elsewhere in these specifications for work including but not limited to raceways, electrical boxes and fittings required for installation of lighting control equipment, not work of this section.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. To ensure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with lighting control equipment installation work similar to that required for project.
- C. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.
- D. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA Standard regarding the types of electrical equipment enclosure.
- E. Codes and Standards: Provide units that meet the requirements of IEEE Std. 2000.1.1999.
- F. Independent Testing Laboratory: Provide units that have been tested and listed under UL 916 energy management equipment.
- G. Component Pre-testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on lighting control equipment including, but not limited to published catalog data sheets, rough-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
- B. Shop Drawings: Submit detailed drawings and documentation of lighting control components and interconnection including, but not necessarily limited to:
  - 1. Electronic controllers
  - 2. Control stations
  - 3. Photo sensors
  - 4. Occupancy sensors
  - 5. Network wiring details
  - 6. Input and output wiring details
  - 7. Lighting control panel load schedules
  - 8. Accurately scaled equipment layouts, wire/cable routing and connections to control wiring and electrical power feeders.

## PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide lighting control equipment of one of the following;
  - 1. Douglas Lighting Controls
  - 2. Greengate Lighting Control
  - 3. Lighting Control & Design
  - 4. Lutron
  - 5. Nexlight
  - 6. Wattstopper

## 2.2 SYSTEM DESCRIPTION

- A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed.
- B. The lighting control system shall consist of low voltage relay control panels with programmable switch inputs.
- C. Programmable intelligence shall include:
  - 1. Time of day control (64 time-of-day/holiday schedules)
  - 2. 32 holiday dates
  - 3. Timed inputs (adjustable from 1 to 99 minutes)
  - 4. Timed override (from touchscreen, adjustable from 1 to 999 minutes, then resumes normal schedule)

5. Pre-set controls
  6. Auto daylight savings adjust
  7. Astronomical clock with offsets
  8. Local control (from touchscreen and local switch)
  9. Digital switches
  10. Flash warning of impending off for occupants
  11. Network override
- D. The controller shall permit lighting to be overridden on for after-hours use or cleaning. The controller shall provide priority and masking choices to allow for customizing the functions of switch inputs, thereby enabling switches to function differently at different times of day. These overrides shall be digital, network or hard-wired inputs.
- E. The lighting control system shall be fully programmable through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem or TCP/IP.

## 2.3 EQUIPMENT

### A. Relay Panel

1. Enclosure: Shall be NEMA 1 rated, code gauge steel cabinet. Enclosure and contents shall be designed to operate in interior spaces with temperatures of 32°F - 104°F (0°-40°C) and 0-90% non-condensing humidity. Enclosure shall be available with optional recessed mounting hardware. See drawings for mounting requirements and refer to schedules on drawings for sizes.
2. Interior: Interiors shall be sized to accept relays and will provide true on/off indication of relay status through LED's. The system shall employ all modular connectors to avoid repeat wiring in case of component failure. The system CPU board shall be mounted on quick release hinge pins. All connections for the dry contact inputs shall incorporate modular connectors.
3. Power Supply: The control panel shall incorporate the use of a multi-tapped transformer. The panel shall not require specification of voltage for each control location. The voltage of 120 and 277 VAC shall be available with each control panel.
4. Cover: Provide surface cover with captive screws in hinged, lockable configuration. A wiring schedule directory card shall be affixed to the covers back to allow identification of circuits/relays/load controlled. Schedules must be typed and related to final room names and numbers (not bid document room names and numbers).
5. High Voltage Barrier: The controller shall provide the ability to provide for either voltage separation or emergency circuit separation.
6. Relays: The system shall utilize normally open control relays, that are rated to 20A at 120/277 VAC. The relays shall be mechanically latching, and shall permit individual override and LED configuration of relay status. The relays shall be rated for 10 million operations.
7. System Controller: The system controller shall consist of an integral touchscreen that provides access to the main programming features. The touchscreen shall

permit the user to manually command any or all relays individually.

- a. Provide master on/off control of a relay group while still allowing individual relays to be overridden by their local switch.
- b. The control system shall permit up to 32 dry contact inputs for override purposes. Momentary 3 wire or 2 wire (toggle) inputs shall be supported. Any input shall be software linked to any number or relays.
- c. The controller shall provide timers for each override. Each override timer shall be capable of 0-999 minutes. Software shall enable or disable overrides based on priorities, masks or time of day scheduling.
- d. The controller shall accept either dry contact or analog ambient light sensors. The controller shall provide power for the sensor. Sensors shall provide for outdoor, indoor or skylight applications and issue a command to the controller once the threshold is reached.
- e. Each control panel shall incorporate diagnostic aids for confirmation of proper operation. The control panel shall employ both a backlit touchscreen and LED's to indicate:
  - i. Power
  - ii. System OK
  - iii. Network communications
  - iv. System clock and date
  - v. Programming confirmation
  - vi. Control panel subnet network communications

8. Switches: The lighting controller shall support digitally addressable LED annunciated switches. Provide low voltage push-button switches in up to 6 button configurations. Provide factory engraved labeling for individual push-buttons. Provide in color to match wiring devices and coverplate to match devices and plates in Wiring Devices (Section 26 2726).

9. Wiring:

- a. Provide CAT5 cable between switches and controller to create a digital switch network.
- b. Provide CAT5 cable between controller and other controllers via a RS-485 network. The RS-485 network shall support up to 250 controllers with a maximum distance of 4000 feet.
- c. Programming: Provide a RS-232 (RJ-R Connection) to allow programming through either a local connection or remotely through a modem.
- d. Provide wiring in conduit located within the walls and non-accessible ceilings. Provide wiring above accessible ceilings in conduit to system enclosure.

B. Room Controllers:

1. The room controller shall provide the following functionality;
  - a. Provide interface with room occupancy sensor to provide lighting control and be programmable as either manual on/automatic off or automatic on/automatic off (automatic on shall not allow lighting to exceed 50%

- level). Provide interface with room wall stations to provide multi-level switching and/or variable dimming. Provide interface with daylight photosensors to provide daylighting controls of lighting fixture via multi-level (step dimming) and/or variable dimming.
2. Provide with network interface to tie to building relay panel
  3. The room controller shall be a fully functional lighting control system to match the room lighting and control requirements. The controller shall provide the following features:
    - a. Separate compartments for line voltage, emergency voltage and low voltage connections.
    - b. Breakouts for direct conduit connections.
    - c. Dual voltage (120/277 VAC)
    - d. Low voltage connections using standard RJ-45 connectors.
    - e. Zero cross circuitry for each load.
    - f. Relay and 0-10V dimming zone configuration to match room requirements.
  4. Daylight photo sensors shall work with the room controller to provide automatic daylight dimming capabilities for loads connected to the room controller. The daylight sensor shall include the following features:
    - a. An additional photodiode that measures only the visible spectrum.
    - b. The sensor shall have three light level ranges;
      - i. Low (3-300 LUX), high (30-3000 LUX) and direct sun (300-30,000 LUX).
    - c. The sensor shall provide the capability of controlling multiple (up to three) daylight zones for dimming daylight harvesting.
    - d. The sensor shall include an internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
  5. Ceiling Mounted Occupancy Sensors: Sensors shall utilize dual-technology (ultrasonic and infrared technologies) and have the following additional features:
    - a. Sensor shall be class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
    - b. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
    - c. Sensor shall have 360 degree field of view.
    - d. Sensor shall incorporate non-volatile memory such that all settings and parameters are saved in protected memory.
    - e. Sensor shall have time delays from 10 to 30 minutes.
    - f. Sensor shall provide a visual means of indication that motion is being detected via an LED.
    - g. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity.

6. Wall Stations: Provide low voltage momentary push-button switches up to 6 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wall station shall connect to the room controller via the room controller local network.

### PART 3 - EXECUTION:

#### 3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.
- B. Comply with Requirements of NEC, and applicable portions of NECA's 'Standard of Installation' pertaining to general electrical installation practices.
- C. Coordinate with other electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Electrical Identification: Refer to Section 26 0553 for requirements.

#### 3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

#### 3.3 PRODUCT SUPPORT AND SERVICES:

- A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
  1. The control system has been fully installed in accordance with manufacturer's installation instructions.
  2. Low voltage wiring for overrides and sensors is completed.
  3. Accurate 'as-built' load schedules have been prepared for each lighting control panel.
  4. Proper notification of the impending start-up has been provided to the owner's representative.
  5. Programming of all switches, relays, groups of relays shall be completed by factory authorized technician, prior to final and training.
- B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.



## 3.4 WARRANTY:

- A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

## 3.5 AS-BUILT DRAWINGS:

- A. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
- B. Provide a CD to the owner containing the information specified below. The CD shall include all information required to allow the Owner to change the schedules themselves. The CD shall contain a minimum of following:
  - 1. CAD drawing files of 'as-built' lighting control components and point to point connections.
  - 2. General configuration programming.
  - 3. Job specific configuration programming to include schedule.
  - 4. Tutorial file on complete programming of lighting control system.

## 3.6 TRAINING

- A. Provide four (4) hours of video taped training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

**END OF SECTION 26 0943**

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**SECTION 26 2413****SWITCHGEAR AND SWITCHBOARDS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and methods sections apply to work of this section except as otherwise indicated. See Section 262713 Service Entrance, for metering requirements. See Section 264313 for SPD requirements.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of switchgear and switchboards is indicated by drawings and schedules.
- B. Types of switchgear and switchboards in this section include the following:
  - 1. AC Dead Front Switchboards (600V)
  - 2. AC Metal Clad Switchgear (600V)

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC as applicable to construction and installation of electrical switchgear and switchboards. Provide switchgear and switchboards that have been UL listed and labeled.

**1.4 SUBMITTALS:**

- A. PRODUCT DATA: Submit manufacturer's data on switchgear and switchboards.
- B. SHOP DRAWINGS: Submit dimensioned drawings of switchgear and switchboards showing accurately scaled basic sections including, but not necessarily limited to, auxiliary compartments, section components, and combination sections. Show plan view of equipment with dimensioned clearances to proximate equipment. Failure to submit said plan view shall not relieve contractor of responsibility to verify required clearances before release of equipment for fabrication.
- C. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2413 submittals received prior to submission of the preliminary protective device study will be REJECTED.
- D. MAINTENANCE STOCK FUSES: For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than 3 units of each.

**PART 2 – PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products of one of the following (for each type of switchgear and switchboard):
- B. AC DEAD FRONT SWITCHBOARDS (600V):
  - 1. Cutler-Hammer Products, Eaton Corp.
  - 2. General Electric Co.
  - 3. Siemens Energy & Automation, Inc.

4. Square D Co.
- C. AC METAL CLAD SWITCHGEAR (600V):
  1. Cutler-Hammer Products, Eaton Corp.
  2. General Electric Co.
  3. Siemens Energy & Automation, Inc.
  4. Square D Co.

## **2.2 EQUIPMENT SECTIONS AND COMPONENTS:**

- A. GENERAL: Except as otherwise indicated, provide switchgear and switchboards of types, sizes, characteristics, and ratings indicated, that comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation. See drawings and Section 262815. Series rated systems are not accepted.
- B. Overcurrent Protection Devices, for main and branch devices. Provide switchgear, switchboards, and overcurrent devices of one manufacturer.
- C. Provide each service entrance switchboard with surge protective device (SPD) mounted in a separate enclosure adjacent to the switchboard/switchgear. See Section 264313 for SPD unit requirements. Provide in-line fusing for each phase of the device, and wire in accordance with manufacturer's instructions, with conductor length not exceeding 18".

## **2.3 AC DEAD-FRONT SWITCHBOARDS (600V):**

- A. Provide factory assembled, dead front, metal enclosed, floor standing, self supporting, group mounted, secondary power switch boards, of sizes, electrical ratings and characteristics indicated consisting of panel (vertical) units, and containing circuit breaker and fusible switch assemblies of quantities, ratings and types indicated. Provide copper main bus and connections to switching devices of sufficient capacity to limit rated continuous current operating temperature rise to UL standard; with main bus and tap connections silver-surfaced or tin-plated and tightly bolted for maximum interrupting capacity. Provide accessibility of line and load terminations from front of switchboard. Prime and paint switchboard with manufacturer's standard finish and color. Equip units with built-in lifting eyes and yokes; provide individual panel (vertical) units, suitable for bolting together at project site, and constructed for the following environment:
  1. Installation: Indoors, NEMA Type 1.
- B. Limit height of upper most overcurrent device handle to 6'-2" to accommodate 4" curb.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF SWITCHGEAR AND SWITCHBOARDS:**

- A. Install switchgear and switchboards where shown, in accordance with manufacturer's written instructions with recognized industry practices to ensure that switchgear and switchboards comply with requirements of NEMA and NEC standards, and applicable portions of NECA's "Standard of Installation".
- B. Install all switchgear and switchboards on 4" high concrete curb. Install concrete wiring trench under switchgear and switchboards; 18" deep, and 4" smaller in length and width than equipment base. Install grounding bushings on conduits penetrating trench. Secure equipment to pad/trench. Refer to section 26 0548 Electrical Seismic Control.
- C. Arrange conductors within switchgear and switchboards in neat fashion, and secure with suitable ties.
- D. Tighten fuses, if any, in each switchgear and switchboard.
- E. Provide and install spare fuse cabinet in main electrical room.

- F. Electrical Identification: Refer to Section 260553 for requirements.
- G. Provide a surge protective device on each switchboard located on the emergency distribution system. Refer to Section 26 4313 for requirements.

**3.2 ADJUST AND CLEAN:**

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

**3.3 FIELD QUALITY CONTROL:**

- A. Prior to energization of switchgear and switchboards, check with ground resistance tester phase to phase and phase to ground insulation resistance levels to ensure requirements are fulfilled.
- B. Prior to energization, check switchgear and switchboards for electrical continuity of circuits, and for short circuits.
- C. Subsequent to wire and cable connections, energize switchgear and switchboard and demonstrate functioning in accordance with requirements.

**END OF SECTION 26 2413**

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**SECTION 26 2416****PANELBOARDS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to panelboards specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of panelboard and enclosure work, is indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include lighting and appliance panelboards, and power distribution panelboards.

**1.3 QUALITY ASSURANCE:**

- A. Provide units that have been UL listed and labeled. Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC pertaining to installation of wiring and equipment in hazardous locations. Comply with NEMA Stds. Pub No. 250, "Enclosures for Electrical Equipment (1000 volt maximum). Pub No. 1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

**1.4 SUBMITTALS:**

- A. PRODUCT DATA:
  - 1. Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.
- B. SHOP DRAWINGS:
  - 1. Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
- C. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2416 submittals received prior to submission of the preliminary protective device study will be REJECTED.

**PART 2 – PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. Subject to compliance with requirements, provide of one of the following:
  - 1. Cutler Hammer Products, Eaton Corp.
  - 2. General Electric Company
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D Company

**2.2 PANELBOARDS:****A. GENERAL:**

1. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated. Equip with number of unit panelboard devices as required for complete installation. Fully equip "spaces" with hardware to receive breaker or switch of size indicated. Provide CU/AL rated lugs of proper size to accommodate conductors specified.

**B. POWER DISTRIBUTION PANELBOARDS:**

1. Provide dead-front safety type power distribution panelboards as indicated, with switching and protective devices in quantities, ratings, types and with arrangement shown. Equip with copper bus bars, full-sized neutral bus and ground bus. Provide fusible or circuit breaker branch and main devices as indicated. Series rated systems are not acceptable. See Section 262815, Overcurrent Protection Devices.

**C. LIGHTING AND APPLIANCE PANELBOARDS:**

1. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangement shown. Provide bolt-on thermal magnetic type branch breakers. Where multiple breakers are indicated, provide with common trip handle. Series rated systems are not acceptable. Equip with copper bus bars, full-sized neutral bus, and ground bus.

**D. PANELBOARD ENCLOSURES:**

1. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage minimum 16-gage thickness. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Provide enclosures fabricated by same manufacturer as overcurrent devices contained therein Bolt engraved plastic laminate labels indicating panel name and voltage on the interior and exterior of panelboards.

**E. FINISH:**

1. Coat interior and exterior of surface with manufacturer's standard color; baked on enamel finish.

**F. ELECTRICAL IDENTIFICATION:**

1. Refer to Section 260553 for requirements.

**PART 3 – EXECUTION****3.1 INSTALLATION OF PANELBOARDS:****A. GENERAL:**

1. Install panelboards and enclosures where indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", in compliance with recognized industry practices to ensure products fulfill requirements.
2. Provide a surge protective device on each panelboard located on the emergency distribution system. Refer to section 26 4313 for requirements.



## B. MOUNTING:

1. Provide 4" high concrete curb under floor standing distribution panelboards.
2. Coordinate installation of panelboards and enclosures with cable and raceway installation work. Anchor enclosures firmly to walls and structural surfaces, ensuring they are permanently and mechanically secure. Arrange conductors neatly within enclosure, and secure with suitable nylon ties. Fill out panelboard's circuit directory card upon completion of installation work. Utilize actual final building room numbers, not architectural numbers used on drawings. Identify individual lighting circuits and individual receptacle circuits by room served. Label circuit breakers to identify location of subpanel or equipment supplied using room numbers and equipment names. Include room number with equipment circuit designations. All directories to be typewritten.

**END OF SECTION 26 2416**

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**SECTION 26 2713****SERVICE ENTRANCE****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of service-entrance work is indicated by drawings and schedules.
- B. Switchboards, panels, disconnects, transformers, etc., used for service-entrance equipment are specified in applicable Division-26 sections, and are included as work of this section.
- C. Consult local utility relative to all costs for line extensions, connections, etc., and include all costs for bringing service to the facility in base bid. Confirm location of point of service before bidding.
- D. Provide labor and materials as required to accomplish power company metering in accordance with power company standards and requirements.
- E. Provide concrete pads of size and type required for service transformers. Verify location, size, openings, reinforcing requirements with local utility before beginning work. Comply with local utility code required clearance requirements.

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC and NEMA standards as applicable to construction and installation of service-entrance equipment and accessories. Provide service-entrance equipment and accessories that are UL-listed and labeled, and equipment marked, "Suitable for use as Service Equipment".

**1.4 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on service-entrance equipment and accessories.
- B. **SHOP DRAWINGS:** Submit dimensioned layouts of service-entrance equipment and spatial relationships to proximate equipment. Failure to submit said layouts shall not relieve contractor of responsibility to verify required clearances before release of equipment to fabrication.
- C. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2713 submittals received prior to submission of the preliminary protective device study will be REJECTED.
- D. **MAINTENANCE STOCK, FUSES:** For types and ratings required, furnish additional fuses, amounting to one unit for every 2 installed units, but not less than one unit of each.

**PART 2 – PRODUCTS****2.1 SERVICE - ENTRANCE EQUIPMENT:**

- A. **GENERAL:** Provide service-entrance equipment and accessories, of types, sizes, ratings and electrical characteristics indicated, that comply with manufacturer's standard materials, design and construction in accordance with published product information, and

as required for complete installation, and as herein specified.

- B. Provide each service entrance switchboard with Surge Protective Devices as required by Section 264313.

## 2.2 OVERCURRENT PROTECTIVE DEVICES:

- A. GENERAL: Provide overcurrent protective devices complying with Division-26 section "Overcurrent Protective Devices", and as indicated on drawings.

## 2.3 METERING:

- A. METER SOCKETS: Provide meter sockets that comply with requirements of local utility company supplying electrical power to service-entrance equipment of building project.
- B. METERS: Provide meters, current and potential transformers, selector switches, wiring, etc. for a complete metering system. Provide meter of same manufacturer as switchboard (equal to Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250), integrally mounted in service equipment, completely wired with control power input. Provide capability for metering the following data:

<u>INSTANTANEOUS READINGS</u>	<u>DEMAND READINGS</u>
<u>RMS Current Values</u>	<u>Current Values</u>
Phase A Current	Average Demand Current Phase A
Phase B Current	Average Demand Current Phase B
Phase C Current	Average Demand current Phase C
3-Phase Average Current	Peak Demand Current Phase A
Apparent RMS Current	Peak Demand Current Phase B
RMS Voltage Values	Peak Demand Current Phase C
Phase A-B Voltage	Real Power Values
Phase B-C Voltage	Average Demand Real Power
Phase C-A Voltage	Predicted Demand Real Power
Phase A-N Voltage	Peak Demand Real Power
Phase B-N Voltage	Phase C-N Voltage
<u>Power Factor Values</u>	<u>Energy Readings</u>
Phase A Power Factor	-
Phase B Power Factor	Energy Accumulated
Phase C Power Factor	Reactive Energy Accumulated
3-Phase Total Power Factor	-
3-Phase Total Power Values	-
Real Power, 3-Phase Total	-
Reactive Power, 3-Phase Total	-
Apparent Power, 3-Phase Total	-
Frequency	-
Temperature	-

- C. Provide with integral display, selection keys, and indicating LEDs. For each instantaneous reading, provide a running maximum and minimum history in non-volatile memory, capable of externally operated reset. Provide "waveform capture" feature to allow subsequent analysis of actual current and voltage profile for harmonic distortion.

**2.4 RACEWAYS AND CONDUCTORS:**

- A. GENERAL: Provide raceways and conductors complying with applicable Division-26 Basic Materials and Methods sections.
- B. WALL AND FLOOR SEALS: Provide wall and floor seals complying with Division-26 Basic Materials and Methods section "Raceways".

**PART 3 – EXECUTION****3.1 INSTALLATION OF SERVICE-ENTRANCE EQUIPMENT:**

- A. Install service-entrance equipment as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that service-entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards.
- B. Coordinate with other work, including utility company wiring, as necessary to interface installation of service-entrance equipment work with other work.
- C. Install all floor standing service equipment on 4" high concrete curb and bolt equipment to curb with 3/8" anchors at each corner and at intervals not to exceed 8' along perimeter. Install concrete wiring trench under floor standing equipment; 12" deep, and 4" smaller in length and width than equipment base. Install grounding bushings on conduits penetrating trench.

**3.2 GROUNDING:**

- A. Provide system and equipment grounding and bonding connections for service-entrance equipment and conductors, as required.

**3.3 ADJUST AND CLEAN:**

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred enclosure surfaces to match original finishes.

**3.4 FIELD QUALITY CONTROL:**

- A. Upon completion of installation of service-entrance equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

**END OF SECTION 26 2713**

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**SECTION 26 2726****WIRING DEVICES****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems that are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Receptacles
  - 2. Switches
  - 3. Dimmer controls
  - 4. Cord caps
  - 5. Cord connectors
  - 6. Poke-through assemblies
  - 7. Telephone/power poles

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices that have been UL listed and labeled.

**1.4 SUBMITTALS:**

- A. PRODUCT DATA:
  - 1. Submit manufacturer's data on electrical wiring devices.

**PART 2 - PRODUCTS****2.1 FABRICATED WIRING DEVICES:**

- A. GENERAL:
  - 1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.
- B. Provide wiring devices (of proper voltage rating) as follows:

	<u>RECEPTACLE</u>	<u>SWITCHES</u>			
<u>MFGR</u>		<u>1-POLE</u>	<u>3-WAY</u>	<u>4-WAY</u>	<u>W-PILOT</u>

Hubbell	HBL 5352	HBL 1221	HBL 1223	HBL 1224	HBL 1221-PL
Bryant	5352	1221	1223	1224	1221-PL
Pass Seymour	5352	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	5362	1221	1223	1224	
Cooper	5352	1221	1273	1224	1221-PL

C. Provide devices in colors selected by Architect. Provide red devices on all emergency circuits.

D. CONTROLLED RECEPTACLE:

1. Provide a commercial spec grade receptacle with factory markings to comply with NEC 406.3E. Provide NEMA 5-20R, 20 Amp, 125V receptacle of one of the following manufacturers:
  - a. Leviton-16252-2P
  - b. Pass & Seymour – 26352CD

E. GROUND-FAULT INTERRUPTER:

1. Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:
  - a. P&S/Sierra
  - b. Hubbell
  - c. Leviton
  - d. Square D

F. USB RECEPTACLE

1. Provide duplex receptacle with two (2) USB 3.0 amps, 5VDC, 2.0 Type A charging ports.
2. Provide products of one of the following:
  - a. Bryant – USB20-X
  - b. Cooper – TR7736-X
  - c. Hubbell – USB20X2-X
  - d. Legrand – TR5362USB-X
  - e. Leviton – T5832-X

G. TAMPER RESISTANT RECEPTACLES:

1. Provide tamper resistant receptacles in the following areas; Dwelling units, child care facilities, kindergarten and pre-school classrooms, guest rooms, guest suites and pediatric locations within healthcare facilities.
2. Provide products of one of the following:



- a. Leviton-TWR20-X
- b. Hubbell – BR20XTR
- c. Pass Seymour – TR63X
- d. Cooper – TR5362

#### H. WEATHER-RESISTANT RECEPTACLES

- 1. Provide weather-resistant receptacles in outdoor locations such as under roofed open porches, canopies, marquees, etc.
- 2. Provide products of one of the following:
  - a. Pass & Seymour 2095TRWRXXX.
  - b. Hubbell GFTR20XX

#### I. CORD CAPS AND CONNECTORS:

- 1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.
- 2. Provide products of one of the following:
  - a. Cooper
  - b. General Electric
  - c. Hubbell
  - d. Leviton
  - e. P&S

## 2.2 WIRING DEVICE ACCESSORIES:

#### A. WALL PLATES:

- 1. Provide coverplates for wiring devices; plate color to match attached wiring devices. Provide nylon or Lexan coverplates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes.

#### B. WEATHER-PROTECTING DEVICE ENCLOSURES:

- 1. Where required for compliance with NEC 406-8 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers that provide complete protection with the cord and cap inserted into the wiring device. Provide units that mount on either single or double gang devices.
- 2. Provide products of one of the following for In Box Horizontal for brick and cast stone:
  - a. Arlington Industries
    - i. DSHB1C Clear Cover
    - ii. DSHB1W White Cover
    - iii. DSHB1BR Brown Cover
    - iv. DSHB1BRC Brown Clear Cover
- 3. Provide products of one of the following for In Box Vertical or Horizontal for Stucco and Metal Sidings:
  - a. Arlington Industries

- i. DSBVM1C Clear Cover
  - ii. DSBVM1W White Cover
  - iii. DSBHM1C Clear Cover
  - iv. DSBHM1W White Cover
4. Provide products of one of the following for roof mounted installations:
  - a. Intermatic WP1020 or WP1030
  - b. P&S WIUC10C or WIUC20c

## 2.3 POKE-THROUGH ASSEMBLY DEVICES:

- A. Provide factory-assembled poke-through assembly devices equipped with wiring devices as specified herein; capable of maintaining fire floor rating of 3 hours. Unit shall be UL514A listed. Construct for installation in concrete floor with center tube, fire-stop wafers, spreader plates, service fitting base plate, and 4-11/16" conduit box. Provide service fitting with alignment adjustment screws for complete installation; finish as selected by Architect. Provide devices manufactured by one of the following:
  1. Hubbell
  2. Wiremold Co.
- B. Provide the following poke-thru assemblies as noted on the drawings:
  1. Type PT-1 Power and Data; Provide a poke-thru assembly to provide interface between power and communications cabling. These devices shall provide flush device outlets that will not obstruct the floor area. The activation cover shall be supplied with a 20 amp duplex receptacle and capable of accommodations for up to four (4) modular communications jacks.
  2. Type PT-3 AV 6"; Provide a poke-thru assembly to provide interface between power, communications and audio/visual (AV) and the workstation or activation location. This assembly shall provide recessed device outlets that will not obstruct the floor. The insert body shall have three compartments that allows for up to three duplex receptacles and/or twelve communications ports and/or ten Extron® electronics MAAP™ and/or two AAP™ devices.
  3. Type PT-4 AV 8"; Provide a poke-thru assembly to provide interface between power, communications and/or audio/visual (AV) and the workstation or activation location. This assembly shall provide recessed device outlets that will not obstruct the floor. The insert body shall have five compartments that allow for up to five duplex receptacles and/or twenty-two communications ports and/or sixteen Extron® electronics MAAP™ and/or two APP™ devices.

## 2.4 TELEPHONE/POWER POLES:

- A. Provide factory-assembled telephone/power poles of types, sizes and ratings indicated; for use with telephone and power systems installed above suspended ceilings. Provide with 2 duplex receptacles as specified herein. Isolate power section from telephone compartment with separating steel enclosure. Extend wiring from receptacles to junction box at top of pole where connections are made above suspended ceiling. Provide pole foot with carpet pad and ceiling tile trim pad. Provide poles in color selected by Architect, manufactured by one of the following:
  1. Hubbell
  2. Wiremold Co.

**PART 3 – EXECUTION****3.1 GENERAL**

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.
- C. Install wiring devices only in electrical boxes that are clean; free from excess building materials, dirt, and debris.
- D. Install blank plates on all boxes without devices.
- E. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.
- F. Install GFI receptacles for all receptacles installed in the following locations:
  - 1. Restrooms, locker rooms, kitchens, within 6 feet of any sink, or when serving vending machines and electric drinking fountains.
  - 2. Indoor wet locations, non-dwelling garages, elevator rooms and pits.
  - 3. Outdoors, and on rooftops.
  - 4. Dwelling unit garages, crawlspaces and unfinished basements, accessory buildings, boathouses, and receptacles for boat hoists.
- G. Where light switches or wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits that switches or dimmers are connected.
- H. Electrical Identification: Refer to Section 260553 for requirements.

**3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:**

- A. At time of substantial completion, replace those items, that have been damaged, including those stained, burned and scored.

**3.3 GROUNDING:**

- A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

**3.4 TESTING:**

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

**END OF SECTION 26 2726**

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**SECTION 26 2815 - OVERCURRENT PROTECTIVE DEVICES****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of overcurrent protective device work is indicated by drawings and schedules and specified herein. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboard and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.
- B. Types of overcurrent protective devices in this section include the following for operation at 600 Volts and below:
  - 1. Molded case thermal circuit breakers
  - 2. Molded case solid-state circuit breakers
  - 3. Insulated case circuit breakers
  - 4. Power circuit breakers
  - 5. Fusible switches
  - 6. Bolted pressure switches
  - 7. Fuses
- C. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices.

**1.3 QUALITY ASSURANCE**

- A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent devices.

**1.4 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.
- B. **SHOP DRAWINGS:** Submit layout drawings of overcurrent protective devices, with layouts of circuit breakers, including spatial relationships to proximate equipment. Failure to submit said spatial layouts does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.
- C. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2815 submittals received prior to submission of the preliminary protective device study will be

REJECTED.

- D. MAINTENANCE STOCK, FUSES: For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than two units of each size and type, unless specified otherwise in another section of these specifications.
- E. TRIP CURVES & SETTINGS:
  - 1. Submit time-current trip curves (in log-log format) and trip setting parameter/range information (for each trip function) for all solid-state circuit breakers.
    - a. Manufacturer shall also provide recommended trip settings with the shop drawing submittal (including ground fault settings) for coordination with downstream overcurrent devices. Manufacturer shall base recommendations on the AIC rating of the electrical equipment.
    - b. Where the Protective Device Study specification section 260573 is included in the project, the time-current curves and recommended trip settings for all solid-state circuit breakers shall be submitted as part of the protective device study.

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (main and branch device manufacturer must be same as panelboard and/or switchboard manufacturer):
- B. CIRCUIT BREAKERS AND FUSIBLE SWITCHES:
  - 1. Cutler Hammer Products, Eaton Corp.
  - 2. General Electric Co.
  - 3. Square D Co.
  - 4. Siemens Energy and Automation
- C. BOLTED PRESSURE SWITCHES:
  - 1. Bolt Switch Co.
  - 2. General Electric Co. (HPC; High Pressure Contact Switches)
  - 3. Pringle Switch Co.
  - 4. Square D Co.
- D. MOLDED CASE THERMAL TRIP CIRCUIT BREAKERS:
  - 1. Provide factory-assembled, molded case circuit breaker for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers of amperage, voltage, and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole. Series rated systems are not acceptable. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with

mechanical screw type removable connector lugs, AL/CU rated, of proper size to accommodate conductors specified.

2. Circuit breakers 15 amps through 799 amps shall be molded case thermal trip circuit breakers.

E. MOLDED CASE SOLID-STATE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case solid-state circuit breakers for power distribution switchgear and switchboards. Provide breakers of amperage, voltage and RMS interrupting rating shown, and with solid-state trip mechanisms. Breakers shall be UL listed for application at 100% of their continuous ampere rating.
2. Circuit breakers 800 amps through 1199 amps shall be molded case solid-state circuit breakers.
3. Solid-state trip mechanisms shall have the following functions: Adjustable long time ampere rating; adjustable long time delay; adjustable short time pick up; adjustable short time delay and adjustable instantaneous pick up.

F. INSULATED CASE CIRCUIT BREAKERS

1. Provide factory-assembled, insulated case circuit breakers for power distribution switchgear and switchboards. Provide breakers of amperage, voltage and RMS interrupting rating shown, with solid-state trip mechanisms and with manual spring charging mechanism. Breakers shall be UL listed for application at 100% of their continuous ampere rating.
2. Circuit breakers 1200 amps and larger shall be insulated case circuit breakers.
3. Solid-state trip mechanisms shall have the following functions: Adjustable long time ampere rating; adjustable long time delay; adjustable short time pick up; adjustable short time delay and adjustable instantaneous pick up.
4. On service disconnect breakers where phase to ground voltage exceeds 150V and the breaker is capable of being set at or over 1000A (and also where GFP protection is indicated on the one line diagram for downstream breakers), the solid-state trip mechanism shall also include the following:
  - a. Adjustable ground fault pick up and adjustable ground fault time delay, and ground fault test button.
  - b. Over/under voltage trip
  - c. Current imbalance trip
5. Provide an energy-reducing maintenance switch with local, lit status indicator to allow for a reduction of the instantaneous pickup and instantaneous delay settings for use during maintenance. Device shall mount in face of dead-front. The switch shall be provided by the same manufacturer as the circuit breaker.
6. Include integral phase failure (single-phasing) protection where phase failure (PF) is indicated on the one line diagram

G. FUSIBLE SWITCHES:

1. Provide factory-assembled fusible switch units for power distribution panelboards and switchboards, and individual mounting as indicated. Provide switch units of amperage, voltage, and RMS interrupting rating as shown, with

quick-make, quick-break mechanisms, visible blades and dual horsepower ratings. Series rated systems are not acceptable. Equip with lockable handles with on-off indication. Interlock switch covers and handles to prevent opening in "ON" position. Provide switch with Class R rejection fuse clip kits. Provide AL/CU rated lugs of proper size to accommodate conductors specified.

**H. BOLTED PRESSURE SWITCHES:**

1. Provide factory-assembled fusible bolted pressure contact type switches of amperage, voltage and RMS interrupting ratings shown. Equip switches with quick-make, quick-break mechanisms with electric capacitor operated trip. Provide Buss KAZ signal activating fuses open. Provide "blown fuse protection" in HPC switches. Provide AL/CU rated lugs of proper size to accommodate conductors specified.

**I. PHASE FAILURE PROTECTION:**

1. Provide phase failure protection on overcurrent protective devices as indicated, by means of a single-phase, dead phase, reverse phase relay (Taylor Electronics Md1 PNDR). Provide relay to operate shunt trip or capacitor trip as required to open overcurrent protective device upon malfunction. Provide relay with adjustable time delay.

**J. GROUND FAULT PROTECTION:**

1. Provide ground fault sensing and relaying equipment on all overcurrent protective devices where phase to ground voltage is in excess of 150 volts and the overcurrent protection device is capable of being set at or over 1000 amps. Provide ground fault sensing and relaying equipment on other devices as indicated.
2. Provide zero sequence current sensors for overcurrent protective devices; inputs compatible with relay. Construct sensor frame so it can be opened to prevent removal or installation around conductors without disturbing conductors. Provide test winding in sensor for testing operation of GFP unit including sensor pick-up relay, and circuit protection device operation.
3. Provide solid-state ground-fault relay, that requires no external source of electrical power, drawing energy to operate GFP system directly from output of current sensor. Construct with adjustable pick-up current sensitivity for GF current from 200 to 1200 amperes, with calibrated dial to show pick-up point settings. Provide factory-set time delay of 1.5 seconds and protection that precludes tampering with setting after installation.
4. Provide monitor panel capable of indicating relay operation, and provide means for testing system with or without interruption of service. Construct so GF system can not be left in an inactive or OFF state. Provide indicator lamps and TEST and RESET control switches.
5. MANUFACTURER: Subject to compliance with requirements, provide ground-fault sensing and relaying equipment of one of the following:
  - a. General Electric Co.
  - b. Brown Boveri Electric, Inc.
  - c. HI-Z Corporation



- d. Pringle Electric Mfg. Co.
- e. Square D Co.

## 2.2 FUSES

- A. GENERAL: Except as otherwise indicated, provided fuses of type, sizes and ratings and electrical characteristics of a single manufacturer as follows. Provide fuses labeled UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Provide Buss KAZ signal activating fuses where required elsewhere in specification.
- B. Where fuses are shown feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing; adjust fuse size and type as necessary to comply with manufacturer's recommendation.
- C. Provide and install spare fuse cabinet in main electrical room.
- D. MAIN SERVICE AND FEEDER CIRCUITS: For fuse ratings over 600 amperes provide UL Class L Fuses (KRP-C, or A4BQ or LCL or KLPC). For fuse ratings up to 600 amperes, provide UL Class RK1 (KTN-R, KTS-R or A2K-R, A6K-R or NCCR, SCLR or KLN-R, KLS-R). If fuse directly feeds motors, transformers or other inductive load provide UL RK5 time delay (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECS-R or FLN-R, FLS-R).
- E. BRANCH CIRCUITS: For motor circuits, transformer circuits, or other inductive loads, provide UL Class RK5 (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECN-S or FLN-R, FLS-A). For other circuits, provide UL Class RK1, (KTN-R, KTS-R OR A2K-R, A6K-R or NCLR, SCLR OR KLSR).
- F. MANUFACTURER: Subject to compliance with requirements, provide fuses of one of the following:
  - 1. Bussman Mfg. Co.
  - 2. Mersen (Ferraz Shawmut)
  - 3. Reliance Fuse Div./Brush Fuse Inc.
  - 4. Littlefuse, Inc.

## PART 3 – EXECUTION

### 3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES:

- A. Install overcurrent protective devices as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.
- B. Coordinate with work as necessary to interface installations of overcurrent protective devices with other work.
- C. Install fuses in overcurrent protective devices. For motor circuits, fuse sizes shown on drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) as required to provide nuisance free tripping. Adjust fuse size properly for ambient temperature, frequent starting and stopping of motor loads, and for loads with

long start times. Include all costs in bid.

- D. After the switchgear is energized and just prior to Substantial Completion, the contractor shall ensure that the field-adjustable circuit breakers and solid-state circuit breakers and associated trip mechanisms have been set to the appropriate settings as recommended by the equipment Manufacturer (or as recommended by the electrical contractor's Protective Device Study if section 260573 has been included in the project). Time-current trip curves and trip setting information as was required in the Submittal portion of this specification shall be made available by the contractor at this time.
- E. Field test all ground fault protective devices for proper operation; test to be performed by representative of the manufacturer. Include verification of complete time current trip characteristics.
- F. Electrical Identification: Refer to Section 260553 for requirements.

### 3.2 FIELD QUALITY CONTROL

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

**END OF SECTION 26 2815**

**SECTION 26 2816****MOTOR AND CIRCUIT DISCONNECTS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to motor and circuit disconnect switches specified herein.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedule. Work includes complete installations and electrical connections.

**1.3 QUALITY ASSURANCE:**

- A. Provide motor and circuit disconnect switches that have been UL listed and labeled. Comply with applicable requirements of NEMA Standards Pub. No. KS 1, and NEC.

**1.4 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data including specifications, installation and general recommendations, for each type of motor and circuit disconnect switch required.
- B. **SHOP DRAWINGS:** Submit dimensioned drawings of electrical motor and circuit disconnect switches that have rating of 100 amperes and larger.

**PART 2 - PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. **MANUFACTURER:** Subject to compliance with requirements, provide products of one of the following (for each type of switch):
  - 1. Cutler Hammer Products, Eaton Corp.
  - 2. Square D Company
  - 3. General Electric Company
  - 4. Siemens Energy & Automation, Inc.

**2.2 FABRICATED SWITCHES:**

- A. **GENERAL:** Provide disconnect and safety switches as indicated herein. Provide:
  - 1. General duty switches on 240 Volt rated circuits.
  - 2. Heavy duty switches on 480 volt rated circuits.
  - 3. HP rated switches on all motor circuits.
- B. **GENERAL DUTY SWITCHES:** Provide general-duty type, sheet-steel enclosed switches, fusible or non-fusible as indicated of types, sizes and electrical characteristics indicated; rated 240 volts, 60 hertz; incorporating spring assisted, quick-make, quick-break mechanisms. Provide single phase or three phase and with solid neutral as required by

application. Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application, unless noted. Provide fusible switches with Class R rejection fuse clip kits.

- C. **HEAVY-DUTY SWITCHES:** Provide heavy-duty type, sheet-steel enclosed safety switches, fusible or non-fusible as indicated, of types, sizes and electrical characteristics indicated; rated 600 volts, 60 hertz; incorporating quick-make, quick-break type mechanisms. Provide single phase or 3 phase, and with solid neutral as required by application. Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application unless noted. Provide fusible switches with Class R rejection fuse clip kits.
- D. **FUSES:** Provide fuses for switches, as required of classes, types and ratings needed to fulfill electrical requirements for service indicated. Provide spare fuses amounting to one spare fuse for each 10 installed but not less than three of any one type and size. See Section 262815 Overcurrent Protective Devices for fuse types.
- E. **Electrical Identification:** Refer to Section 260553 for requirements.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES:**

- A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.
- C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.
- D. For disconnect switches serving motors controlled by variable frequency drives, provide late-make, early-break auxiliary contacts on each disconnect switch.. Wire auxiliary contact to VFD safety contact, such that disconnecting the motor will shut down the drive first, and closing the switch will start the drive only after power is applied to the motor.

END OF SECTION 26 2816

**SECTION 26 4313****SURGE PROTECTIVE DEVICES (SPD)****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division 26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of SPD's work is indicated by drawings, schedules and specified herein. Work includes complete installation, electrical connections, testing, and commissioning.

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC, NEMA and IEEE Standards as applicable to wiring methods, construction and installation of SPD's. Comply with applicable requirements of ANSI/IEEE C62.11, C62.41.2 and C62.45; NFPA 70 285 (Type 2), 75, and 78; and ANSI/UL 1449 4<sup>th</sup> edition. Provide complete packaged units that have been listed and labeled by Underwriters Laboratory. UL surge ratings (UL 1449) must be permanently affixed to the SPD's device.

**1.4 SUBMITTALS:****A. PRODUCT DATA:**

- 1. Submit manufacturer's data on SPD's listing all performance ratings specified or required herein.

**B. SHOP DRAWINGS:**

- 1. Submit dimensioned drawings of SPD's including, but not necessarily limited to, the following.
  - a. Complete data sheet.
  - b. Set of outline drawings giving complete mounting information, conduit entry and exit locations and dimensions, overall unit dimensions, weights, physical characteristics, etc.
  - c. Set of complete electrical drawings for power and control wiring.
  - d. Manufacturer's literature giving detailed information of equipment including parts numbers, model numbers and ratings.
  - e. UL 1449 suppressed voltage rating documentation.

**PART 2 - PRODUCTS:****2.1 ACCEPTABLE MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products manufactured by one of the following as indicated by "Location Category" herein.
  - 1. Advanced Protection Technologies Inc.
  - 2. Current Technology Inc.
  - 3. Cutler Hammer, Inc.
  - 4. L.E.A. International

5. Emerson Network Power Surge Protection Inc.
6. United Power Corporation
7. GE
8. Eaton
9. Surgelogic (Square D)
10. Siemens Energy & Automation, Inc.

## 2.2 GENERAL:

- A. Except as otherwise indicated, provide high energy surge protective devices, with high frequency line noise filtering, suitable for application in Category A, B, and C environments as indicated. Provide types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design, and construction in accordance with published information and as required for a complete installation.

## 2.3 VOLTAGE SURGE SUPPRESSION – GENERAL:

### A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.
6. ANSI/UL 1449 4<sup>th</sup> Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4<sup>th</sup> Edition VPR for the device shall not exceed the following:

### B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic

tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. **Balanced Suppression Platform** – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. **Electrical Noise Filter** – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. **Internal Connections** – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. **Monitoring Diagnostics** – Each SPD shall provide the following integral monitoring options:
  - a. **Protection Status Indicators** - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
    - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
    - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
  - b. **Remote Status Monitor** – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
  - c. **Audible Alarm and Silence Button** – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
  - d. **Surge Counter** – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The

reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

- i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- 6. Overcurrent Protection
  - a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- 7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- 8. Safety Requirements
  - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
  - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
  - c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

## **2.4 SYSTEM APPLICATION**

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Provide a surge protective device on each switchboard and panelboard located on the emergency distribution system. Refer to table below for category type.



Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- C. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:
- D. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

## 2.5 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
- The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
  - SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
  - The panelboard shall be capable of re-energizing upon removal of the SPD.
  - The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
  - The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  - The SPD shall be of the same manufacturer as the panelboard.
  - The complete panelboard including the SPD shall be UL67 listed.
- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)
- Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.
- C. Switchgear, Switchboard, MCC and Busway Requirements
- The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
  - The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway

3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

## **2.6 ENCLOSURES**

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
  1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
  2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
  3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install SPD's as indicated in accordance with manufacturers recommendations and as necessary to meet requirements. Install with conductors of minimum length practicable, but in no case exceeding 30" in length; minimum conductor size - #8 AWG copper.
- B. Install conductors in straight runs with a minimum of turns or bends (minimum bend radius to be 90 degrees). Do not splice phase or ground conductors in SPD's circuit. Torque all conductor terminations in accordance with manufacturer's recommendations.

### **3.2 FIELD QUALITY CONTROL:**

- A. Upon completion of installation of equipment, energize and demonstrate capability and compliance with requirements. Remove malfunctioning units, replace with new units and proceed with retesting.

**END OF SECTION 26 4313**

**SECTION 26 5100****INTERIOR AND EXTERIOR BUILDING LIGHTING****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Types of lighting fixtures in this section are indicated by schedule and include the following:
  - 1. High-Intensity-Discharge (HID)
  - 2. Fluorescent
  - 3. Incandescent/Halogen
  - 4. LED (Light Emitting Diode)

**1.3 QUALITY ASSURANCE:**

- A. Comply with NEC, NEMA and ANSI 132.1 as applicable to installation and construction of lighting fixtures. Provide lighting fixtures that have been UL-listed and labeled.
- B. Components and fixtures shall be listed and approved for the intended use by a National Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA or equivalent
- C. All led products shall comply with the latest version of Illuminating Engineer Society (IES) publications LM-79 and LM-80.

**1.4 SUBMITTALS:**

- A. PRODUCT DATA:
  - 1. Submit manufacturer's data on interior and exterior building lighting fixtures.
- B. SHOP DRAWINGS:
  - 1. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in PDF format with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture catalog number and accessories clearly indicated on each sheet.
  - 2. When applicable submit standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided.
  - 3. Submit ballast and driver manufacturer cut sheets.
  - 4. Submit a list of all lamps used on projects.
  - 5. Provide list of spare parts (See Spare Parts in Part 3).

**PART 2 – PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):
  - 1. LED:
    - a. Cree
    - b. Nichia
    - c. Samsung
    - d. Philips Lumiled
    - e. Osram
    - f. Xicato

**2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:**

- A. GENERAL:
  - 1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, LED drivers, starters, and wiring. Label each fixture with manufacturer's name and catalog number. Provide all enclosed fixtures with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.
- B. SUPPORT REQUIREMENTS:
  - 1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.
- C. LIGHT EMITTING DIODE (LED) LUMINAIRES:
  - 1. LED luminaires that can be serviced in place shall have a disconnecting means internal to the luminaires to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded conductor. Disconnects shall not be required under the following exceptions:
    - a. Luminaires located in hazardous locations.
    - b. Luminaires used for egress lighting.
    - c. Cord-and-plug luminaires.
    - d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.
    - e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.
    - f. Provide LED luminaires which are tested in accordance with IES LM-79, diodes tested in accordance with IES LM-80, and provide a minimum R9 rating of  $\geq 50$  (unless specified differently), a CRI rating of  $\geq$  than 80 and L70 (6K) = 50,000 hours (IES TM-21). Provide with 0-10V dimming drivers as standard.

- g. The fixture manufacturer(s) shall warrant the luminaires, in their entirety, to be free from defects in material or workmanship for at least 5 years from date of manufacture. Provide warranty in accordance with other sections of this specification and include a certificate of warranty from the fixture manufacturer with extended warranty information and proper forms and procedure description.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF LIGHTING FIXTURES**

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.
- C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.
- D. Coordinate lighting in mechanical room with duct and equipment locations to avoid obstruction of illumination.
- E. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to ensure fire rating of each ceiling that the fixtures are installed in.
- F. COORDINATION MEETINGS:
  - 1. Meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.
  - 2. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.
- G. ADJUST AND CLEAN:
  - 1. Clean lighting fixtures of dirt and debris upon completion of installation.
  - 2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.
- H. SPARE PARTS:
  - 1. Provide spare diffusers (acrylic and/or glass only) for each fixture type. One set shall be provided per fixture type and one additional per every (10) fixtures of each type; quantity shall not exceed (10) spares for any single fixture type.
  - 2. LED FIXTURES
    - a. Furnish stock of replacement LED drivers for each type and size provided on the project. A minimum quantity of 15% but no less than two

- (2) shall be furnished.
- b. Furnish stock of replacement LED components for each type and size provided on the project. A minimum quantity of 15% but no less than two (2) shall be furnished.
- c. Furnish stock of replacement LED light fixtures for each type and size provided on the project. A minimum quantity of two (2) fixtures shall be furnished. For linear pendant fixtures, provide three (3) four-foot modules.
- 3. All Other Light Fixtures
  - a. Furnish stock of replacement lamps for all other fixtures for each type and size provided on the project. A minimum quantity of 15% but no less than one (1) lamp shall be furnished.
- 4. Stock of all spare items shall be delivered as directed to Owner's storage space. All components shall be labeled to match construction document nomenclature,
- 5. Provide a complete spare parts list in lighting shop drawing review.

### **3.2 FIELD QUALITY CONTROL:**

- A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.
- C. At the time of Substantial Completion, replace lamps in interior lighting fixtures that are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.
- D. GROUNDING:
  - 1. Provide equipment grounding connections for each lighting fixture.

**END OF SECTION 26 5100**

**SECTION 27 1501****TELEPHONE SYSTEM (RACEWAYS)****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. The extent of telephone system work is indicated by drawings and is hereby defined to include, but not be limited to raceway, outlets, device plates, backboards, grounding and miscellaneous items required for complete raceway system.
- B. Refer to other Division-26 sections for requirements for raceways, trays, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.

**1.3 QUALITY ASSURANCE:**

- A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials that have been UL-listed and labeled.

**PART 2 - PRODUCTS****2.1 GENERAL:**

- A. Provide complete raceway system for telephone including but not limited to, raceway, outlets, device plates, backboards, grounding and miscellaneous items as required.
- B. Provide 4" square box with appropriate plaster or tile ring.
- C. Provide telephone coverplates for wall outlets to match color and material of wiring device plates; for floor outlets, match color and material of floor power outlet covers.
- D. Provide fire treated, or hypalon coated plywood terminal backboards, 4' x 8' x 3/4" mounted vertically in the 8' direction on a minimum of two full walls or as shown on plans.
- E. Provide terminal cabinets of code gauge steel, flush or surface, as indicated, with concealed trim clamp, concealed hinges and flush lock, with gray baked enamel finish to match finish of panelboard covers. Construct back boxes of code gauge galvanized steel with removable endwalls.

**PART 3 - EXECUTION****3.1 INSTALLATION OF TELEPHONE SYSTEM:**

- A. CONDUIT
  - 1. Contractor shall provide 1" conduit from telecommunications outlet/connector to EF/ER/TR/TE.
  - 2. Contractor shall provide 1" conduit from telecommunications outlet/connector to accessible ceiling space, then utilize non-continuous cable support devices to EF/ER/TR/TE.
  - 3. Contractor shall provide 1" conduit from telecommunications outlet/connector to accessible ceiling space, then utilize non-continuous cable support devices to cable tray.

4. Contractor shall provide 1" conduit from telecommunications outlet/connector to cable tray.
5. Paint all electrical boxes and their covers for the telephone and data system green.
6. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
7. Conduit runs shall not have continuous sections longer than 100 feet without a pull box and may only be filled to 35% capacity. The overall length of conduit from the telecommunications outlet to the data room shall not exceed 275 ft.
8. Ream all conduit ends and fit with an insulated throat nylon bushing with non-indenter type malleable steel fittings to eliminate sharp edges.
9. Telecommunications conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
10. Conduits that enter an EF/ER/TR must terminate near the corners to allow for proper cable racking. Terminate these conduits as close as possible to the wall where the backboard is mounted to minimize the cable route.
11. Terminate conduits that protrude through the structural floor 1" to 3" above the surface within an EF/ER/TR.
12. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
13. A 200 lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.
14. When the number of conduits requires more than one row, restrict the number of rows to two wherever practicable.
15. Run a minimum of one 1" conduit from telephone terminal backboard or cabinet to the fire alarm control panel.

**B. PULL BOX REQUIREMENTS**

1. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
2. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.
3. Conduits that enter the pull box from opposite ends should be aligned.
4. Pull boxes shall have a length 12 times the diameter of the largest conduit.
5. All pull boxes must be accessible.

**C. FIRESTOPPING:**

1. Provide firestop solution equivalent to the wall/ceiling/floor rating.
2. Provide firestop labels next to each penetration with written date. Label both sides of the penetration.
3. Take picture of both sides of the firestopping seal and include in O&M documentation of all firestopped locations. Provide drawing correlating photographs to actual locations in building.
4. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate Firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and



- sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.
5. Firestop systems shall be UL Classified to ASTM E8124 (UL 1479). A drawing showing the proposed firestop system shall be provided to the Engineer prior to installing the firestop system(s).
  6. Firestopping within conduits and sleeves shall be re-enterable. Firestopping outside and around annular space of sleeves and conduits at wall penetrations shall dry to a hard consistency. Mineral wool or other cavity stuffing shall be utilized as noted in the firestop system approved for this project.
- D. Utilize firestop pass-through type devices for medium to large penetrations into fire walls/floors. Similar to STI Series SSB
- E. GROUNDING
1. Provide a Telecommunication Main Grounding Bus Bar (TMGB) 12" L x 4" H x 1/4" thick copper bus bar on insulating standoffs adjacent to phone board in Main Telephone Room. Connect to Intersystem Bonding Terminal utilizing copper conductors per the following chart:
    - a. < 25' - #4
    - b. < 50' - #1
    - c. < 75' - #2/0
    - d. > 75' - #3/0
  2. For Secondary Telephone Rooms provide a Telecommunication Grounding Bus Bar (TGB) 12" L x 2" H x 1/4" thick copper bus bar on insulating standoffs adjacent to phone board. Connect to TMGB utilizing copper conductors per the schedule above.
  3. Bond cable tray, raceway system, structural steel and all other metal equipment located within the Telephone Room utilizing copper conductors per the schedule above.
- F. POWER: Provide a minimum of four duplex receptacles on two dedicated circuits adjacent to each terminal backboard or cabinet. See drawings for additional power outlets.

**END OF SECTION 27 1501**

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**SECTION 27 4100****AUDIOVISUAL SYSTEM****PART 1 – GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.
- C. Refer to specification 26 0553 for cabling, conduit and junction box color requirements.
- D. Refer to specification 27 1500 for category and/or optical fiber cable and connectivity specifications.
- E. All unshielded category 'UTP' and/or optical fiber cable, for AV equipment, used on this projector shall match the horizontal cabling within the building.
  - 1. Category cables used for transporting video, audio and controls simultaneously from transmitters to receivers and/or switchers shall follow the Manufacturer's recommend cabling specifications.
  - 2. Refer to and coordinate with specification 27 4100 for any audiovisual equipment requiring UTP based category and/or optical fiber cabling and connectivity. Division 27 1500 shall provide installation and execution requirements for all category and/or optical fiber cabling and connectivity required within the audiovisual system

**1.2 ADMINISTRATIVE REQUIREMENTS:**

- A. BNA Project Contact:
  - 1. Joe Morris, CTS
    - a. Phone: 801-532-2196
    - b. Email: [jmorris@bnaconsulting.com](mailto:jmorris@bnaconsulting.com)
  - 2. Jaime Verhaal, CTS-D
    - a. Phone: 801-532-2196
    - b. Email: [jverhaal@bnaconsulting.com](mailto:jverhaal@bnaconsulting.com)
- B. Bid Submittal:
  - 1. Equipment Costs: Breakout cost of material and labor as different line items.
- C. Coordination:
  - 1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.
  - 2. Obtain GANTT chart for construction time frame from the General Contractor.
  - 3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.
  - 4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.

5. Meet with Electrical contractor prior to pathway rough-in to coordinate AV system requirements in each area.
6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all AV network requirements. Coordinate cable color according to specification 26 0553.
7. Meet at least twice with owner to coordinate AV network requirements. Hold the first meeting before submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to AV system deployment.
8. Coordinate color and finish of all AV system components with Architect or Electrical contractor as appropriate.
9. Coordinate all AV system components within millwork/furniture with millwork shop drawings prior to rough-in.
10. Coordinate color (including custom color) and finish of all AV system components with Architect prior to ordering. Architect may require custom color of grills, face plates, etc.. AV contractor shall paint or have devices painted by others. The cost for custom colors shall be within the AV Contractors Bid.
11. Notify AV Consultant when rough-in is complete and ready to inspect. AV Consultant and Electrical Engineer to sign off on rough-in prior to rough-in resuming rough-in for typical rooms.

### 1.3 DESCRIPTION OF WORK:

- A. Provide the specified systems in a complete and operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components. Contractor shall furnish all cables, materials and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.
- B. Master quotes do not relieve contractor from performing due diligence for equipment type, equipment quantity, and quantity of room types. Any errors, conflicts, or omissions between the drawings and/or specifications and master quotes shall be the responsibility of the contractor to resolve.
- C. Bidders wishing to provide equipment other than the equipment specified shall submit proposed substitute equipment to AV Consultant (8) working days prior to bidding. Submittals for prior approval shall include description of equipment, design intent, complete riser diagrams for proposed equipment, equipment specifications, cut sheets of proposed equipment, reason for alternate equipment. AV Consultant may request physical equipment to test and demo. Acceptance of proposed equipment by AV Consultant shall not relieve AV contractor from responsibility to provide audio-visual systems equal to those specified in this Section. Contractor shall be ultimately responsible for providing complete and working audio-visual systems that function, control and operate in the same manner as the specified equipment. AV Consultant has final say if proposed equipment is equal to the specified equipment. Equipment that AV Consultant is not familiar with will require the contractor to provide manufacturer training at manufacturer's facility and have a manufacturer representative present at time of commissioning.
- D. Equipment submitted in bid proposal that has not been approved by AV Consultant in writing will not be accepted and shall be replaced by approved equipment at contractor's expense. Equipment not listed within this specification, or contract documents, that are required for a complete and working system, shall be of professional grade and used in the same manner as needed for a complete and working system.

- E. Input plates shall match the color and style being used throughout the project.
- F. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.
- G. All control processors and controllers are to be on an unswitched power connection.
- H. All cabling shall be installed in a minimum of 1" conduit to accessible ceiling space unless otherwise noted. Provide conduit to accessible ceiling space and then utilize non-continuous open top cable supports every 5'.
- I. AV contractor shall participate in a mandatory pre-construction meeting no more than (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating meeting. The meeting will be held at AV Consultant's office. All submittals, shop drawings, and bill of materials shall be completed and submitted to AV Consultant for review (8) working days prior to this meeting.
- J. AV contractor shall attend the electrical pre-construction meeting per specification 26 0500.

#### **1.4 QUALITY ASSURANCE:**

- A. Installer:
  - 1. Integrating firm shall have worked satisfactorily for a minimum of (5) years of completing systems equal to this scope, quality, type and complexity.
  - 2. Key personnel assigned to the project shall each have minimum of (10) years of experience in completing systems equal to this scope, quality, type and complexity.
  - 3. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
  - 4. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
  - 5. Contractor shall have current manufacturer certificates for all AV systems and equipment listed within this specification.
  - 6. Contractor shall be in good standing with owner based on previous projects.
  - 7. Contractors that do not meet the above requirements cannot bid on this project.
- B. Contractor must follow the standards described within:
  - 1. BICSI/AVIXA AV Design Reference manual.
  - 2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
  - 3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.
- C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.
- D. PRE-APPROVED INSTALLERS:
  - 1. Cache Valley Elec.
  - 2. Digital Video Networks
  - 3. GenComm
  - 4. Marshall Industries.
  - 5. Performance Audio
  - 6. Poll Sound.

7. PST
8. TPI
9. WEBB AV
10. Bids submitted by non-approved installers will not be accepted.
11. Bidders not pre-approved shall submit in writing the following for review at least (8) working days prior to bid:
  - a. List of qualifications including:
    - i. Industries certifications including manufacturers.
    - ii. Approved resale manufacturers.
  - b. Past and current projects within the last 5 years similar in scope and size.
  - c. (3) Different referrals from the owners of (3) different projects within the last 5 years.

**1.5 SUBMITTALS:**

- A. Refer to specification 26 0500 for shop drawing submittal requirements. The following items shall be included in the shop drawings submittal.
  1. All submittals shall be submitted in a digital format with bookmarks for each section of equipment. Any submittals that are partial or incomplete shall be rejected and count as one submittal against the submittal allowance.
  2. Project manager to provide written proof, signed and dated, that shop drawings and/or brochure has been checked for accuracy prior to submittal. Shop drawings to comply in all respects with the requirements of the contract drawings and specifications for this project.
  3. Provide a complete bill of materials for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.
  4. Submit manufacturer's data and installation details for all devices, plates, cables and similar equipment. Product data showing multiple options, products and/or models shall be clearly marked identifying the specific options, products and/or models being provided.
  5. Submit dimensioned drawings and device wiring layouts for Audio, Video, Control, and power.
  6. Submit equipment rack elevation diagrams.
  7. Submit matrix routing and preset configuration tables, and digital signal processing configuration details.
  8. Submit wireless microphone transmission frequencies.
  9. Submit all manufacturer training, 3rd party and/or organization certificates for each equipment and/or systems required for the implementation of this specification.
- B. Provide shop drawings for 27 4100 at the time of original shop drawing submission. Do not order AV equipment from the first submission. 120 days prior to the time of AV equipment installation, provide a second submission of AV equipment only. Provide current equivalent if specified model has been discontinued.

**1.6 WARRANTY:**

- A. Systems shall be guaranteed for a period of one (1) year from the date of substantial

completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor.

- B. If system failure causes audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair system so it will be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.
- C. Contractor shall supply (1) year warranty on all system programming from the date of substantial completion. During this time period, upon owner request, the contractor shall provide programming changes up to (4) four times free of charge. During this time the programs shall be password protected. At any time during the (1) year, the owner can terminate the warranty and request the programming of each system. At this time the programs are to be turned over to the owner and all passwords are to be removed. The owner shall own all rights to the programming after this time, to be used in this facility. Provide the Owner written proof that all ownership has been relinquished.
- D. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL:**

- A. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications or the drawings shall be submitted in writing to the AV Consultant for clarification.
- B. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings, system risers and equipment lists for system intent. Provide a complete and functional system as described within the construction documents.

### **2.2 MANUFACTURER APPROVED EQUALS:**

- A. The Manufacturers listed below have the potential to be considered equals, as it relates to the system design intent and the equipment specified herein. Any equipment chosen as equal to what has been specified in section 2.4 will be the responsibilities of the AV Integrator to coordinate all resulting changes and guarantee a complete and functional system e.g. rough-in requirements, programming, etc. Please note that some components have been chosen over others for features and/or size limitations. Equipment listed in section 2.4 with an asterisk have feature and/or size limitations and may not be substituted.
  - 1. Amplifiers – Ashly, Crown, Lab Gruppen and QSC
  - 2. Cables – Belden, Gepco/General, Ice, Liberty and Westpenn cables
  - 3. Displays – LG, NEC, Planar, Samsung and Sharp
  - 4. DSPs – Biamp, BSS, Extron, QSC and Symetrix
  - 5. Equipment racks – Atlas Sound, Chief and Middle Atlantic
  - 6. Loudspeakers – Atlas Sound, Community, JBL and SoundTube
  - 7. Microphones – AKG, Audio Technica, Sennheiser and Shure
  - 8. Mounts – Chief and Premier mounts
  - 9. Projection Screens – Da-Lite, Draper and Stewart Films
  - 10. Wall plates – Attero tech, Crestron, Extron, RCI Custom and RDL

**2.3 GENERAL EQUIPMENT REQUIREMENTS:****A. Loudspeakers:**

1. Provide applicable mounting equipment as needed, including but not limited to; back boxes, mounting hardware, safety equipment, and seismic restraints.

**B. Equipment Racks:**

1. All AV equipment racks within this specification shall have the following accessories and/or features, either rack mountable or built into the rack, depending on the model of the rack.
  - a. Surge protection for all devices located within the rack. Surge protector shall be: 20 AMPs, rack mountable or mount to a side rail and at least 1,000 joules of protection.
    - i. Acceptable manufacturers: Furman, Juice Goose, Middle Atlantic and SurgeX.
  - b. Horizontal, vertical, and entry cable management.
  - c. Power strips as necessary.
  - d. Sequencers
    - i. All equipment racks with the following equipment shall have a sequencer within the equipment rack. AV integrator to follow industry standards when using sequencers.
      1. Amplifiers
      2. Video processors without control processors
  - e. Active Thermal Management
    - i. Solid rear door.
    - ii. Fan kit totaling 190 CFM mounted on the top face of the equipment rack.
      1. Thermostatic fan controller (set temperature range between 80 degrees and 90 degrees Fahrenheit.
      2. Fan guards
    - iii. Blank panels on the front of the equipment rack in all unused rack spaces.
    - iv. Solid blank panels in unused rack spaces in top (6) six racks spaces.
    - v. Stack power amplifiers with 1 open rack space between.
    - vi. Provide active thermal management in the following equipment racks in the following systems.
      1. Activity Room



**2.4 EQUIPMENT REQUIRED PER ROOM TYPE**

<b>ACTIVITY ROOM EQUIPMENT SCHEDULE</b>			
<b>TYPE</b>	<b>DESCRIPTION</b>	<b>MANFR.</b>	<b>MODEL NO.</b>
MDT	MICROPHONE INPUT, DUAL, WALL PLATE TRANSMITTER OVER UTP	RDL	D-TPSM2A (TRANSMITTER)
AXT	AUXILIARY INPUT, WALL PLATE 3.5 MM & DUAL RCA, TRANSMITTER OVER UTP	RDL	D-TPS7A (TRANSMITTER)
Rx	LINE-LEVEL (3) OUTPUT UTP RECEIVER	RDL	TX-TPR3A
TxH	HDMI INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP T HWP 4K 231 D
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
WMH	WIRELESS HANDHELD MICROPHONE, WIRELESS RECEIVER KIT	SHURE	QLXD24/SM58 QTY: REFER TO PLANS
WMB	MICROPHONE, WIRELESS RECEIVER AND LAVALIER CHARGER AND LI-ON BATTERY	SHURE	QLXD14/83 W/ SB900 AND SBC100 QTY: REFER TO PLANS
AT	ANTENNA DISTRIBUTION SYSTEM WITH DIRECTIONAL ANTENNA (2) TOTAL	SHURE	UA874 (ANTENNA) UA844SWB
ALS	ALS RF	LISTEN	LS-55-072 PROVIDE (8) RECEIVERS PROVIDE (8) EAR SPEAKERS PROVIDE (2) NECK LOOPS
	NETWORK SWITCH, 10 PORT, 8 PORT POE+	CISCO	SG300-10PP
KP2	KEYPAD, 4 BUTTONS WITH VOLUME KNOB	EXTRON	MLC PLUS 100
	VIDEO SWITCHER, 8 INPUT HDBaseT OUTPUT, SCALING W/ CONTROL PROCESSOR	EXTRON	IN1608 xi IPCP SA W/ LINK LICENSE
	DIGITAL SIGNAL PROCESSOR 12 INPUTS X 8 OUTPUTS	BSS	BLU - 100
	POWER AMPLIFIER 4 CHANNELS X 300 WATTS	CROWN	DCi 4 300
P6	LOUDSPEAKER, 6", PENDANT, HIGH CEILING 75 DEGREE COVERAGE	JBL	CONTROL 67 HC/T WHITE
	PROJECTOR CEILING MOUNT, 12" EXTENSION	CHIEF	CMS440 CMS012 RPMA1 PL4
P1	1-CHIP DLP, 5,400 lm, HD, 1920x1200 COLOR BY ARCHITECT	PANASONIC	PT-RZ570
SC1	CEILING MOUNTED, MOTORIZED, 16x10, 363" SCREEN WITH MATT WHITE XT1000V MATERIAL	DRAPER	PARAGON/SERIES E WITH MC1 CONTROLLER
<b>END OF SCHEDULE</b>			

CONFERENCE ROOM EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
HD	HDMI INPUT, WALL PLATE W/ STEREO AUDIO & CONTROL	EXTRON	WPD 110 A
	POWER AMPLIFIER 1 CHANNEL X 60 WATTS, 70 V	EXTRON	MPA 601 70V
C4	LOUDSPEAKER, 4", CEILING 130 DEGREE COVERAGE	JBL	CONTROL 24CT
	FLAT PANEL TILT MOUNT X-LARGE	CHIEF	XTM1U
D90	FLAT PANEL DISPLAY, 90" DIAGONAL, 1080P	SHARP	PN-LE901
END OF SCHEDULE			

BUILDING EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
R1	EQUIPMENT RACK, WALL MOUNT 42" TALL, 22" DEEP, 24 RU WITH VENTED FRONT DOOR	MIDDLE ATLANTIC	DWR-24-22 WITH LVFD-24
	SURGE PROTECTOR	MIDDLE ATLANTIC	PD-920R-SP
	SHELF, PULL OUT, RACK MOUNT LATCHING, 1 RU	MIDDLE ATLANTIC	SS
	DRAWER, PULL OUT, RACK MOUNT LATCHING, 2 RU	MIDDLE ATLANTIC	D2
END OF SCHEDULE			

**PART 3 – EXECUTION****3.1 INSTALLATION OF AV SYSTEMS:**

- A. Provide AV systems and ancillary equipment as indicated on drawings and in accordance with equipment manufacturer's written instructions, the NEC, and with industry best practices.
- B. Coordinate all work performed by other contractors pertaining to the AV system, including raceways, electrical boxes and fittings.
- C. Video systems.
  1. HDCP:
    - a. All equipment within the signal path must be capable of processing HDCP-compliant material.
    - b. All switcher, scalers, transmitters, and receivers shall reflect the HDCP compliance of the endpoint/display(s).
    - c. HDCP shall be disabled in the switcher/scaler when a non-HDCP-compliant endpoint/display is used.
  2. EDID Strategy:
    - a. Permanent video sources shall be set manually within the equipment to output their native resolution. Video properties shall not rely on EDID.
    - b. Portable video sources and wall plates shall use EDID tables within the switcher/scaler for preferred video properties. The EDID table shall be

set with the following settings:

- i. Most common resolutions within the display's aspect ratio.
  - 1. 1280 x 800 recommended resolution.
  - 2. 1920 x 1200
- ii. 60 and/or 30 frames per second
- iii. RGB color space
- iv. Stereo audio, 44,100 Hz, 16 bit

D. Pathway Requirements:

1. General:

- a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
- b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Arrangements to remove any major obstructions not identified on plans need to be determined at that time with the Engineer.

2. Conduits:

- a. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
- b. Provide large radius elbows on all bends.
- c. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.
- d. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
- e. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
- f. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.

3. Open Top Cable Support Requirements:

- a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables
- b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

4. Pull Box Requirements:

- a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
- b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.

- c. Conduits that enter a pull box from opposite ends should be aligned.
- d. Pull boxes shall have a length 12 times the diameter of the largest conduit.
- e. All pull boxes must be accessible.

E. Cabling System:

- 1. Follow T568B scheme for copper category cabling terminations.
- 2. Follow TIA/EIA-568A for commercial buildings cabling.
- 3. Provide a minimum 6" service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.
- 4. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.
- 5. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- 6. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.
- 7. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- 8. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
- 9. Pair untwist at the termination shall not exceed 0.125". The cable jacket shall be maintained as close as possible to the termination point.
- 10. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.

F. Grounding System:

- 1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
- 2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
- 3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
- 4. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
- 5. Racks shall have individual, appropriately sized conductors bonded to the

grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.

6. Refer to electrical diagrams for additional ground connection requirements.
- G. Cabling groups and conduit separation:
  1. Refer to "CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE".
- H. Firmly secure all equipment in place that is not intended for portability.
- I. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.
- J. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

### **3.2 LABELING**

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size and color.
- C. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including riser diagrams) in each and every AV Rack.

### **3.3 CONTROL SYSTEM FUNCTIONALITY:**

- A. ROOM FUNCTIONS:
  1. Refer to drawings for keypad layouts, button callouts and description of system intent.
  2. All room controls are required to have the similar looks and functionality.
- B. Amplifiers shall be set to go to stand by after 30 minutes of no audio detection.

### **3.4 FIELD QUALITY CONTROL:**

- A. TESTING:
  1. Refer to Appendix A, "INTEGRATOR VERIFICATION CHECKLIST", for system verification requirements. Verification checklist shall be complete prior to final commissioning.
  2. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
  3. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.
  4. Adjust, balance and align equipment for optimum quality and to meet the manufacturer's published specifications.

5. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components, while maintaining the highest amount of gain possible.
  6. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.
  7. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers, located near displays, on all cables that are more than 30 feet in length and/or have more than 4 connection points.
  8. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.
  9. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.
  10. Loose parts and poor workmanship or soldering shall be replaced.
  11. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.
  12. Equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).
  13. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. AV Contractor shall own and have access to a handheld Quantum Data 780C tester to allow for on-site verification testing and troubleshooting of HDMI and digital video networks and analog video displays. All test equipment used shall be factory calibrated within one year of use with references set daily prior to testing.
  14. Contractor shall provide HDCP compliant device with digital cables, and digital HDCP content for testing of routing and HDCP compliant distribution and switching. Also provide analog VGA output equipment for testing of video switching, scaling, and distribution if analog is included with this project.
  15. Horizontal cabling contractor shall test all twisted pair cabling used within the AV system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to AV Consultant prior to final walk through.
- B. At the time of final commissioning, if the AV consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least 3 days prior to the visit, then a return visit will be required. The AV Consultant's return visit will be paid for in advance by the AV integrator at a flat rate of \$500 per person, at no cost to the owner.

### 3.5 OPERATING AND MAINTENANCE MANUALS:

- A. Operating and maintenance manuals shall be submitted prior to testing of system. Total of two (2) manuals, shall be delivered to the Company. Manuals shall include all model numbers, service, installation, and programming information.
- B. Include all the following information:
  1. Warranty
  2. Network settings
  3. Riser diagrams from Shop drawings

4. Training videos
5. USB Flash drive with programing source code and software editing programs

**3.6 TRAINING:**

- A. Provide two (2) sessions of two (2) hours each of training on the operation of each system, at job site, at no cost to owner.
- B. Training shall be video recorded. Two (2) DVD copies shall be given to the owner.
- C. The second training shall take place within a month of the first training and all questions shall be answered.

**3.7 RECORD DRAWINGS:**

- A. The Owner shall provide electronic (DWG) format of AV System system drawings that as-built construction information can be added to. These documents will be modified by the AV contractor to denote as-built information as defined above and returned to the Owner.
- B. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

**END OF SECTION 27 4100**

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**SECTION 28 2205**  
**ACCESS CONTROL SYSTEM**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK**

- A. The Access Control System is indicated by drawings and is hereby defined to include, but not be limited to equipment, raceway, outlets, coverplates, cabinets, grounding and miscellaneous items required for complete system.
- B. Refer to other Division-26 & 28 sections for requirements for raceways, trays, boxes and fittings, and supporting devices, and other sections, as applicable.

**1.3 QUALITY ASSURANCE:**

- A. MANUFACTURERS: Firms regularly engaged in manufacture of security system equipment and components of the types described here-in and whose products have been in satisfactory use in similar applications for not less than 5 years.
- B. INSTALLER: Qualified technicians: With at least 3 years of successful installation experience with security systems. Installer must be factory certified.
- C. AlphaCorp is the only qualified and approved security solutions integrator and provider.
  - 1. Name:
    - a. Brian Minner
    - b. bminner@alphacorpsecurity.com
    - c. 762-532-3259
  - 2. Address:
    - a. 2211 West 2300 South
    - b. West Valley City, UT 84119
  - 3. Main Phone
    - a. (801) 977-8705

**1.4 SUBMITTALS:**

- A. PRODUCT DATA: Submit manufacturer's data sheets including specifications, installation instructions, and general recommendation for each type of equipment specified.
- B. SHOP DRAWINGS: Submit dimensioned drawings and wiring layout for any changes in wiring from the layout on the drawings. Submit actual riser diagrams of complete system and elevations of required equipment. Typical risers are not acceptable.

## 1.5 REFERENCE STANDARDS

- A. Where more than one (1) reference standard, code, or regulation applies, the more stringent one shall govern.
- B. Underwriters Laboratories Inc. (UL):
  - 1. UL 294 - Standard for Access Control System Units.
  - 2. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems.
  - 3. UL 1981 - Standard for Central-Station Automation Systems.

## PART 2 – PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS:

- A. MANUFACTURER: Subject to compliance with the requirements, provide access control system of one of the following:
  - 1. Lenel Systems International, Inc., 1212 Pittsford-Victor Road, Pittsford, NY 14534; telephone: 585-248-9720, fax: 585-248-9185; Web site: [www.lenel.com](http://www.lenel.com).

### 2.2 GENERAL: Provide a complete and operable access control system, that utilizes door contact, request to exit devices, and card readers to maintain building security.

### 2.3 SMS SOFTWARE

- A. Security Management System (SMS) Software: Lenel Systems International
  - 1. OnGuard™ Series ADV
  - 2. 5 Client Workstations

### 2.4 SMS FIELD HARDWARE

- A. Security Management System (SMS) Hardware: The SMS shall be equipped with the access control field hardware required to receive alarms and administer all access granted or denied decisions. All field hardware must be designed to meet UL 294 requirements. The SMS must be able to retrieve device serial numbers from all field hardware, excluding card readers, biometric readers, and keypads. Depending upon the configuration, the SMS field hardware must be able to include any or all of the following components:
  - 1. Intelligent System Controllers (ISC): LNL-500 or LNL-2220 or LNL-3300
  - 2. Input Control Module (ICM): LNL-1100
  - 3. Dual Reader Interface Module (DRI): LNL-1320
  - 4. Biometric Reader Interface Gateway: LNL-500B
  - 5. Altronix AL600-ULX Power supplies and enclosures
  - 6. UL, CUL, and CE listed power supplies and enclosures
- B. SMS Authentication Hardware:

1. XceedID Proximity Readers
2. XceedID Smart Card Readers

## **2.5 SERVER AND WORKSTATION REQUIREMENTS**

- A. Database Servers and Application Servers (Located in Basement Equipment Room Rack, Total of One)
1. Rack mountable 2U Dell PowerEdge R720 or latest comparable system. Mount server in Basement Equipment Room.
  2. Intel® Xeon® E5520, 2.26Ghz, 8M Cache, Turbo, HT, 1066MHz
  3. 8GB Memory, 1066MHz Dual Ranked UDIMMs for 1 Processor, Adv ECC
  4. 24X IDE CD-RW/DVD ROM Drive
  5. 1TB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Operating System
  6. 1TB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Database
  7. RD1000 Backup, Internal SATA Drive Bay for 2.5" Chassis
  8. RD1000 Internal Removable Hard Disk for RD1000, 160GB Native / 320GB Comp
  9. Four 10/100/1000 Ethernet Network Ports
  10. 17 in. Flat LCD Monitor
  11. Onboard VGA
  12. 1 serial port
  13. 6 USB 2.0 ports
  14. Speakers
  15. USB Keyboard
  16. USB Optical Mouse
  17. Surge Suppression Strip
  18. Microsoft Windows Server 2012
  19. Microsoft SQL Server 2012 Relational Database Management System
  20. SMS Server Software for Windows 2012
- B. Client Workstations PC Specifications (Located in Basement Security Office, Total of One)
1. Intel Pentium 4 Dual Core E2180, 2.0GHz, 1M L2 Cache, 800FSB
  2. 8GB non-ECC, 667MHz DDR2 1x1GB (1DIMM)
  3. 24X CD-RW/DVD Combo Drive
  4. 1TB SATA II 3.0Gb/s, 8MB Cache, 7200 RPM hard drive
  5. 10/100/1000 Ethernet Network Port
  6. 1 serial port
  7. 1 parallel port
  8. 8 USB 2.0 ports

9. 23 in. Flat LCD Monitor
  10. 1GB Video Card
  11. Speakers
  12. USB Keyboard
  13. USB Optical Mouse
  14. Surge Suppression Strip
  15. Microsoft Windows XP or 7
  16. Microsoft SQL Server 2012 Client License
  17. SMS Client Software for Windows 8
- C. System Administration only
1. Dell OptiPlex 780 Small Form Factor
  2. Intel® Pentium® Dual Core E5300 with VT (2.60GHz, 2M, 800MHz FSB)
  3. 4GB DDR3 Non-ECC SDRAM, 1066MHz, (4 DIMM)
  4. 8X Slimline DVD+/-RW
  5. 160GB 7,200 RPM 3.5" SATA, 3.0Gb/s Hard Drive with NCQ and 8MB Cache
  6. 10/100/1000 Ethernet Network Port
  7. 1 serial port
  8. 1 parallel port
  9. 8 USB 2.0 ports
  10. 19 in. Flat LCD Monitor
  11. Integrated Video, Intel® GMA 4500
  12. Internal Chassis Speakers
  13. USB Keyboard
  14. USB Optical Mouse
  15. Surge Suppression Strip
  16. Microsoft Windows 7
  17. Microsoft SQL Server 2008 Client License
  18. SMS Client Software for Windows 7

## 2.6 COMPONENTS

- A. SMS Software Capabilities: Support an unlimited number of card readers, input points, video cameras, intrusion detection points, and relay outputs. The SMS database server shall support an unlimited number of cardholders, visitors, and assets limited only by the available memory on the ISC. The database server shall also support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. Client Workstations shall be limited only by the limitations of the operating system server software. The SMS functions are categorized into nineteen primary "system modules" that shall include:

1. **Access Control**

- a. One of the SMS's primary purposes shall be to provide access control. The SMS shall be able to make access granted or denied decisions, define access levels, and set time zones and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SMS shall support features such as area control (two man control, hard, soft, and timed anti-pass back, database segmentation, and time zone or holiday overrides.

2. **Alarm Monitoring**

- a. The main Alarm Monitoring window shall provide information about the time and location of the alarm, along with its priority. The main Alarm Monitoring window must be able to sort pending and/or insert new alarms based on any of the following attributes: priority, date or time, alarm description, Intelligent System Controller, Card Reader, Input Control Module, asset name, or cardholder. Date or time sorts must be System Operator selectable to be either ascending or descending and must have the option of displaying the seconds of the minute that the alarm arrived into the SMS. All columns of information in the main Alarm Monitoring window shall be able to be arranged in any order by the System Operator.
- b. The SMS must allow unique emergency instructions to be specified for each type of alarm. It shall also allow for the automatic sending of alphanumeric pages or e-mail messages upon alarm arrival. It shall allow for the sending of alarms to a Central Station. A real-time graphical system status tree on the screen shall indicate if card readers, alarm panels, digital video recorders, video cameras, intrusion detection panels, or Intelligent System Controllers are secured, unsecured, in alarm, or offline. Output control operations must be available to lock, unlock or pulse control points as a standard feature. An automatic cardholder call-up feature shall allow the quicksearch and display of images in the database. A System Operator journal shall be available to log important daily events. A trace function shall be available for System Operators to locate and track activity on specific cardholders, assets, video cameras, or card readers. An image comparison feature must be provided for use in conjunction with a CCTV interface. All alarms and hardware icons MUST have the ability to control the associated hardware via right-mouse clicks.
- c. The SMS must provide the option to be used as a UL 1981 Classified Central Station Automation System. This option must be classified by Underwriters Laboratories for use as a Commercial Burglar Central Station Automation System, to allow the monitoring

station where it is used to be made compliant with the UL 1981 standard and listed by UL. This classification shall apply to alarm panels monitored through a connected, UL approved Central Station Alarm Receiver.

**3. Asset Management**

- a. The SMS shall include a seamlessly integrated asset management module to include real time management and tracking of CUSTOMER assets. The SMS shall allow for the centralized management of assets. System Administrators shall be able to generate reports on current asset assignments as well as the history of cardholder assignments for assets. The SMS shall also be able to restrict assets from passing through checkpoints with unauthorized personnel and report assets that pass through checkpoints with authorized personnel. The SMS shall also allow specified readers to require an authorized asset before granting access.

**4. Visitor Management**

- a. The SMS shall include a visitor management module. The visitor management module shall be an application utilizing technology that allows a CUSTOMER to enroll and track visitors of the organization.
- b. The visitor management module shall allow a CUSTOMER to enroll visitors, sign them in or out, capture a photo, and capture a driver's license or passport. The visitor management module shall allow System Operators to enter and pre-schedule visits. The visitor management module shall allow System Operators to print visitor badges.

**5. Remote Access Level Management**

- a. The SMS shall include a seamlessly integrated remote access level management module. The remote access level module shall be a desktop-based application technology that allows CUSTOMER managers to assign and remove access levels to and from cardholders in the existing SMS database. All transactions relating to the adding and/or removal of access levels shall be recorded complete with a time and date stamp and the System Operator who made the change.

**6. Third-Party Interfaces**

- a. The SMS shall integrate with a number of third-party hardware and software products. The SMS shall provide an industry standard OPC Server utility to allow the export of any and all SMS alarms and events to industry standard OPC Clients, such as building automation and/or process control systems. The SMS shall also provide the ability for an Alarm Monitoring Workstation to function as an OPC Client that shall accept alarms and events from industry standard OPC Servers, such as those from Building Automation or Process Control Systems.
- b. The SMS shall provide seamless integration with fire

alarm systems such as Pyrotronics and Notifier, and central station alarm receivers such as Bosch 6500 or 6600 and Osborne Hoffman 2020. The SMS shall allow alarms and events from the third-party systems to report into the same main Alarm Monitoring window as access control alarms. Third-party interface hardware shall be configured in the SMS access control module. In some cases, System Operators shall be able to control third-party hardware devices from the Alarm Monitoring Workstation. Third-party hardware alarms and events shall be stored in the SMS database for audit trail and reporting purposes.

**7. System Administration**

- a. System Administrative tasks such as defining client workstation and System Operator permissions set-up, access groups, timezones, reports, maps, etc. shall be provided from any client workstation on the network. Initial setup of the cardholder screen layout shall occur on the database server. The SMS shall support the use of strong passwords.

**8. Screen or Forms Creation**

- a. The SMS shall provide a Forms Designing and Editing Module that gives System Administrators the ability to modify any standard field to customize any or all of the cardholder, asset, or visitor forms. The SMS shall also allow System Administrators to add custom fields in addition to any standard fields on a minimum of 32 pages each of information for cardholder, visitor, and visit related data. User-defined fields absolutely shall not be pre-defined, meaning only the labels can change while the properties cannot. System Administrators shall have a minimum of 96 pages to design their cardholder, visitor, and visit screens with standard and custom fields.

**9. Graphical Map Creation**

- a. The SMS shall provide Graphical Map Creation and Editing Software that must allow System Administrators to import customized map backgrounds of their facility and to attach custom icons to those maps.

**10. Application Programming Interfaces**

- a. The SMS shall provide a set of standard Application Programming Interfaces (API's) and supporting documentation that allows hardware manufacturers and software application developers to integrate their products into the SMS. The Application Programming Interfaces shall allow requests from CUSTOMER to integrate a third-party hardware or software solution based on SMS open architecture and SMS device independence.

**B. SMS Software Functionality:**

1. **Time zones:**

- a. The SMS shall be capable of creating and storing up to 255 time zones. Each time zone shall have a minimum of six (6) intervals. Each interval shall be assignable to any day of the week.
- b. Each time zone shall be assignable to an alphanumeric name of up to 64 characters. Time zones shall be applied to access levels, card reader modes, alarm inputs, alarm outputs, and alarm masking and logging functions. Time zones shall be allowed to belong to any or all access levels so that the time zone only has to be defined once.

2. **Access Levels:**

- a. Capable of defining a minimum of 32,000 access levels with a minimum of 128 access levels per cardholder per database segment. Access levels shall consist of a combination of card readers and timezones.
- b. Each access level shall be assignable to an alphanumeric name using up to 64 characters.
- c. Card readers shall have the ability to be assigned to any or all access levels defined in the SMS. Individual card readers shall be capable of having a distinct timezone assigned to it.
- d. Allow an 'Allow User Commands' option to be assigned on a per access level basis where keypad readers are in use.
- e. Allow a 'First Card Unlock' option to be assigned on a per access level basis.

3. **Temporary Access Levels:**

- a. Capable of assigning Temporary Access Levels inclusive of the 32,000 assignable Access Levels.
- b. Each Temporary Access Level shall be assignable to an alphanumeric name using up to 64 characters.
- c. Each Temporary Access Level shall be definable with a start and end date.
- d. Temporary Access Levels shall be stored in the ISC and functionality shall be maintained in the event of disconnection with the ISC.

4. **Access Groups:**

- a. The SMS shall be capable of assigning Access Groups with a maximum of 32 Access Levels per Access Group.
- b. Each Access Group shall be assignable to an alphanumeric name using up to 64 characters.

5. **Holidays:**

- a. The SMS shall provide a minimum of 255 Holiday assignments using an embedded calendar. Holidays shall be assigned an alphanumeric name using up to 64 characters and shall be grouped into eight (8) types of holidays, and shall be assignable to individual time zones. Access rights, card reader modes, and alarm masking schedules must be able to be altered when the current date is designated a Holiday.
- b. Dates for Daylight Saving Time changes shall be definable and shall take effect automatically.



- c. The SMS shall support Holiday Ranges that allow a single holiday to span across multiple calendar days.
- d. Holidays shall be able to be configured to repeat yearly.
- 6. **First Card Unlock:** Feature that when configured retards a pre-determined time zone activated unlock command until a valid credential has been presented and granted access to the portal.
- 7. **Field Hardware Communications:**
  - a. The SMS shall communicate with the ISCs by the following protocols:
    - i. RS-232
    - ii. RS-485
    - iii. TCP/IP
    - iv. Dialup via Modem
- 8. **SMS to Intelligent System Controller Encryption**
  - a. Data security for encrypted connections between SMS and Intelligent System Controllers shall be provided by the full implementation of the Federal Information Processing Standard, FIPS-197, utilizing the 128-bit Advanced Encryption Standard (AES), also known as Rijndael, a symmetric encryption algorithm. The 128-bit AES encryption MUST be certified by the National Institute of Standards and Technology (NIST) and FIPS 140-2.
  - b. The Intelligent System Controllers shall also support a 32-bit issue code. This shall only be used when implementing a Physical Access Control Systems (PACS) low and medium security profile enhancement.
- 9. **Intelligent System Controller to Reader Interface and I/O Module Encryption**
  - a. Data security for encrypted connections between Intelligent System Controller and downstream modules (Reader interface and I/O Modules) shall be provided by utilizing the 128-bit Advanced Encryption Standard (AES), also known as Rijndael, a symmetric encryption algorithm.
  - b. The encryption between the ISC and downstream modules must support use of a diversified session key derived from a shared secret master key algorithm. The shared secret master key must be settable to insure uniqueness, and to authenticate connected modules prior to activating them for the session.
- 10. **Alarm Masking Groups:** Support a group alarm masking feature whereas System Administrators shall be able to create groups of alarm inputs that enable them to mask or unmask multiple Input Control Module inputs and card reader inputs simultaneously. The following events shall have the ability to be part of an alarm masking group:
  - a. Input Control Module Events
    - i. Alarm Input Active
  - b. Card Reader Events
    - i. Auxiliary Input Active

- ii. Denied Count Exceeded
  - iii. Door Contact Tamper
  - iv. Door Forced Open
  - v. Door Held Open
  - vi. Card Reader Input Tamper
11. **Extended Individual Strike Times**
12. **Extended Individual Door Held Open Times**
13. **Elevator Control:**
- a. The SMS shall provide elevator control using standard access control field hardware that will permit the restriction of cardholder access to certain floors while also allowing general access to other floors. The elevator control feature shall allow, at the elevator, the use of any card reader and all card reader modes used on any other card reader in the SMS.
14. **Graphical System Overview Tree:** Displays a graphical representation of all field hardware (including ISCs, fire panels, intrusion detection devices, personal safety devices, intercom systems, and central station alarm receivers), digital video hardware, access levels, timezones, access groups, holidays, and card formats that have been configured in the SMS. System Administrators shall be able to modify a device that is depicted on the graphical system overview tree or see its properties by double-clicking on the icon and the SMS shall bring them to the appropriate form.
15. **Alarm or Event Logging:**
- a. All alarms and events in the SMS shall by default, always be recorded in the database. The SMS shall give System Administrators the ability to select on a timezone basis, the times that they require the SMS to log specific events to the database.
  - b. System Administrators shall have the option for Alarm or Events to be set to log or not to log particular alarms or events on any individual reader and or input.
16. **Scheduling Utility:**
- a. An integral Scheduling Utility shall be provided. The Scheduling Utility shall allow System Administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.
17. **Multiple Card Formats:** Support an unlimited number of card formats. Magnetic stripe and Wiegand card formats shall be supported.
18. **Monitor Zones:**
- a. The SMS shall provide System Administrators the ability to segment their access control SMS field hardware devices into various zones or areas where alarm monitoring client workstations will monitor. These zones shall be assigned an alphanumeric name using up to 128 characters.
19. **Alarm or Event Routing:**

- a. The SMS shall be capable of allowing System Administrators to route alarms and events to various alarm monitoring client workstations on the network. The SMS shall allow any alarm or event to be routed to one or multiple client workstations on the network regardless of where the alarm is generated in the field.
20. Text Instructions: Allow for a set of text instructions to be associated with each alarm that arrives into the SMS.
21. Alarm Attributes: The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis.
22. System Downloads:
  - a. The SMS shall provide for the downloading of data to the ISCs. Downloads shall load SMS information (timezones, access levels, alarm configurations, etc.) into the ISCs first, followed by cardholder information and card reader configurations.
23. Input Control Module (ICM) Options: Provide the following options for the Input Control Modules:
  - a. Alarm Masking: The ability to mask the alarm input on a timezone basis.
  - b. Local Linkage: The ability to locally link outputs with inputs that are attached to the same ICM or Output Control Module (OCM).
  - c. Activate Output: The ability to activate an output tied to the ICM or OCM on a timezone basis.
  - d. Activate Output Always: The ability to activate an output always.
  - e. Configuration of Debounce Times: The ability to control the amount of time that an input state change must remain consistent in order for it to be considered a real change of state.
  - f. Configuration of Hold Times: When configuring an Alarm Input, a hold time setting shall be settable from 0-15 seconds.
  - g. Supervised Input: The ability to specify if a specific alarm contact on the ICM is a supervised or unsupervised contact.
24. Intelligent System Controller Options: System Administrators shall have the ability to group add, modify, and delete Intelligent System Controllers (ISCs) in the SMS. The SMS shall have a copy command, allowing System Administrators to easily and efficiently add ISCs. The copy command will copy all information configured for an ISC selected and apply those same characteristics to the new ISC being added. System Administrators shall also have the ability mark ISCs as 'online' or 'offline' depending on whether those panels are online. The SMS shall also prompt the System Administrator if the System Administrator attempts to configure the number of cardholders (and assets, if applicable) that will be downloaded to an ISC to a number greater than the ISC's memory can handle.
25. Alarm Monitoring - Alarms Monitored: When the SMS is configured, the System Administrator shall assign a default monitor zone to be monitored. The monitor zone shall include default alarm types with default time zones that the alarm type will be monitored.

26. Alarm Annunciation Configuration: The System Administrator shall have the capability to configure how the SMS handles the annunciation of alarms on an individual alarm or event basis.
27. Current Status Indication: The alarm monitoring window shall provide a visual status that displays the current status of all devices in the device tree including child devices downstream from the primary device.
28. Alarm Monitoring on Multiple Windows: Alarm Monitoring shall be able to be displayed on multiple windows. This shall allow the user to manage multiple integrated hardware pieces from the Alarm Monitoring operating environment and improves the consistency and usability of the monitoring interface. The display mode of Alarm Monitoring windows can be toggled between standard and floating behavior. When a window is in the floating display mode, it can be positioned outside the main Alarm Monitoring window onto one or more monitors.
29. Pending Alarm Windows: The SMS shall support a Pending Alarm Window in the Alarm Monitoring Workstation. This shall be a separate window from the Main Alarm Monitoring Window that shall be opened at any time to view a list of only pending alarms.
30. Color Coding for Alarm Priorities: Display alarms in the active alarm monitoring window with a flashing colored bar across the alarm based upon priority.
31. Highlighting of Unacknowledged Alarms: The SMS shall allow for unacknowledged alarms to automatically be displayed in a pop-up window after a user-defined amount of time. The user-defined amount of time shall be set in System Administration.
32. Pre-Defined "Canned" Alarm Acknowledgment Responses: Have the capability for pre-defined alarm acknowledgment responses for alarms in the SMS.
33. Inactive Badge Alarm: The SMS shall provide an alarm, indicating current badge status, if an attempt to gain access is made with a badge that has a status set to any value other than "Active" in the cardholder record. Typical inactive badge status values include "Lost" and "Terminated". Access shall be denied for this attempt. By default, the SMS shall come with this feature disabled; the System Administrator shall have the ability to enable this functionality.
34. Request to Exit Event: The SMS shall provide an event when a Request to Exit (REX) is used. By default, the SMS shall come with this feature disabled; the System Administrator has the ability to enable this on a reader by reader basis.
35. Cardholder, Card Reader, or any Field Hardware Device Trace: From the alarm monitoring window, the System Operator must be able to initiate several traces of cardholders, assets, and/or field hardware devices while monitoring alarms. This information shall be continuously accumulated in the dedicated trace window until the trace is stopped. The trace operations must not interfere with the operation of the alarm monitoring, and be continuous while alarms are monitored. The results of each trace shall be printable on the report printer or displayed on the screen.
36. Single-Click or Double-Click Device Command Execution
37. Destination Assurance: Provide the ability to alert the system operator when a cardholder does not reach a required location and present their credential after entering at a designated checkpoint in a designated period of time.
38. Real-Time, Dynamic Graphical Maps:
  - a. Support graphical maps that display device or group status, function lists and video cameras dynamically

in real-time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device. The SMS shall indicate if the field hardware is not operating with the most current version of firmware.

- b. Support all map formats listed below:
    - i. Adobe Photoshop (.psd)
    - ii. AutoCAD DXF (.dxf)
    - iii. CALS Raster (.cal)
    - iv. Encapsulated Post Script (.eps)
    - v. GEM or Ventura (.img)
    - vi. IBM IOCA (.ica)
    - vii. JPEG (.jpg)
    - viii. JIFF (.jif)
    - ix. Kodak Photo-CD (.pcd)
    - x. Kodak Flashpix (.fpx)
    - xi. LEAD (.cmp)
    - xii. Macintosh PICT (.pct)
    - xiii. MacPaint (.mac)
    - xiv. Microsoft Paint (.msp)
    - xv. Port Net Graphics (.png)
    - xvi. Sun Raster (.ras)
    - xvii. Targa (.tga)
    - xviii. TIFF (.tif)
    - xix. Windows Metafile (.wmf, .emf)
    - xx. Windows Bitmap (.bmp, .dib)
    - xxi. WordPerfect Raster (.wpg)
    - xxii. Zsoft PCS or DCX (.pcx, .dcx)
  - c. Support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously.
  - d. Support user-defined icons for field hardware devices. The SMS shall also give System Operators the ability to affect the mode of card readers, open doors, start a trace on a device, mask or unmask alarm inputs, and activate or deactivate or pulse an output from the map icons.
  - e. The graphical maps shall have the ability to be printed to a local printer.
39. **Automatic Credential Deactivation by Lack of Use:** Have an automatic credential deactivation function where a cardholder's credential will automatically deactivate after an extended period of inactivity based upon a predetermined time period. The credential status may be reset by authorized System Operators.
40. **Alarm Filtering:** Have the capability for filtering out alarm types from the alarm monitoring window. Alarms that may be filtered are access granted alarms, access denied alarms, system alarms, duress alarms, and area control alarms. If applicable, fire alarms, asset alarms, intercom alarms, central station receiver alarms, intrusion detection alarms, video event alarms, and transmitter alarms may also be filtered.
41. **Manual Override of Card Readers:** Support System Operator overrides of card readers from the alarm monitoring window, graphical maps or the real-time

- system status tree. Also support the ability to manually set a reader back to default mode.
42. Online Context-Sensitive Help: Provide online context-sensitive help. The help menus shall be available from any window in the SMS by pressing the F1 function key or clicking on the help icon in the toolbar.
43. Alarm aggregation: Alarm aggregation is a mechanism of combining several alarms into a single item (group) based on certain criteria. The SMS's System Administration application shall have an Aggregate option.
- a. There shall be a Fast or Group Acknowledge command. If the command is applied to one or more groups of aggregated alarms, all alarms from the selected groups shall be acknowledged or marked in progress depending on what option the user selected.
44. Runaway Detection: Runaway detection is the situation when there is more than a specified number of alarms coming from a given device within a specified time interval. Runaway detection shall be configurable per segment basis in the SMS's System Administration application. The System Administrator shall be able to configure runaway detection settings. The following system settings shall be available for each segment:
- a. General settings:
    - i. Detect runaway devices
    - ii. Number of events\*
    - iii. Time interval\*
    - iv. Log events to the database\*
  - b. Receiver Accounts settings\*\*:
    - i. Number of events
    - ii. Time interval
45. E-mail Interface Option: Support an e-mail interface seamlessly integrated within the SMS Alarm Monitoring application. System Operators shall have the ability to manually or automatically send ASCII text e-mail messages from the Alarm Monitoring application on demand regarding any alarm currently displayed in the Main alarm monitoring window. E-mails shall have the ability to be sent to multiple e-mail accounts if desired. Integrate with Microsoft Exchange Server.
46. Modify Existing Field Names of SMS Cardholder Form: The SMS shall provide a method of defining basic user-defined fields. It shall allow System Administrators to rename the standard database fields in the cardholder form of the SMS and move the fields to different locations on the form. Additional functionality shall be available in the advanced Forms Designing and Editing Module.
47. Assign Access Levels: At the time a badge is created it shall be possible to have up to 128 access levels assigned to the cardholder's badge plus any precision access groups.
48. Bulk Assignment or Modification or Deletion of Access Levels: System Administrators or System Operators shall have the option for Bulk Assignment, Modification, and/or Deletion of Access Levels to active badges for a group of cardholders.
49. Search Records: The SMS must allow the System Operator to search for records and images using search criteria on any field(s) in the database. The System Operator must be able to enter the search criteria for one or a combination of fields. In addition, partial searches shall be performed.

50. Bulk Deletion of Cardholder Records: System Administrators shall have the option to perform Bulk Deletion functions for a group of cardholders. This feature shall allow System Administrators to perform a search against the cardholder database and then delete that group of cardholders.
51. Credentials:
  - a. Proximity credentials
    - i. 125KHZ
52. Biometric Verification: Biometric verification shall be available as a seamlessly integrated solution with other SMS modules. Through the measurement and comparison of human characteristics such as fingerprints, hand geometry, or Iris imaging, the SMS shall have the capability to verify the identity of enrolled individuals. The SMS shall NOT require the use of third-party software for enrollment, capture, and encoding of biometrics for the products listed below. These functions shall be seamlessly integrated into the core SMS.
  - a. The SMS shall provide the ability to view, capture, and delete biometric templates. The System Administrator shall be able to provide permission to view, capture, and delete biometric templates to System Operators. The permission to view, capture, and delete inputted biometric templates shall not be all inclusive. For example, some System Operators may only have the ability to capture biometric templates, while others may have the ability capture biometric templates and delete biometric templates. The System Administrator has the ability to assign the System Operator access to any or all of the aforementioned biometric template abilities.
  - b. Through seamless integration with Schlage Handkey Series readers, the SMS shall have the ability to seamlessly capture biometric information (hand geometry) and create biometric templates during the cardholder enrollment process.
  - c. Biometric seamless verification based on hand geometry shall require the accompaniment of a badge or PIN entry using a reader connected to a Single or Dual Reader Interface Module residing on the same Intelligent System Controller, but physically independent of the Biometric Reader Interface and its devices. In the case of PINs, the integrated RSI keypad shall be used.
  - d. Enrollment
    - i. Biometric templates shall be created during the badge enrollment process or added to existing badges in the SMS database. Biometric information shall also be stored at Intelligent System Controllers, along with badge information. If a smart card is used, cardholder, biometric, and access information shall be added to the smart card.
    - ii. System Operators shall be able to enroll biometrics templates on a one by one basis. System Operators shall fill in all required fields. The biometric data shall be captured via the configured enrollment reader specified.
    - iii. Biometric enrollment readers shall be directly

connected to the enrollment workstation. Field hardware connections shall not be required for enrollment readers.

- e. System Operator Activity Logging
  - i. The SMS shall provide full System Operator activity tracking of critical keyboard functions. The activity log shall be comprehensive, recording the date and time of the activity, the client workstation that the activity was performed, the System Operator who performed the activity, the program the activity occurred in, and the function that was performed within it. The SMS shall record any and all changes to the database made by all System Operators.
- f. Access Control Reports
  - i. There shall be a minimum of 145 standard SMS reports provided with the SMS. All reports MUST be stored in the SMS database and MUST be able to be viewed from any SMS client workstation with proper permissions. Reports shall use UTC time. The SMS shall allow the SMS USER to e-mail reports based on system events or on a user-defined schedule.

**53. Ad-hoc Database Report Generator**

- a. The SMS must provide an ad-hoc customized report generator package integrated with the SMS's database.

**54. Archiving**

- a. The SMS shall allow System Administrators to archive offline history files to magnetic media. Offline files shall include access events and System Operator transactions that have been purged from the reportable database. The offline files MUST be in a "ready to import" format for easy insertion of information back into the online database. Different event types may remain in the database for different time periods according to the System Operator's specification.
- b. Any record older than the specified dates shall be purged to the offline history file for archiving. Reports shall be generated from the archived files if necessary. Archiving shall be a scheduled, automatic function.

**55. Import Module: The SMS shall support an import utility, that shall allow the CUSTOMER or VAR to import cardholder information into the SMS database. This shall allow the CUSTOMER or VAR to pre-populate the SMS database with existing cardholder data and/or add NEW records to an existing SMS database. The Import Module only supports SQL Server; it does not support Oracle. For Oracle, Data Exchange must be used for data import.**

- a. The Import Utility shall be a 32-bit Windows application that shall be used to import standard ASCII delimited text files into the SMS. The import utility shall be utilized at the initial SMS setup and anytime a large number of records need to be imported into the SMS after the initial import. For example, a large university may import 10,000 records



- into the SMS during the initial SMS setup and then import 2,000 additional records each semester thereafter. The SMS shall check for duplicate records during the import, so that multiple copies of the same record are not added into the SMS database.
- b. The import utility shall allow System Administrators to choose the delimiter for the ASCII file. This delimiter may be, but is not limited to, a comma, vertical bar, semi-colon, or asterisk. Fields in the SMS database, such as Address 2, that the CUSTOMER does not wish to use, may be left blank in the ASCII file.
  - c. The import utility shall be able to select the source drive where the ASCII delimited file is located as well as the destination drive where the SMS database is located.
  - d. The import utility shall also be able to import photos as part of the record into the SMS database. The SMS shall support the following file formats for the import of cardholder photos:
    - i. Bitmaps (.bmp, .dib)
    - ii. JPEG (.jpg)
    - iii. JIFF (.jif)
    - iv. Zsoft PCX/DCX (.pcx, .dcx)
    - v. Adobe Photoshop (.psd)
    - vi. CALS Raster (.cal)
    - vii. GEM/Ventura IMG (.img)
    - viii. IBM IOCA (.ica)
    - ix. WordPerfect Raster (.wpg)
    - x. Macintosh PICT (.pct)
    - xi. Portable Network Graphics (.png)
    - xii. TIFF (.tif)
    - xiii. Windows Metafile (.wmf, .emf)
    - xiv. Targa (.tga)
    - xv. Kodak Photo CD (.pcd)
    - xvi. Kodak Flashpix (.fpx)
    - xvii. Encapsulated Post Script (.eps)
  - e. The SMS shall include a progress meter to show the System Administrator the percentage of the import complete when importing large quantities of records.

## **2.7 REQUEST TO EXIT DEVICES:**

- A. Exit Motion Detector: Provide passive infrared (PIR) motion detector specifically designed for access control use. Detector will detect approaching occupant and signal the system to differentiate between normal exiting and a forced open door condition.

## **2.8 CARD READER**

- A. Proximity Readers: The system shall be provided with uni-directional proximity card readers. The card reader shall have a read range of five to eight inches. The reader shall be able to be mounted with its sides against metal door or window frames, and masonry walls. The reader shall be powered by an external +12VDC regulated power supply. The card shall use 32 or 34 bits and have a label indicating the encoded number. The reader shall meet the following specifications:

1. Electrical: Voltage +12 VDC nominal voltage (10.5-14 volts), 130 mA.
2. Environmental: Outdoor operating temperature -30 to +65 degrees. Indoor operating temperature 0 to +50 degrees.
3. Provide models that match existing equipment.

## **2.9 BIOMETRIC HAND GEOMETRY READER**

- A. Provide a Schlage HandKey II or approved equal wall mounted biometric hand geometry reader. The reader shall meet the following specifications:
  1. The platen shall have a antimicrobial coating to inhibit the growth of bacteria, mold and mildew.
  2. Provide with blue hand outline on the platen to reduce error rates during verification.
  3. Communication
    - a. RS232
    - b. RS422
    - c. RS485
  4. Electrical: Voltage 12- 24VDC, 7Watts
  5. Operating temperature: 0° C to +45° C / 32° F to 113° F
  6. Relative Humidity: 20% to 80% RH Non-condensing

## **2.10 WIRING:**

- A. Provide wiring for the access control system components as recommended by manufacturer.
- B. Provide data cabling (coordinate with building cabling standard) from head end equipment and closest data rack,

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION OF SECURITY SYSTEM**

- A. GENERAL: Access Control System as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standards of Installation" practices.
- B. Coordinate all equipment locations and mounting details with other trades and suppliers.
- C. GROUNDING: Provide grounding connections sufficiently tight to assure permanent and effective ground.
- D. TESTING: Upon completion of installation of system and after energized, demonstrate system compliance with intent.
- E. WIRING: Install all wiring in metal raceway in walls and above hard lid ceilings. Wiring may be run in overhead cable tray. Wire all components of the system in accordance with factory recommendations. Control and data transmission wiring shall not share

conduit with other building wiring systems. All final connections shall be made by a qualified technician, familiar with the manufacturer's equipment.

- F. WARRANTY: Provide warranty complying with Division 16001.

### **3.2 SYSTEM INTEGRATION**

- A. Integrate electronic security system with the following systems and equipment:
1. Electronic door hardware.
  2. Elevators.
  3. Access control.
  4. Fire-alarm system.

### **3.3 AS BUILT DRAWINGS:**

- A. A complete set of CAD "AS-BUILT" Drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.
- B. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD security drawing. Edges of the sign shall be colored to match the building interior.
- C. The disk containing the files shall be supplied to the owner. These disks shall include all information required to allow the district to change the security program themselves. These computer disks shall contain a minimum of the following:
1. CAD drawing files of building security map.
  2. CAD drawing files of AS BUILT security components and point to point connections.
  3. General configuration programming.
  4. Job specific configuration programming.
  5. Tutorial file on complete programming of security system.

### **3.4 OPERATING AND MAINTENANCE MANUALS:**

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

### **3.5 TRAINING:**

- A. Provide four (4) hours of training on the operation and installation of the access control system, at the job site, at no cost to the owner.
- B. Provide programming training and software sub-licensing in owner's name. Sub-licensing agreement shall include the U.L. requirement to allow the owner to do any programming

that the supplier is allowed to do during commissioning, testing, service and field additions or deletions to the access control system. The access control system shall provide this training and licensing at no cost to the owner, including transportation (if outside Salt Lake City), lodging, meals, and training manuals.

END OF SECTION 28 2205

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**SECTION 28 3111****FIRE ALARM AND DETECTION SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of fire alarm and detection systems work is indicated by drawings, schedules and as specified herein.
- B. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems that are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories that are FM approved. Comply with State and local requirements as applicable.
- C. Comply with applicable provisions of current NFPA Standards 72, National Fire Alarm Code, local building codes, and meet requirements of local authorities having jurisdiction.
- D. Carefully review all Division 23 drawings for all fire/smoke dampers. Fire/smoke dampers are NOT shown on electrical plans. Electrical contractor is responsible for coordinating 120V power to all dampers and providing fire alarm connections to each one. See mechanical drawings for all locations.

**1.3 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
- B. **SHOP DRAWINGS:** Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic.
  - 1. Shop drawings shall be prepared by an individual with a minimum NICET III (Fire Protection Engineering Technology/Fire Alarm Systems) certification. The individual's name and certification number shall be shown on the submittal design drawings.
- C. **CERTIFICATION:** Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.
- D. Provide to the Fire Marshall's office the following:
  - 1. A complete set of shop drawings indicating:
    - a. Location of all alarm-initiating and alarm-signaling devices.
    - b. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.
  - 2. Wiring diagrams for:
    - a. Alarm control panels.
    - b. Auxiliary function relays and solenoids.

- c. Remote signaling equipment.
  - d. Standby battery calculations, including voltage drop calculation.
- 3. A complete equipment list identifying:
  - a. Type
  - b. Model
  - c. Manufacturer
  - d. Manufacturer catalog data sheets
  - e. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)
- 4. A complete zone list identifying all:
  - a. Alarm-initiating and alarm-signaling devices.
  - b. Remote signaling and auxiliary function zones.
  - c. Specific devices associated with each zone.
- E. Submit to State and Local Fire Marshall, a complete Certificate of Compliance

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS:**

- A. MANUFACTURER: Subject to compliance with requirements, provide fire alarm and detection systems of one of the following:
  - 1. Grinnell
  - 2. EST
  - 3. Gamewell - FCI
  - 4. Simplex (Tyco Safety Products)
  - 5. Notifier
  - 6. Silent Knight
  - 7. Siemens Fire
- B. The job foreman or lead technician shall be factory trained and certified on the system being installed. Individual shall have a minimum NICET II certification.

### **2.2 FIRE ALARM AND DETECTION SYSTEMS:**

- A. GENERAL: Provide an electrically operated, electrically supervised fire alarm system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide a complete operating system. Enclose entire system in raceway. Provide basic wiring materials that comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.
- B. SYSTEM TYPE: Analog addressable, non-coded. Either manual activation of a fire alarm station or activation of an automatic initiating device energizes all fire alarm signaling devices, sounding a non-coded alarm and providing device identification on an annunciator panel.
- C. SYSTEM OPERATION: Provide system such that any manual station or automatic initiating device annunciates all alarm indicating units (bells, horns, buzzers, chimes, visual alarm lamps, etc.) continuously until the manual station or initiating device is restored to normal and the fire alarm control unit reset. Annunciate alarm signals by device at the control panel and all remote annunciators. Provide all conductors, raceway, equipment and



labor to accomplish the following:

- D. For fans that are not part of the smoke evacuation system, deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.
- E. Selectively activate and/or deactivate fan units as required.
- F. Release all magnetic door holders upon activation of an alarm from any device by use of a master relay in the control panel.
- G. Provide supervised circuits for the following:
  - 1. Close dampers upon activation of an alarm from any device through the HVAC interface relays at the Fire Command Center.
  - 2. Recall elevators, upon activation of an alarm, to the floor of building egress unless the alarm is on the egress floor, in that case recall elevator to the level designated by the Fire Marshall. Cooperate with the elevator supplier to ensure complete operable system. Provide shunt trip breaker(s) as required.
- H. Central Station Monitoring. Provide a UL listed fire control communicator in accordance with NFPA 71 with a minimum of two reporting zones to the central station. Provide a communicator with dual phone lines for central station reporting by using BFSK or pulsed single round fast format. Provide integral trouble annunciator. Provide with compatibility for automatic test reports every 24 hours. Provide system and components that comply with UL 2635 and UL 864.
- I. Provide fire alarm control panel with capability of shutting down individual initiating devices for maintenance purposes without affecting the continued operation of other initiating devices.
- J. Provide manual fire alarm stations in boiler rooms, and main administrative office. Provide external alarm horns sufficient to be heard in all parking areas.
- K. Sprinkler Supervision. Provide a signal initiating and supervisory circuit to each PIV (post indicator) valve, and to each sprinkler riser and subdivision. Provide continuous alarm signal upon actuation of any water flow signal initiating device. Sound alarm until the condition has been corrected and the panel manually reset as required by UL864. Provide separate alarm zones for: (1) alarm zones from "waterflow alarms", (2) alarm zones from "supervisory alarm" indicating sprinkler system trouble. Provide power to all alarm bells furnished under Division 21 Review final fire sprinkler drawings and coordinate for panel, flow and tamper switch locations.
- L. Provide relays, monitor modules and connections as required at control panel of kitchen hood suppression system for initiation of alarm signal to fire alarm control panel. Connect hood suppression control panel to shunt trip breakers as required.
- M. Provide all required wiring from gas shut off valve to the hood suppression control panel. Make all connections to ensure a properly operating system. Verify with Mechanical Contractor.

## **2.3 SCOPE OF THE WORK:**

- A. Provide a new addressable fire alarm system with 08 ANALOG initiating loops/minimum of 1500 points.
- B. Provide all fire alarm devices.
- C. Provide duct smoke detectors and fan relays at all fan units 2000 CFM and over. Shut down all supply and return fans upon a general alarm signal.
- D. Provide a fire alarm duct detector within 5-feet of any fire/smoke damper as required to

comply with IMC 607.5.4.1. The duct detector shall be listed for the air velocity, temperature and humidity at the point where it is to be installed. A duct detector will not be required at a fire/smoke damper located on a corridor wall where the corridor has smoke detection devices installed. For dampers installed within an un-ducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5-feet horizontally of the damper. Provide a fire alarm relay at each fire/smoke damper. Provide a test switch at each location where the damper is located above an inaccessible ceiling or is located more than 10 feet above the finished floor. Coordinate the location of test switches with owner/architect.

- E. All initiating devices connected to the fire alarm control panel shall be analog addressable.
- F. All wiring shall be in conduit (3/4" minimum). All conduit and connectors, shall be made of steel. All conduit runs shall form a complete loop from the fire alarm control panel.
- G. Provide vandal resistant cages to protect horn/strobes, smoke and heat detectors as indicated and, in gyms whether shown or not. Securely fasten security cages as required. Provide backing and bracing as required to ensure that attachment extends beyond the ceiling materials. Cages shall have two pieces, one backplate and one cover to attach to backplate.

## **2.4 FIRE ALARM CONTROL PANEL:**

- A. The fire alarm control panel shall be microprocessor-based. Each loop shall be capable of 99 analog addresses and 98 monitor and/or control addresses.
- B. If the microprocessor fails, the system shall execute a default signaling program. This program will enable the panel to sound the audible signals and summon the Fire Department. In addition, a red LED shall light to indicate the device wherein the alarm originated. Inability of the system to sound signals or summon the fire department during microprocessor failure shall not be acceptable.
- C. The fire alarm control panel shall contain a 80 digit alphanumeric display and permit the user to perform all necessary functions including but not limited to the following:
  - 1. Alarm/Trouble Acknowledge
  - 2. Alarm Silence
  - 3. Reset
  - 4. Lamp Test
  - 5. Control of Initiating Devices (on/off)
  - 6. Control of output modules (on/off)
  - 7. Change sensitivity of devices
  - 8. Change time
  - 9. Walk test
  - 10. Check system on battery voltage and current
- D. The fire alarm control panel shall be capable of alarm verification. The control panel shall indicate which smoke detector is in alarm during the pre-alarm window.
- E. All alarm signals shall be locked in at the panel until the operated device is returned to it's normal condition and the control panel is manually reset.
- F. Alarm or trouble activation of initiating points shall be represented in English on the alphanumeric display on both the remote operating panel and the fire alarm control panel indicating the address of the specific device, i.e. Device L4S76, Smoke Detector, 1st floor Rm. 17.
- G. Each initiating and signal circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.

- H. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition.
- I. The system communication loops shall be capable of being wired using Class "A" (Style 6) supervised circuits (a ground fault on either conductor or a break shall not prevent a device from operating on either side of the break)
- J. The fire alarm control panel shall contain circuitry permitting the transmission of trouble and alarm signals over leased phone lines by the means of reverse polarity. There shall be a supervised disconnect switch to allow testing of the fire alarm control panel without transmitting an alarm to the central station.
- K. The fire alarm control panel shall include the following features:
  - 1. Auxiliary SPDT alarm actuated contacts.
  - 2. Auxiliary SPDT trouble actuated contacts.
  - 3. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting the normal microprocessor scan and minimize resultant nuisance troubles and/or alarms.
  - 4. A ground fault detector to detect positive or negative grounds on the initiating circuits, signal circuits, power circuits, and telephone line circuit. A ground fault code on the alphanumeric display shall provide indication of either a positive or negative ground fault and shall operate a general trouble but shall not cause an alarm to be sounded
  - 5. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored and shall have a distinctive error message.
  - 6. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.
  - 7. Individual circuit breakers shall be provided for the following: smoke detector power, main power supply, signal circuit #1, signal circuit #2, battery standby power, and auxiliary output.
  - 8. The fire alarm control panel shall be of dead-front construction. One key shall allow access to all electronics or to the dead-front access to the operator functions
  - 9. Opening the main door shall expose all components for inspection or adjustment without further dismantling of the cabinet, control unit, or wiring.
  - 10. It shall be possible to check and adjust the sensitivity of all analog devices from the main fire alarm panel.
- L. The fire alarm control panel shall have batteries capable of powering the system for (24) hours in standby condition and (5) minutes in alarm.
- M. There shall be no special tools required for the programming of devices. A standard slot head screwdriver only.

## **2.5 REMOTE OPERATING PANEL:**

- A. Remote Operating Panel (Provide color as selected by Architect)
- B. The Remote Operating Panel shall contain 80 digit alphanumeric display providing status of all devices including the fire alarm control panel.
- C. The Remote Operating Panel shall permit the user to perform all necessary functions including but not limited to the following:
  - 1. Alarm/Trouble Acknowledge

2. Alarm Silence
3. Reset
4. Lamp Test
5. Control of Initiating Devices (on/off)
6. Control of Output Modules (on/off)
7. Change sensitivity of devices
8. Change time
9. Walk test
10. Check System on battery voltage and current

**2.6 PRINTER (#FCI-PTR):**

- A. The fire alarm control panel shall report all status changes to an 80 column wide carriage printer using 8.5"x11 standard printer paper. The printer shall be supervised by the control panel. In the event of a power outage, the control panel shall be capable of storing and printing out the last 500 events, including event during the power outage.
- B. The panel shall report a supervisory signal to the printer every 8 hours.

**2.7 MONITOR MODULE (FCI AMM-2):**

- A. Remote identification module devices shall be attached to any single normally open initiating device (heat detector, waterflow switch, duct detectors, sprinkler, tamper switches, kitchen hood, pull station, etc.). The modules shall supply addressing and status information to the Fire Alarm Control Panel through the dual loop module.

**2.8 CONTROL POINT MODULE (FCI AOM):**

- A. The control point module shall be connected to the same loop as the initiating devices, and shall provide a relay output (Form "C" 2 Amp @ 24 VDC, resistive only).
- B. This relay output shall be used to perform auxiliary functions.
- C. When the AOM is activated, the red "ACTIVE" LED shall be on solid. Under normal conditions, the red "ON LINE" LED shall flash.

**2.9 DOOR HOLDER (FCI FM-988):**

- A. The door holder shall be wall mounted, semi-recessed; be powered at 120 VAC; and have 35 lbs. of holding force and be of a brushed aluminum finish.

**2.10 MANUAL FIRE ALARM STATION (FCI, MS-2, W/AMM-2):**

- A. Provide red enclosure, manual fire alarm stations with the following features:
  1. Aluminum construction, for flush mounting.
  2. Addressable alarm type electrically compatible with system requirements.
  3. Double Action
  4. Dual-Action design requiring unit to be opened for resetting, and requiring resetting before closing. Key reset, keyed like fire control panel.

**2.11 IONIZATION SMOKE DETECTORS (FCI ASD-I W/ADB-F BASE):**

- A. All ionization smoke detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All ionization fire detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

**2.12 PHOTOELECTRIC DETECTORS (FCI ASD-P W/ADB-F BASE):**

- A. All photoelectric detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All photoelectric detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

**2.13 DUCT FIRE DETECTORS (FCI DH500AC/DC WITH SAMPLING TUBE):**

- A. Provide ionization type with UL 268A listings. Each detector shall be equipped with a remote light. Each detector shall have (2) form "c" alarm contacts rated at 10 amps (at 120VAC).

**2.14 BEAM SMOKE DETECTORS (FCI PBD/AMM-2):**

- A. Provide projected beam smoke detectors, with each detector consisting of a transmitter head, receiver head and receiver control unit. The receiver head shall be capable of being located up to 100 feet from the receiver control unit.

**2.15 THERMAL DETECTORS (FCI ATD WITH/ADB-F BASE):**

- A. Thermal detectors shall operate on the Rate-of-Rise principal. The detectors shall have a fixed temperature rating of 135 degrees Fahrenheit. Exception: in Boiler rooms, provide temperature rating of 200 degrees Fahrenheit.
  - 1. The heat detector shall consist of a base and a head.
  - 2. The base shall be capable of accepting either a smoke detector or a 135 (or 200) degree heat detector.
  - 3. The head shall automatically restore to its normal standby condition when the temperature returns to its normal range.

**2.16 AUDIOVISUAL ALARM HORNS (FCI, HMF/STS SEMI-FLUSH MOUNTED OR EQUAL):**

- A. Provide audio-visual alarm horns with the following features:
  - 1. Die cast or stamped steel construction, finished in red/white (color by Architect) enamel, suitable for indoor or outdoor application.
  - 2. Capable of 90 db (UL rating) sound level at 10 feet.
  - 3. Flush mounted
  - 4. Integrally mounted flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and 110 candela minimum.
  - 5. Electrically compatible with system requirements.
  - 6. Horns shall sound the temporal pattern (code 3) until silenced.
  - 7. Audiovisual alarm horns shall have the ability to silence horns while maintaining the strobe flash, until reset.
  - 8. Mechanical horn mechanism only, electronic horns are not acceptable.
  - 9. Maximum 24 horns per circuit, maximum 8 strobes per circuit.
- B. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer.

**2.17 STROBES (FCI Model STS, FLUSH MOUNT):**

- A. Provide strobe with flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and high intensity 110 candela minimum. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer. Furnish in Red/White (color by Architect).

**2.18 CEILING MOUNT STROBES (WHEELLOCK RSS24100C-FW, FLUSH MOUNT, WHITE):**

- A. Provide strobe UL listed for ceiling mounting, flush mounted in ceiling or concrete vaulted ceiling. Provide strobe with flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and 110 candela minimum.
- B. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer.
- C. Furnish in Red/White (color by Architect).

**2.19 PORTABLE PLUGABLE PHONE (FCI 3200): Not Required****2.20 AUXILIARY RELAY (FCI, ARB-C):**

- A. Remote auxiliary relay boards shall be rated at 10 AMPS @ 120 VAC. A red LED shall light to indicate relay activation. All relays shall transfer on general alarm and latch on until reset. All relays shall be supervised. The control output provided can be used in conjunction with fire alarm applications (i.e. fan controls, dampers, doors, and any other general alarm control).

**2.21 INITIATING MODULES:**

- A. Provide style "6" initiating modules capable of receiving and annunciating an alarm from any detector, even with a single fault condition on any initiating circuit.
- B. Power all smoke detectors from the "Style 6" initiating loop wiring. For systems that power smoke detectors separately from the "Style 6" loop, provide monitoring for both the power source and the independent initiating wiring, so that complete trouble and alarm indication is achieved by loop. Provide capability to operate all smoke detectors, even with a single fault condition on the smoke detector power wiring. Provide one spare initiating circuit.

**2.22 SIGNALING MODULES:**

- A. Provide signaling as required. Provide power adequate to sound all signaling devices concurrently. Provide supervised indicating circuits for polarized 24V D.C. alarm signaling devices. Provide 2 spare signaling circuits.
- B. Each signal circuit shall have a separate disconnect switch for servicing the fire alarm system. Each and every indicating circuit shall have a distinct location description. Power supply shall be at fire alarm control panel. Remote power supplies and indicating circuits will not be acceptable.

**2.23 SUPPLEMENTAL NOTIFICATION CIRCUITS (FCI SNAC-4):**

- A. Provide supplementary notification appliance circuit panel(s) as required. The 'SNAC' shall be capable of supplying up to four, Class A, Style Z notification appliance circuits. The panel shall contain its own battery charger, regulated power supply, and shall be supervised for ground fault, overcurrent, open circuits and low battery conditions. Ground fault, battery and circuit trouble conditions shall transmit a trouble signal to the main fire alarm control panel.

**2.24 DOOR HOLDER POWER SUPPLY (FCI #(PS5-BFS-24-UL):**

- A. Door holders shall be powered by a power supply separate from the fire alarm system power supply. The power supply shall have its own battery back-up capable of holding all doors for a minimum of one hour on the loss of 120vac supply power.

**2.25 SYSTEM CONFIGURATION PROGRAMMING:**

- A. To help the owner in programming, system changes, and servicing, the fire alarm system shall have the following functions.

1. The FACP shall be capable of an auto-configuration, that via a password, all analog devices and panel modules are automatically programmed into the system. At this point the system will operate as a general alarm system without any other programming.
2. If any two devices are addressed the same, the LED's on both devices will light steady and the panel will read "extra address and the address number".
3. If any device is installed and not programmed into the system the LED will light steady and the panel will read the same as above.

## **2.26 BATTERIES/POWER SUPPLIES:**

- A. Provide standby batteries capable of operating fire alarm system for minimum of 24 hours, then operating all indicating units for at least five minutes. Locate batteries in fire alarm control unit, or in similar type enclosure located as directed. Provide all interconnecting wiring. Place batteries that vent hydrogen gas in separate enclosure. Provide 30 percent spare capacity.

## **PART 3 - EXECUTION**

### **3.1 GENERAL REQUIREMENTS:**

- A. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "standard of installation".
- B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 Basic Materials and Methods section, "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings", and in accordance with other sections, as applicable.
- C. All wire used on the fire alarm system shall be U.L. Listed as fire alarm protective signaling circuit cable per NEC, Article 760.
- D. If twisted or shielded wire is required or recommended by the manufacturer it must be used.
- E. Review proper installation procedure for each type of device with equipment supplier before installation.
- F. Provide a minimum of one 3/4" conduit with (2) Cat 5e telephone cables from FACP to main telephone terminal.
- G. Where smoke or heat detectors are specified, install device a minimum of three feet from adjacent air supply diffusers to ensure proper operation of device.
- H. Refer to NFPA for spacing and exact placement of fire alarm devices.
- I. Electrical Identification: Refer to Section 260553 for requirements.

## **PART 4 - FINAL ACCEPTANCE AND GUARANTEE**

### **4.1 GUARANTEE:**

- A. Furnish a three-year guarantee for all equipment, materials and installation, including all labor, transportation, and equipment.
- B. Emergency Response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

### **4.2 PRE-TEST:**

- A. The contractor shall with a representative of the manufacturer conduct a test 3 days before the final test to verify operation of all devices. Any problems must be corrected before the final test.

**4.3 FINAL TEST:**

- A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:
  - 1. The contractor's job foreman, a representative of the manufacturer, a representative of the owner, shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel. Fan shutdown and door holder circuits shall operate.
  - 2. Conduct a full 24 hour test of battery operation. System shall be put on the batteries for a full 24 hours and all notification appliances shall be operational for a period of 5 minutes.
- B. The supervisory circuitry of the initiating and indicating circuits shall also be verified.
- C. Provide the following spare devices:
  - 1. 10 smoke detectors with base
  - 2. 10 thermal detectors with base
  - 3. 10 strobe/horns
  - 4. 5 manual pull stations with addressable modules
  - 5. 4 duct smoke detectors
- D. Provide 20 feet of conduit with wiring (completely installed and wired) for each spare device

**PART 5 - AS BUILT DRAWINGS AND OPERATION AND MAINTENANCE MANUALS:****5.1 LABELING:**

- A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.
- B. All initiating devices shall be programmed to include the device address and a complete user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17

**5.2 AS BUILT DRAWINGS:**

- A. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.
- B. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).
- C. Provide a CD to the Owner containing the information specified below. The CD shall include all information required to allow the Owner to change the fire alarm program themselves. The CD shall contain a minimum of the following:
  - 1. CAD drawing files of building fire alarm map.
  - 2. CAD drawing files of as-built fire alarm components and point to point connections.
  - 3. General configuration programming.
  - 4. Job specific configuration programming.



5. Tutorial file on complete programming of fire alarm system.

**5.3 OPERATING AND MAINTENANCE MANUALS:**

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

**5.4 TRAINING:**

- A. Provide four (4) hours training on the operation and installation of fire alarm system, at job site, at no cost to owner.
- B. Provide programming training and software sub-licensing in owner's name. Sub-licensing agreement shall include the U.L. requirement to allow the owner to do any programming that the supplier is allowed to do during commissioning, testing, service and field additions or deletions to the fire alarm system. The fire alarm supplier shall provide this training and licensing at no cost to the owner, including transportation, lodging, meals, and training manuals.

**END OF SECTION 28 3111**

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**SECTION 28 3112****FIRE SPRINKLER MONITORING SYSTEM****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

**1.2 DESCRIPTION OF WORK:**

- A. Extent of monitoring and annunciation systems work shall comply with NEC as applicable to construction and installation of system components and accessories. Provide components and systems that are UL-listed and labeled. Comply with State and local requirements as applicable.
- B. Comply with applicable provisions of current NFPA Standards for 72A Local Protective Signaling Systems, 72B Auxiliary Protective Signaling Systems, 72C Remote Station Protective Signaling Systems (as applicable), NFPA 71, UL Standards 2635 and 864, local building codes, and meet requirements of local authorities having jurisdiction.

**1.3 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on fire sprinkler monitoring systems including, but not limited to, roughing-in diagrams and instructions for installation, operation and maintenance, suitable for inclusion in maintenance manuals. Also include standard or typical riser and complete wiring diagrams for panel and system.
- B. **SHOP DRAWINGS:** Provide shop drawings showing equipment/device locations and connecting wiring of system. Include wiring diagrams and riser diagrams.
- C. **CERTIFICATION:** Submit a written statement to the Architect, and the state and local Fire Marshal's Office that each device of the system has been installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72. This statement shall be submitted at the time of completion of the system installation.

**PART 2 - PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. **MANUFACTURER:** Subject to compliance with requirements, provide a sprinkler monitoring system of one of the following:
  - 1. Auto Call Co.
  - 2. Edwards Co., Inc.
  - 3. Gamewell – FCI
  - 4. Honeywell, Inc.
  - 5. Simplex (Tyco Safety Products)
  - 6. Mirtone

**2.2 SPRINKLER MONITORING AND ANNUNCIATION SYSTEMS:**

- A. **GENERAL:** Provide an electrically operated, electrically supervised central station monitoring system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide

a complete operating system. Enclose entire system in raceway. Provide basic wiring materials that comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.

- B. **SYSTEM TYPE:** Provide a Fire Control Communicator Panel with a minimum of two reporting zones to a central monitoring station. Provide alarm initiating circuits for each flow and tamper switch, with a minimum of one spare initiating zone. Provide each initiating zone with LED's for trouble and alarm annunciation. Identify zone by specific location on the panel face. Provide the communicator with dual telephone lines for central station reporting by using BFSK or pulsed single round fast format. Include telephone trouble LED and audible trouble annunciator. Communicator must be capable of providing automatic test reports to control station every 24 hours. Include central station equipment and installation. Alarm initiating circuits must be Class A.
- C. **BATTERIES:** Provide sealed standby batteries, in suitable enclosure, capable of operating the unit for 24 hours in supervisory mode, and for 5 minutes at fully functional level.

### **2.3 WATER FLOW SWITCHES (Honeywell, Model PTRVSRB):**

- A. Provide water flow switches for the wet pipe sprinkler system with the following features:
  - 1. Corrosion resistant vane-type, pressure tested at 300 lbs/sq in. water pressure, operable flow of 10 gpm.
  - 2. Suitable for mounting in vertical or horizontal pipe runs, with adjustable time delay to avoid false alarms from water hammer, surges, or variation in water pressures.
  - 3. Electrically compatible with system requirements.

### **2.4 GATE VALVE SUPERVISORY SWITCHES (Honeywell, Model PTROSYB):**

- A. Constructed of corrosion resistant metal and finished in red enamel paint.
- B. Capable of activating trouble signal upon removal of cover.
- C. Electrically compatible with system requirements.
- D. Provide switches in configuration such that they will not interfere with normal operation of valve; operate in the horizontal or vertical position; and activate alarm between first and second revolution of the valve wheel.

### **2.5 AUDIOVISUAL ALARM HORNS (FCI, HMF/STS SEMI-FLUSH MOUNTED OR EQUAL):**

- A. Provide audio-visual alarm horns with the following features:
  - 1. Die cast or stamped steel construction, finished in red enamel, suitable for indoor or outdoor application.
  - 2. Capable of 90 db (UL rating) sound level at 10 feet.
  - 3. Flush mounted
  - 4. Integrally mounted flashing light unit, with Lexan lens with block letters "FIRE", and minimum flash rate of ONE per second, and 110 candela minimum.
  - 5. Electrically compatible with system requirements.
  - 6. Horns shall sound the temporal pattern (code 3) until silenced.
  - 7. Audiovisual alarm horns shall have the ability to silence horns while maintaining the strobe flash, until reset.
  - 8. Mechanical horn mechanism only, electronic horns are not acceptable.
  - 9. Maximum 24 horns per circuit, maximum 8 strobes per circuit.

10. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer.

## **2.6 SMOKE DETECTOR (FCI, 2W-B):**

- A. Provide smoke detector mounted above panel with the following features:
  1. Built-in remote maintenance signaling.
  2. Drift compensation and smoothing algorithms.
  3. Sensitivity measurement.
  4. Plug-in detector line with mounting base.
  5. Ability to mount to octagonal, single gang and 4 square backboxes.
  6. Removable detector cover and chamber to allow for cleaning.
  7. Built-in test switch.

## **2.7 MANUAL PULL STATIONS:**

- A. Provide manual pull stations with the following features:
  1. Dual action.
  2. Tumbler lock for test and reset keyed to fire alarm panel.
  3. Rugged metal construction.
  4. Positive indication of operation.
  5. Surface or semi-flush mounting.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF FIRE SPRINKLER MONITORING SYSTEMS:**

- A. Install system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation".
- B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division-26 Basic Materials and Methods sections, "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings", and in accordance with other sections, as applicable.
- C. Wire initiating circuits are four wire, Class A circuits with separate conduit runs for outgoing and return portions of the Class A loop, such that a single fault in the indicating loop does not prevent operation of the indicating devices.
- D. Install all wiring in raceway. Minimum raceway size, 3/4"; minimum conductor size, #14 AWG. Ensure that raceway size, and wire quantity, size, and type is suitable for equipment supplied. Review proper installation procedure for each type of device with equipment supplier before installation. Run 3/4" conduit from communicator to telephone terminal for installation of telephone lines.
- E. Electrical Identification: Refer to Section 260553 for requirements.

### **3.2 TESTING:**

- A. Provide factory trained representative to perform complete system testing upon completion of installation. Test each initiating and annunciating device for proper operation. Test operation of trouble annunciation on each circuit. Perform complete testing of all control panel functions. Conduct full 24 hour test of battery operation. After completion of testing instruct Owner's representative in proper operation and maintenance procedure.

**END OF SECTION 28 3112**

**SECTION 328400 - PLANTING IRRIGATION****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Piping.
2. Manual valves.
3. Automatic control valves.
4. Sprinklers.
5. Quick couplers.
6. Drip specialties.
7. Controllers.
8. Valve boxes.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs, light fixtures, and other site improvements. Maintain 100 percent head-to-head coverage over new and existing turf areas.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
  1. Irrigation Main Piping: 200 psig.
  2. Circuit Piping: 150 psig.

**1.3 PREINSTALLATION MEETINGS**

- A. Pre-installation Conference: Conduct conference at Project Site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Zoning Chart: Graphically show each irrigation zone and its control valve. Shall be included in Operation and Maintenance Data.
- B. Controller Timing Schedule: Indicate timing settings for each automatic controller zone. Shall be included in Operation and Maintenance Data.
- C. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. As-Built Drawings to scale, showing field locations and all adjustments to irrigation components and piping made during construction.
- C. Written guarantee/warranty.

## 1.7 QUALITY ASSURANCE

- 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.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping 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.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to any facilities occupied by the Owner, or others, unless permitted under the following conditions and then only after arranging to provide temporary water service according to the requirements indicated:
  - 1. Notify Architect and Owner no fewer than two days in advance of the proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without written permission from the Architect and Owner.

## 1.10 SCOPE

- A. It is the intention of these specifications, together with the accompanying drawings to accomplish the work of installing a complete and fully functioning irrigation system which will operate in an efficient and satisfactory manner according to current industry irrigation standards.



- B. The work consists of furnishing and installing a complete underground irrigation system as shown on the drawings and described in these specifications. Include all labor, equipment and materials, and perform all operations in connection with the installation of the irrigation system.
- C. It will be the Contractor's responsibility to report to the Owner's representative and the Landscape Architect on Contractor company letterhead, any contradictions between the drawings, specifications, and site prior to submitting the bid in sufficient time to allow the issuance of an addendum to the bid documents. Failure to do so will require the Contractor, at no additional cost to the Owner, to include any replacements and/or relocations necessary to complete a fully functional installation in full compliance with the contract documents, when such conditions were identifiable prior to the bid.
- D. Irrigation layout shown on the drawings is generally diagrammatic. The locations of all valves, piping, wiring, etc. will be changed only with the approval by the Landscape Architect.
- E. Do not combine differing plant materials or environments on the same zone. Each zone is to serve plants with similar water requirements.

#### 1.11 WARRANTY

- A. Installer agrees to repair or replace irrigation components that fail in materials or workmanship for a period of One Year from the date of Substantial Completion.
  - 1. Failures include, but are not limited to, the following:
    - a. Leaks.
    - b. Faulty or malfunctioning equipment.
    - c. Settling of grades around boxes or other components.
- B. Installer shall immediately correct any failures or deficiencies when notified during the warranty period, and also correct to the satisfaction of the owner any damage to buildings or grounds caused by the deficiencies, at no additional cost to the owner.

### PART 2 - PRODUCTS

#### 2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.
  - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless-steel pipe with threaded ends.
  - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
  - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
  - 4. Cast-Iron Flanges: ASME B16.1, Class 125.

- C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
- D. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound.
  - 1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners, as required.
- E. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
  - 1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
  - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
  - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- F. Encasement for Piping: Schedule 40 Schedule 80 PVC Socket Fittings and solvent-cemented joints.
- G. Electrical Conduit: Gray PVC SCH40 Conduit, non-metallic above ground and underground UL Listed 3KA0, UA9AEB.

## 2.2 TRANSITION FITTINGS

- A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. Transition Couplings:
  - 1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
- C. Plastic-to-Metal Transition Fittings:
  - 1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
  - 1. Description: MSS SP-107, PVC four-part union. Include one brass threaded end, one solvent- cement-joint or threaded plastic end, rubber O-ring, and union nut.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; 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. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.4 MANUAL VALVES

### A. Curb Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - Mueller Co. (basis of design).
  - Ford Meter Box Company, Inc.
  - Jones.
  - Equal, as approved.
- 2. Description:
  - Body Material: Brass with ball or ground-key plug.
  - End Connections: FIPT.
  - Stem: With wide-tee head.

### B. Curb-Valve Casing:

- 1. Casing: 3 inch Schedule 40 PVC of length required for depth of burial of curb valve.
- 2. Casing Plug: Yellow with lettering "WATER."

### C. Shutoff Rods for Curb-Valve Casings: Furnish one steel, tee-handle shutoff rod with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

### D. Brass Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - NIBCO, Inc. (basis of design).
    - Legend Valve & Fitting, Inc.
    - Watts.
    - Equal, as approved.

### E. Plastic Manual Flush Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - Netafim (basis of design).
  - Hunter Industries Incorporated.
  - Equal, as approved.

## 2.5 BACKFLOW PREVENTION DEVICE

- A. Reduced pressure assembly valve with accessory construction, modular design, and replaceable seats meeting ASSE No. 103; AWWA C506-78; CSA b65.4; and, FCCCCHR of USC.
- B. Backflow prevention device shall be serviceable "in-line" and shall have ball valve test cocks and valves on both sides for testing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Febco (basis of design).
    - b. Watts.
    - c. Apollo Valves.
    - d. Equal, as approved.

## 2.6 BACKFLOW ENCLOSURE

- A. Description: Vandal-resistant, easy access aluminum backflow enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. V.I.T. Strong Box (basis of design).
  - 2. Equal, as approved.
- C. Characteristics:
  - 1. Marine grade aluminum alloy construction.
  - 2. 100% stainless steel hardware.
  - 3. Flush-mounted locking mechanism.
  - 4. Solid sheet construction.

## 2.7 BACKFLOW INSULATION

- A. Locking insulated cover.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. V.I.T. Strong Box (basis of design).
  - 2. Equal, as approved.

## 2.8 MASTER VALVE

- A. Normally open solenoid valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Griswold Controls (basis of design).
  - b. Buckner Superior.
  - c. Netafim.
  - d. Equal, as approved.
2. Description:
  - a. Operating Pressure: 2 to 200 psi.
  - b. Material: Cast iron or bronze.
  - c. End Threads: NPT
  - d. Voltage Operating Range: 22-28 VAC

## 2.9 AUTOMATIC CONTROL VALVES

### A. Plastic, Automatic Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Rain Bird Corporation (basis of design).
  - b. Hunter Industries Incorporated.
  - c. Irritrol Systems.
  - d. Equal, as approved.
2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid. Drip kit to include in-line filter and pressure regulator.

## 2.10 QUICK COUPLERS

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

1. Hunter Industries Incorporated (basis of design).
2. Rain Bird Corporation.
3. Equal, as approved.

### B. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).

## 2.11 DRIP SPECIALTIES

- A. Description: Surface layout, in-line drip irrigation for trees, and point source drip irrigation components for shrubs, grasses, and flowering perennials within planter areas. Drip specialties shall include the following:
1. In-line 17mm drip tubing, flow rate of .26 gph.
  2. Blank 17mm drip tubing.
  3. Plastic 17mm fittings.
  4. Self-piercing barbed emitters with pressure compensation, flow rates of 1 gph and 5 gph, and an operating pressure range of 10 psi to 50 psi.
  5. 0.25" flexible, polymer blend distribution tubing.
  6. Plastic distribution tubing stake.
  7. Plastic diffuser bug cap.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Netafim (basis of design).
  2. Rain Bird Corporation (basis of design).
  3. Equal, as approved.

## 2.12 CONTROLLERS

- A. Existing controller.
- B. Description:
1. Interior Controller Enclosures: Existing.
    - a. Mounting: Surface type for wall.

## 2.13 FLOW SENSORS

- A. Description: PVC flow sensor with socket end connections, digital output signal proportional to flow, ultra-lightweight impeller, and solid state sensing electronics.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Creative Sensor Technology (CST) (basis of design).
  2. Equal, as approved.

## 2.14 VALVE BOXES FOR MANUAL VALVES

- A. Plastic Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carson (basis of design).

- b. Rain Bird Corporation.
      - a. Equal, as approved.
    - 2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
      - a. Size: As required for valves and service.
      - b. Shape: Round.
      - c. Sidewall Material: PE, ABS, or FRP.
      - d. Sidewall Color: Tan for boxes in planter areas, black for boxes in lawn areas.
      - e. Cover Material: PE, ABS, or FRP.
        - 1) Lettering: "IRRIGATION".
      - f. Cover Color: Tan for boxes in planter areas.
  - B. Drainage Backfill: Cleaned gravel or crushed stone, graded to 3/4 inch maximum.
- 2.15 VALVE BOXES FOR AUTOMATIC CONTROL VALVES
- A. Plastic Boxes:
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Carson (basis of design).
      - b. Rain Bird Corporation.
      - c. Equal, as approved.
    - 2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
      - a. Size: As required for valves and service.
      - b. Shape: Rectangular.
      - c. Sidewall Material: PE, ABS, or FRP.
      - d. Sidewall Color: Tan for boxes in planter areas, black for boxes in lawn areas.
      - e. Cover Material: PE, ABS, or FRP.
        - 1) Lettering: "IRRIGATION".
      - f. Cover Color: Tan for boxes in planter areas.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

- B. Trenches shall be a minimum of 12 inches away from buildings, curbs, and sidewalks, and a minimum of 36 inches away from vehicle access pathways.
- A. Where multiple pipes are to be installed in the same trench, each pipe shall be separated by a minimum distance of 4 inches.
- B. Provide minimum cover over top of underground piping according to the following:
  - 1. Irrigation Main Piping: Not less than 18 inches below finished landscapes area grades, and not less than 36 inches below finished hardscape elevations.
  - 2. Circuit Piping: Not less than 12 inches below finished landscaped area grades, and not less than 24 inches below finished hardscape elevations.
  - 3. Sleeves: Not less than 36 inches below finished hardscape elevations.

### 3.2 PREPARATION

- A. Set stakes to identify locations of new irrigation system. Obtain Landscape Architect's approval before excavation and installation.
- B. Coordinate and install sleeves and conduits under paved surfaces prior to installation of paved surfaces.
  - 1. Sleeves for irrigation lines shall be a minimum of 4 inches in diameter or twice the size of the piping contained in the sleeve, whichever is greater. Identify the location of each sleeve by installing a magnetized masonry nail, flush with the hardscape indicating both ends of each sleeve.
  - 2. Provide conduit as follows:
    - a. (1) one 3/4-inch conduit for up to 5 wires.
    - b. (1) one 1 inch conduit for up to 8 wires.
    - c. (1) one 1-1/4 inch conduit for up to 15 wires.
    - d. (1) one 1-1/2 inch conduit for up to 20 wires.
    - e. (1) one 2 inch conduit for up to 30 wires.
    - f. (1) one 2-1/2 inch conduit for up to 35 wires.
    - g. (1) one 3 inch conduit for up to 40 wires.

### 3.3 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Underground irrigation main line piping shall be the following:
  - 1. Schedule 40 PVC pipe with Schedule 40 PVC socket fittings, and solvent-cemented joints.
- C. Underground irrigation circuit piping shall be the following:
  - 1. Schedule 40 PVC pipe with Schedule 40 PVC socket fittings, and solvent-cemented joints.



- D. Risers to Aboveground Drip Specialties: Schedule 40 PVC pipe with Schedule 40 PVC socket fittings, and solvent-cemented joints.
- E. Manual drain valve piping shall be the following:
  - 1. Schedule 40 PVC pipe with Schedule 40 PVC socket fittings, Schedule 40 Slip x MIPT toe nipples, and solvent-cemented joints on the upstream side of the drain valve.
  - 2. Schedule 40 PVC pipe with Schedule 40 PVC socket fittings, Schedule 40 Slip x MIPT toe nipples, and solvent-cemented joints on the downstream side of the drain valve.

### 3.4 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate general location and arrangement of piping systems. Install piping as indicated unless deviations are coordinated with the Owner and Landscape Architect.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install Schedule 80 Slip toe nipples on both sides of automatic control valves, as indicated on Drawings.
- G. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- H. Install ductile-iron piping according to AWWA C600.
- I. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

### 3.5 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.

- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- G. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.6 BACKFLOW PREVENTION DEVICE INSTALLATION

- A. Install the backflow prevention device at the location indicated on Drawings, according to manufacturer's written instructions and details.
  - 1. Coordinate the location and installation with water service line and additional point-of-connection components.
  - 2. Installation shall comply with all State and Local codes.
  - 3. Install aluminum backflow enclosure according to manufacturer's written instructions and details.
  - 4. Protect backflow prevention device from freezing by installing an insulated cover.

### 3.7 VALVE INSTALLATION

- A. Underground Manual Valves: Install as components of connected pressure piping system, inside of a round valve box. Provide PVC casings from top of valve to finish grade elevations and install casing cap.
- B. Underground Master Valve: Install as a component at the point of connection, inside of a rectangular valve box. Connect master valve to automatic controller with Paige shielded wire, inside of a dedicated conduit.
- C. Underground Automatic Control Valves: Install as components of pressure piping system, inside of a rectangular valve box.
- D. Underground Quick Coupler Valves: Install quick coupler valves as a component at the point of connection, and at each control valve manifold, inside of a round valve box. Secure quick coupler valves in place with rebar stakes, as indicated on Drawings.

### 3.8 FLOW SENSOR INSTALLATION

- A. Install flow sensor as a component at the point of connection, according to manufacturer's instructions, inside of a rectangular valve box.

### 3.9 IDENTIFICATION

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

### 3.10 VALVE BOX INSTALLATION

- A. Install valve boxes at the nearest landscaped area approximately where shown on the Drawings, but no closer than 36 inches to buildings, sidewalks, curbs, and all other paved surface areas unless otherwise specified. Where 36 inches clearance from structures and/or paved surfaces is not possible, install the valve box as far away as practical.
  - 1. Top of valve boxes shall be flush with finish grade. Set valve boxes on a base of 3/4-inch gravel and ensure valve boxes are level and plumb.
  - 2. Provide a 2-inch clearance between irrigation equipment within the valve box and the gravel sump below, and a 2-inch clearance between the top of the irrigation equipment within the valve box and the valve box lid.
  - 3. Place filter fabric between existing subgrade and backfill with cleaned gravel or crushed stone, graded from #8 to 3/4-inch, to 6 inches below base of valve box. Cover gravel or crushed stone with filter fabric and backfill the remainder with excavated material.
  - 4. Do not install valve boxes at the low point of the irrigation system or at lowest elevations of the site.

### 3.11 DRIP SPECIALTY INSTALLATION

- A. Install low flow drip irrigation valves in valve boxes, as indicated on Drawings.
- B. Install drip tubing tree rings as indicated on Drawings. Connect tree rings to PVC lateral risers with 17mm male barbed adapters and slip x FIPT threaded PVC fittings. Seal adapter threads with Teflon tape.
- C. Connect drip tubing to PVC lateral risers with 17mm male barbed adapters and slip x FIPT threaded PVC fittings. Seal adapter threads with Teflon tape.
- D. Install drip tubing directly on top of finished grade surface. Secure drip tubing in place with rounded metal tube stakes, spaced a maximum of 36 inches apart. Following installation, completely cover drip tubing with shredded bark mulch.
- E. Install drip tubing a maximum of 24 inches away from shrubs, ornamental grasses, and flowering perennials.
- F. Insert point source drip emitters directly into drip line tubing, and run 1/4-inch distribution tubing on top of finish grade and weed barrier fabric, but under shredded bark mulch, to within

2 inches of the base of each plant. Secure each length of distribution tubing in place with a plastic tubing stake and cap with a diffuser bug cap.

- G. Install a manual flush valve at the end of each drip tubing line, within a round valve box.

### 3.12 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Verify the location of existing automatic controller and capability to accommodate new irrigation system components and valves.
- B. Install control wiring in same trench as irrigation main line piping next to piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install wiring in separate sleeves under paved areas.

### 3.13 ADJUSTING

- A. Adjust settings of controller to utilize full functionality of all programming features.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each irrigation circuit.
- C. Adjust drip tubing so that it is securely fastened to finish grade and completely concealed by shredded bark mulch.

### 3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Walk Through for Substantial Completion: Following complete installation of the entire irrigation system, the contractor shall request a walk through for substantial completion with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. To prepare for this walk-through, the Contractor shall have all lids removed from valve boxes, and the system pressurized and ready for operation. The Contractor shall provide final as-built drawings to the Landscape Architect for review prior to beginning the walk through. The Walk Through for Substantial Completion shall consist of two parts;

1. Physical Walk Through: During this walk-through a comparison of each valve box and corresponding irrigation components will be made with the irrigation Drawings and details to note conformance to Drawings or lack thereof.
1. Operation Walk Through: Once the physical walk-through is completed, the entire irrigation system will be tested for operational conformance with the Drawings by having the Contractor turn on each valve station using the automatic controller in sequence as requested by the Landscape Architect, noting sequential and operation conformance to the Drawings. Valve station sequence testing will include existing valves that are connected to the existing controller, as well as new valves installed and connected to the existing controller.

The Landscape Architect will prepare and provide a written punch list of any irrigation system components needing adjustment, replacement, and/or repair, and it will be the contractor's responsibility to completely remedy the punch list prior to requesting a final walk through or beginning the maintenance period.

- B. Final Completion Walk-Through: Following completion of all items on the punch list provided by the Landscape Architect at the walk through for substantial completion, the contractor shall request a final walk through with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. Once accepted, the Landscape Architect and the contractor will review only those items listed on the punch list provided at the walk through for substantial completion. In the event that the substantial completion punch list has not been fully completed, the final walk through will be canceled and the contractor shall be responsible for remedying all outstanding items on the punch list prior to making a second request for a final walk through. During the final walk through, only the items on the punch list for substantial completion will be reviewed, noting conformance or lack thereof.

**END OF SECTION 328400**

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**SECTION 329115 – SOIL PREPARATION (PERFORMANCE SPECIFICATION)****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes planting soils specified according to performance requirements of the mixes.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 329300 "Plants" for placing planting soil for plantings.
  - 3. Section 015639 "Temporary Tree and Plant Protection" for protection of existing trees to remain.

**1.2 DEFINITIONS**

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- A. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- B. SSSA: Soil Science Society of America.
- C. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- D. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- E. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- F. USCC: U.S. Composting Council.

## 1.2 PREINSTALLATION MEETINGS

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

## 1.3 ACTION SUBMITTALS

- A. Test Results: On laboratory letterhead, submit soil analysis test results for each source of on-site soil or imported planting soil. Submit results for each source prior to adding amendments and include laboratory recommendations for bringing soils into compliance with the requirements of this section. Also submit results for each source after adding amendments to confirm compliance with requirements of this section.
- B. Product Data: For each type of product.
- C. Soil Source: For imported soils, submit a report stating the location of the source and an account of recent use.
- D. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.

## 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in the types of tests to be performed.



## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. The full topsoil volume required to meet the project need shall be provided as part of the contract, regardless of whether on-site or imported soils are used.

## 2.2 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

- A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained and stockpiled on-site; or imported, naturally formed soil from off-site sources; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend soils to become planting soil complying with the following requirements:

1. Chemical Characteristics:
  - a. pH 5.5 to 8.0.
  - b. Soluble Salts: less than 3.0 dS/m.
  - c. Sodium Absorption Ratio (SAR): less than 6.0.
  - d. Organic Matter: not less than 5 percent.
2. Physical Characteristics: Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
  - a. Sand: 15 to 60 percent.
  - b. Silt: 10 to 60 percent.
  - c. Clay: 5 to 30 percent.
3. Fragment Size Distribution: Soil shall not contain more than 2 percent by dry weight of rocks measuring over 3/32 inch in largest size.
4. Materials to be Removed:
  - a. Unacceptable Materials: Concrete, slurry, concrete layers or chunks, cement, plaster building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
  - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the soil.
  - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inches in any dimension.
5. Soil Amendments: Incorporate soil amendments listed below as recommended in the results of the soils analysis report.

## 2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- A. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- B. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

## 2.4 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
  - 1. Feedstock: Limited to leaves.
  - 2. Reaction: pH of 5.5 to 8.
  - 3. Soluble-Salt Concentration: Less than 4 dS/m.
  - 4. Moisture Content: 35 to 55 percent by weight.
  - 5. Organic-Matter Content: 30 to 40 percent of dry weight.
  - 6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

## 2.5 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

## PART 3 - EXECUTION

## 3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Planting soil shall be placed at a depth of 6 inches in areas to receive turfgrass sod and a depth of 12 inches in all shrub, perennial, and groundcover planting beds.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

## 3.2 PREPARATION OF ON-SITE OR IMPORTED SOILS

- A. General: Do not blend amendments if on-site or imported soils are frozen, muddy, or excessively wet.
- B. Cleaning: Remove all unacceptable, unsuitable, and large materials defined in "Part 2-Products".
- C. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- D. Amending: Add amendments to on-site or imported soils as recommended in soil analysis results. Thoroughly blend amendments throughout to produce the required planting soil.
  - 1. If required, mix lime and sulfur with dry soil before mixing fertilizer.
  - 2. As required, mix fertilizer with planting soil no more than seven days before planting.

## 3.3 PLACING AMENDED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Do not till exposed subgrade or apply planting soil if subgrade or soils area frozen, muddy, or excessively wet.
- B. Excavation: If rough grade elevations do not allow for required planting soil depth, excavate additional subgrade soils from designated planter areas and lawn areas to meet the depth required for each area, and legally dispose of excavated soil off Owner's Property at no additional cost to the owner. Do not reduce the planting soil depth required for planter areas and lawn areas to meet adjacent finish elevations.

- C. Subgrade Preparation: Till excavated subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- A. Placing Planting Soil: Spread amended soil to the total depth required for the planting area, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
- B. Lifts: Apply amended planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

#### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:
  - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.
  - 2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements.
- C. Soil will be considered defective if it does not pass tests.
- D. Label each sample and test report with the date, location keyed to a site plan or other location system, and sampling depth.

#### 3.5 PROTECTION AND CLEANING

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Vehicle traffic.
  - 4. Foot traffic.
  - 5. Erection of sheds or structures.
  - 6. Impoundment of water.
  - 7. Excavation or other digging unless otherwise indicated.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the

subgrade as directed by the Landscape Architect and replace contaminated planting soil with new planting soil.

**END OF SECTION 329115**

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**SECTION 329200 - TURF AND GRASSES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Sodding.

**1.2 DEFINITIONS**

- A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

**1.3 PREINSTALLATION MEETINGS**

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Certification of grass seed.
  1. Certification of each seed mixture for turfgrass sod.
- B. Product certificates.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
  1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  2. Pesticide Applicator: State licensed, commercial.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation"

sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

## PART 2 - PRODUCTS

### 2.1 TURFGRASS SOD

- A. Turfgrass Sod: Approved, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows:
  - 1. Full Sun: <**Poa pretensis 'Kentucky Bluegrass'**>.

### 2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

### 2.3 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to [**Section 329115 "Soil Preparation (Performance Specification)."**]
- B. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.



- D. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.2 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.3 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

### 3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
  - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
  - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

### 3.5 FIELD QUALITY CONTROL

- A. Required Inspections:

1. Walk Through for Substantial Completion: Following complete installation of the entire planting and irrigation system, the contractor shall request a walk through for substantial completion with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. The walk through for substantial completion shall consist of a physical walk through, during which the contractor and the Landscape Architect will walk through each lawn area. The Landscape Architect will prepare and provide a written punch list of lawn areas needing adjustment, replacement and/or repair, and it will be the contractor's responsibility to completely remedy the punch list prior to requesting a final walk through or beginning the maintenance period. If the lawn areas are deemed to be substantially complete at the end of this walk through, the contractor will begin the one-year maintenance period.
- 2.
3. Final Walk Through: Following completion of all items on the punch list provided by the Landscape Architect at the walk through for substantial completion, the contractor shall request a final walk through with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. Once accepted, the Landscape Architect and the contractor will review only those items listed on the punch list provided at the walk through for substantial completion. In the event that the substantial completion punch list has not been fully completed, the final walk through will be canceled and the contractor shall be responsible for remedying all outstanding items on the punch list prior to making a second request for a final walk through. During the final walk through, only the items on the punch list for substantial completion will be reviewed, noting conformance or lack thereof.

**END OF SECTION 329200**

**SECTION 329300 - PLANTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plants.
2. Landscape materials.
3. Tree staking.
4. Landscape edgings.

**B. Related Requirements:**

1. Section 329115 Soil Preparation (Performance Specification).

**1.2 DEFINITIONS**

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for planting soils.
- D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

**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. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale

rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 5 lbs. of organic mulch specified, in five gallon container labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
2. Mineral Mulch: 10 lbs. of each mineral mulch specified, in five gallon containers labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
3. Weed Barrier: 12 inches by 12 inches.

1.1 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Sample warranty.

1.2 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape contractor whose work has resulted in successful establishment of plants.
  1. Field Supervision: Require landscape contractor to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Pesticide Applicator: State licensed, commercial.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or on site before planting for compliance with requirements for genus, species, variety,

cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

## 1.1 DELIVERY, STORAGE, AND HANDLING

### A. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

### B. Upon delivery and throughout the construction installation period, plants shall be sound, healthy, vigorous, and free from pests and diseases. Plants shall be in full leaf, well branched, and have a healthy root system. All plants shall be nursery grown and conform to the species and size specified in the planting legend.

### C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

### D. Handle planting stock by root ball or container.

### E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

### F. Trees and shrubs must be covered with a protective tarp to protect from wind and other damage during transportation.

### G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate solar aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled and burlapped stock on ground and "heel-in" root balls with soil, peat moss, sawdust, or other acceptable material. Do not allow balled stock to fall or blow over.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

## 1.2 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, dimensions of plantings, and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

## 1.1 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
    - b. Structural failures including plantings falling or blowing over.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

## PART 2 - PRODUCTS

## 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4" in diameter; or with stem girdling roots are unacceptable.
  - 2. Collected Stock: Plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery shall not be acceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to the Landscape Architect, with a proportionate increase in size of roots or balls.

- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- A. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

## 2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
  - 1. Size: 21-gram tablets.
  - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

## 2.3 MULCHES

- A. Organic Mulch: Natural shredded hardwood bark mulch.
  - 1. Color: Dyed chocolate brown.
- B. Mineral Mulch: Rounded riverbed gravel or smooth-faced stone.
  - 1. Size Range: 3 inches maximum, 2 inches minimum.
  - 2. Color: A mixture of cream, tan, and brown with shades of rust and dark gray.
  - 3. Depth: 3 inches minimum.

## 2.4 ROOT BARRIER FABRIC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Typar Geotextiles (basis of design).
  - 2. Equal, as approved.
- B. Refer to manufacturer's recommendations for installation.

## 2.5 TREE STAKES

- A. Tree Stakes: Virgin flexible vinyl to conform to tensile and elongation requirements of ASTM- D-412. Tree stakes shall have a double back locking configuration and be secured with galvanized nails. Two 2-inch diameter wood stakes at eight-feet in length, shall be installed per tree. Install tree staking kits according to manufacturer's recommendations and as indicated on Drawings.

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

1. V.I.T. Products: Cinch-Tie 32" (basis of design).
2. Equal, as approved.

## 2.6 LANDSCAPE EDGINGS

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

1. Permaloc Corporation (basis of design).
2. Equal, as approved.

- B. Description: Heavy duty L-shaped maintenance strip edging; high extruded aluminum, 6063 alloy, T-6 hardness, maintenance strip edging for straight-line and gentle curve applications in corrugated L-shaped profile having 1.2 inch horizontal base.

1. Size: 3/16-inch by 4 inches.
2. Length: 8-feet and 16-feet sections.
3. Connection method: Section ends shall splice together with a horizontal 0.060-inch thick by 1 inch wide by 4 inches long aluminum sliding connector.
4. Stake: 12 inch Permaloc Standard Stake; 0.10 inch thick, with optional extruded aluminum, heavy duty 0.125 inch thick by 16 inches, 18 inches, or 24 inches long stakes. Stakes to interlock into section loops.

## 2.7 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.



4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

- A. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Landscape Architect and replace with new planting soil.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and turf areas and existing plants from damage caused by planting operations.
- B. Prior to planting, locate all underground utilities. Do not place trees or plants on or near utility lines. Notify Landscape Architect of any conflicts between tree or plant locations and utility lines.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
- B. Placing Planting Soil: Place planting soil over exposed subgrade.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 2. Excavate approximately three times as wide as ball diameter.
  - 3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- A. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil when blended with planting soil, unless a high content of clay is encountered in the subsoil or topsoil. Remove rocks and all other undesirable materials from excavated soil before blending with planting soil and backfilling.

## 3.5 TREE AND SHRUB PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
  - 1. Backfill: Planting soil. For trees, use excavated soil for backfill as indicated in this section.
  - 2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
  - 4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: As recommended by manufacturer for each plant type and size.
  - 6. Continue backfilling process. Water again after placing and tamping final layer of soil.

## 3.6 TREE AND SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, grasses, and flowering perennials as directed by Landscape Architect.
- C. Prune, thin, and shape trees, shrubs, grasses, and flowering perennials according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

## 3.7 SHRUBS AND PLANTS PLANTING

- A. Set out and space ground cover and plants other than trees and shrubs as indicated on Drawings.
- A. Use planting soil for backfill.
- B. Dig holes large enough to allow spreading of roots.
- C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

## 3.8 PLANTING AREA MULCHING

- A. Following installation of trees and plants, rake planter areas smooth and to a finish grade level. Remove rocks and all other undesirable materials from planter areas.
- B. Install weed-control barriers according to manufacturer's written instructions prior to installation of mineral mulch. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.
- C. Mulch backfilled surfaces of planting areas and other areas indicated.
  - 1. Trees in Turf Areas: Apply mineral mulch ring of 3-inch average thickness, with 60-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
  - 2. Mineral Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

## 3.9 LANDSCAPE EDGING INSTALLATION

- A. Preparation: Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line of edging with string or other means to ensure border straightness as designed.
- B. Set edging into trench with the horizontal base resting on compacted subbase and top of edging at 3 inches above compacted finish grade on planter area side. Loops for stakes are to be placed on the landscape drip edge side. Drive stakes through edging loops until locked in place. Requires eight stakes evenly spaced for each 16 feet section, or 3 stakes evenly spaced for each 8 feet section. Provide longer stakes, heavier grade stakes, or any combination of previously mentioned as necessary to firmly secure edging for permanent intended use.
- C. Where edging sections turn at corners and at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.

- D. Backfilling and Cleanup: backfill both sides of edging, confirm and adjust if necessary, that sections are securely held together and straight, and compact backfill material along edging to provide top of edging at 1/2-inch above turf finish grade. Clean up and remove excess material from site.

### 3.10 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- F. Monitor watering schedules so that plants become well established and adapted to the local conditions. Do not over- or under-water plant materials. The Contractor shall be responsible for coordinating and monitoring watering operations with the Owner. Any plant materials lost due to improper application of water during the warranty period shall be replaced at no additional cost to the Owner.

### 3.11 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  - 1. Maintenance Period for Trees and Shrubs: 12 months from date of Substantial Completion.
  - 2. Maintenance Period for Ground Cover and Other Plants: 12 months from date of Substantial Completion.

## 1.12 FIELD QUALITY CONTROL

## A. Required Inspections:

1. Walk Through for Substantial Completion: Following complete installation of the entire planting and irrigation system, the contractor shall request a walk through for substantial completion with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. The walk through for substantial completion shall consist of a physical walk through, during which the contractor and the Landscape Architect will walk through each planter area. The Landscape Architect will prepare and provide a written punch list of plant materials and mulches needing adjustment, replacement and/or repair, and it will be the contractor's responsibility to completely remedy the punch list prior to requesting a final walk through or beginning the maintenance period. If the planter areas are deemed to be substantially complete at the end of this walk through, the contractor will begin the one-year maintenance period.
2. Final Walk Through: Following completion of all items on the punch list provided by the Landscape Architect at the walk through for substantial completion, the contractor shall request a final walk through with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. Once accepted, the Landscape Architect and the contractor will review only those items listed on the punch list provided at the walk through for substantial completion. In the event that the substantial completion punch list has not been fully completed, the final walk through will be canceled and the contractor shall be responsible for remedying all outstanding items on the punch list prior to making a second request for a final walk through. During the final walk through, only the items on the punch list for substantial completion will be reviewed, noting conformance or lack thereof.
3. Post Maintenance Walk Through: Following a successful final walk through, the contractor will be responsible for maintaining the plant material and the irrigation system for a period of 365 days. The contractor is responsible for including a fee for the 365-day maintenance period in their initial bid for services. In the event that the contractor fails to include such fee in their initial bid, the contractor will still be responsible for the 365-day maintenance period as stated herein at no additional cost to the Owner. Once the 365-day maintenance period has elapsed, the contractor shall request a post maintenance walk through with the Landscape Architect, at least seven (7) days prior to the anticipated walk through date. The post maintenance walk through will consist of a physical walk through to compare the pre-maintenance condition of each planting area to its present condition. Should any non-conformance with the pre-maintenance condition occur, the Landscape Architect will provide a punch list to the contractor for remedy, repair and/or replacement of plant materials and mulches. Such remedy, replacement and/or repair shall be successfully completed by the contractor at no additional cost to the Owner prior to being relieved of the maintenance period and/or final payment made to the contractor by the Owner. Once the contractor has successfully remedied any outstanding items noted during the post maintenance walk through, the Landscape Architect will contact the Owner and recommend that the contractor be released of responsibility and final payment to the contractor be made.

**END OF SECTION 329300**

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## National Ability Center

## Civil Standards and Specifications

**6" PVC SDR 35 Sewer Lateral Extension**

- **Description** - This item includes all materials; equipment; and labor necessary to install 6" PVC SDR-35 pipe. Connection to existing sewer is included in this item. Included in this item is the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning; inspections per SBWRD; backfill; compaction; and all other work required to complete the installation of the sewer lateral.
- **Material and Construction Requirements** - All work shall comply with SBWRD Standards and Specifications. Comply with Section 402.4; 407; 408; 410.1; 410.2; 504-507; and Detail LAT-04. Acceptance testing shall be per section 515; and the following; a) Low pressure air test will not be required. b) An initial TV inspection will be required on an ongoing basis after each segment (manhole to manhole) is completed. Provide inspection video to SBWRD. c) A final cleaning and TV inspection of the entire installation will be required after completion of the sewer system; including any final manhole or cleanout adjustment. Provide inspection video to SBWRD. Tracing wire and continuity test is included in this item. Comply with sections 702-A PCMC Standards (April 2007) for trench bedding and backfill. Material submittal and approval is required prior to installation. Always protect trench excavation from public access.

**4" PVC SDR 35 Lateral**

- **Description** - This item includes all materials; equipment; and labor necessary to install 4" PVC SDR-35 pipe. Connection of the new 4" service lateral to the new 6" sewer lateral extension is included in this item. Included in this item is the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning; inspections per SBWRD; backfill; compaction; and all other work required to complete the installation of the sewer lateral.
- **Materials and Construction Requirements** - All work shall comply with SBWRD Standards and Specifications. Comply with Section 402.4; 408; 410.1; 504-507; 513 and SBWRD detail LAT-01 and LAT-05 for lateral installation with the following modifications; a) Delete 2x4 marker. Install lateral 2% slope from sewer main. Install fittings; couplings; bends; and PVC SDR-35 lateral as necessary to match the existing building sewer and connect to PVC lateral. Coordinate installation with plumbing sub-contractor. Acceptance testing shall be per Section 516. Comply

with sections 702-A PCMC Standards (April 2007) for trench bedding and backfill. Material and lateral connection to mainline equipment and procedure submittal and approval is required prior to installation.

#### **Sewer Lateral Cleanout**

- **Description** - This item includes all materials; equipment; and labor necessary to install a sewer cleanout as in the locations shown on the plans. This item includes adjusting the vertical pipe to grade and installing a cap and ring and cover (box and lid) to grade. Included in this item is the cost of incidental work such as potholing and discovery of existing utilities shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning; inspections per SBWRD; backfill; compaction; and all other work required to complete the installation of the sewer lateral.
- **Materials and Construction Requirements** - All work shall comply with SBWRD Standards and Specifications. Comply with Section 410.6; 410.7; 513.6 and SBWRD detail LAT-07 with ring and cover for cleanout installation. Adjustments to final grade is included in this item. Material submittal and approval is required prior to installation.

#### **8" DIP CL350 Water Main**

- **Description** - This item includes all materials; equipment; and labor necessary to install an 8" Ductile Iron Pipe CL 350 water main and fittings. Connection to existing water main line is included in this item. Included in this item is the cost of corrosion protection. This item includes the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning and disinfecting; hydrostatic testing, backfill; compaction; and all other work required to complete the installation of the water main line. Inspections per PCMC Water Department.
- **Material and Construction Requirements** - All work shall comply with PCMC Water Standards and Specifications, (May 2014). Comply to Sections 540-A, 547-A, (534.1 – 538-D, Corrosion Protection as it applies), 561, 580, Disinfecting, Water System Flushing and Final Flushing, Hydrostatic Testing. Comply with sections 703-A, 703-B PCMC Standards (April 2007) for trench bedding and backfill. Material submittal and approval is required. Always protect trench excavation from public access.

#### **Fire Hydrants**

- **Description** - This item includes all materials; equipment; and labor necessary to install a fire hydrant with gate valve, valve box and main line tee. Included in this item is the cost of corrosion protection. This item includes the cost of incidental work such as potholing and



discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning, disinfecting, hydrostatic testing. backfill; compaction; and all other work required to complete the installation of the fire hydrant.

Inspections per PCMC Water Department.

- **Material and Construction Requirements** - All work shall comply with PCMC Water Standards and Specifications, (May 2014). Comply to Sections 511, 511s, 570, 570s, 571, 540-A, 547-A, (534.1 – 538-D, Corrosion Protection as it applies), 561, 580, Disinfecting, Water System Flushing and Final Flushing, Hydrostatic Testing. Comply with sections 703-A PCMC Standards (April 2007) for trench bedding and backfill. Material submittal and approval is required prior to installation. Always protect trench excavation from public access.

### **Gate Valves**

- **Description** - This item includes all materials; equipment; and labor necessary to install a gate valve or butterfly valve and valve box. Included in this item is the cost of corrosion protection. This item includes incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning, disinfecting, hydrostatic testing. backfill; compaction; and all other work required to complete the installation of the fire hydrant. Inspections per PCMC Water Department.
- **Material and Construction Requirements** - All work shall comply with PCMC Water Standards and Specifications, (May 2014). Comply to Sections 570, 570s, 571, 540-A, 544, 547-A, (534.1 – 538-D, Corrosion Protection as it applies), 561, 580, Disinfecting, Water System Flushing and Final Flushing, Hydrostatic Testing. Comply with sections 703-A, 703-B, PCMC Standards (April 2007) for trench bedding and backfill. Material submittal and approval is required prior to installation. Always protect trench excavation from public access.

### **Storm Drain System**

- **Description** - This item includes all materials; equipment; and labor necessary to install dual wall high-density polyethylene (HDPE) pipe. Connection to existing storm water system is included in this item. This item includes the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning, grouting, backfill; compaction; and all other work required to

complete the installation of the storm drain line. Inspections per PCMC Engineering Department.

- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with sections 702-A for trench bedding and backfill. Material submittal and approval is required. Always protect trench excavation from public access.

#### **Storm Drain Inlet Boxes and Manholes**

- **Description** - This item includes all materials; equipment; and labor necessary to install pre-cast storm drain inlets and storm drain manholes. This item includes the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning, grouting, backfill; compaction; and all other work required to complete the installation of the storm drain line. Inspections per PCMC Engineering Department or Special Inspection.
- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with sections 604-A1 – A7, 605-A, 605B, 605-C1, C2, 605-D, - Comply with sections 702-A for trench bedding and backfill. Material submittal and approval is required prior to installation. Always protect trench excavation from public access.

#### **Concrete Curb and Flatwork**

- **Description** - This item includes all materials; equipment; and labor necessary to install cast in place concrete curb and flatwork. This item includes the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering; pipe line cleaning, grouting, backfill; compaction; and all other work required to complete the installation of the storm drain line. Inspections per PCMC Engineering Department and/or Special Inspection.
- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with Section 500 Street Construction and related Work and subsection 530 Portland Cement & Concrete, in conjunction with 2016 APWA standards and specifications. Material submittal and approval is required prior to installation.

**Earthwork, Excavation and Subgrade Preparation**

- **Description** - This item includes all materials; equipment; and labor necessary to perform earthwork grading and excavation. This item includes the cost of incidental work such as potholing and discovery of existing utilities; shoring; removal and disposal of excess materials; excavation of any material encountered including rock excavation; restoration of all utilities damaged during construction; site dewatering. Compaction testing and inspections per owner's representative or contractor's representative, reports to become a record of work performed.
- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with Section 500 Street Construction and Related Work, subsection 501.

**Untreated Base Course (UBC)**

- **Description** - This item includes all materials; equipment; and labor necessary to install untreated base course. This item includes the cost of hauling and installing untreated base course per PCMC specifications. Compaction testing and inspections are required per owner's representative or contractor's representative, reports to become a record of work performed.
- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with Section 500 Street Construction and Related Work, subsection 510.

**Asphalt Materials and Plant Bituminous Pavement**

- **Description** - This item includes all materials; equipment; and labor necessary to install HMA (hot mix asphalt). This item includes the cost of hauling and installing HMA per PCMC specifications. Compaction testing and inspections to comply with APWA 2016 standard practices and procedures. Testing performed by owner's representative or contractor's representative, reports to become a record of work performed.
- **Material and Construction Requirements** - All work shall comply with PCMC Engineering Department Standards and Specifications, (April 2007), and Park City Municipal Construction Specifications (2007). Comply with Section 500 Street Construction and Related Work, subsection 520 and 521, in conjunction with APWA 2016 Standards and Specifications. Material submittal and approval is required prior to installation.

