



DEPARTMENT OF
AIRPORTS

SALT LAKE CITY INTERNATIONAL AIRPORT

PROJECT MANUAL FOR

NWS Replacement Controls

PROJECT NO. 542412

**DESIGN & CONSTRUCTION MANAGEMENT
DIVISION**

TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

011000	Summary
012500	Substitution Procedures
012600	Contract Modification Procedures
013100	Project Management and Coordination
013200	Construction Progress Documentation
013300	Submittal Procedures
014000	Quality Control
014200	References
015000	Temporary Facilities and Controls
016000	Product Requirements
017300	Execution
017419	Construction Waste Management and Disposal
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
017900	Demonstration and Training

DIVISION 02 – EXISTING CONDITIONS

024120	Selective Demolition
--------	----------------------

DIVISION 09 - FINISHES

092216	Non-Structural Metal Framing
092900	Gypsum Board
095113	Acoustical Panel Ceilings
099123	Interior Painting

DIVISION 22, 23, 25 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

220700	Insulation
230100	General Provisions
230501	Testing
230593	Balancing
230900	Basic Materials & Methods
233000	Air Distribution
250130	BAS Interface Requirements
250205	Field Devices for Building Automation System
250800	Commissioning of Building Automation System (BAS)
251000	Automatic Temperature Controls

END OF TABLE OF CONTENTS

SECTION 011000 – SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Owner-installed (OFOI) products.
4. Contractor's use of site and premises.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Miscellaneous provisions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

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

1.4 PROJECT INFORMATION

- A. Project Identification: NOAA William J. Alder Weather Services Building

1. Project Location: 2242 W. North temple, Salt Lake City, Utah, 84116

- B. Owner: Salt Lake City Department of Airports

1. Owner's Representative: Shawn Wiest

- C. Architect: MHTN Architects, 280 South 400 West Suite 250, Salt Lake City, UT 84101.

1. Architect's Representative: James Knight

- D. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
 - 1. Use web-based software including the following applications:
 - a. Bluebeam, Revu.

1.5 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Owner-Installed (OFOI) Products:
 - 1. Display Monitors
 - 2. Furniture
 - 3. Security – Card Reader
 - 4. Restroom Accessories

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits on Use of Site: Confine construction operations to tenant improvement activities and other work identified in the Drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways parking garage, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Parking: Available parking per Owner
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

- B. On-Site Work Hours: Limit work to hours indicated by Owner
- C. Smoking and Controlled Substance Restrictions: Use of tobacco products (unless otherwise indicated by CMGC), alcoholic beverages, and other controlled substances on Project site is not permitted.
- D. Employee Identification: If required by Owner, require personnel to use identification tags at all times.
- E. Employee Screening: Comply with Owner requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 05 through 28 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

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

1.4 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. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon 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 60 days after the Notice to Proceed. 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. Requested substitution provides sustainable design characteristics that specified product provided for achieving HPBS compliance.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.

- k. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 7 days 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 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 unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.
 - 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 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.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. 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 012500

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. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Construction Manager/General 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.

- B. Key Personnel Names: Within 10 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on 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 sub framing 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. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:

- a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. BIM File Incorporation: Construction Manager will incorporate Subcontractor's coordination drawing files into BIM established for Project.
 - a. Construction Manager will perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - b. Subcontractors listed below shall provide coordination drawings in the form of a Revit 2020 model, developed to LOD Level 350, for incorporation into the Construction Manager's model.
 - 1) Electrical.
 - 2) Mechanical.
 - 3) Plumbing.
 - 4) Fire Protection.

5) Other's as requested by the Construction Manager.

4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit 2020.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

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 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. Owner name.
 3. Owner's Project number.
 4. Name of Architect and Construction Manager.
 5. Architect's Project number.
 6. Date.
 7. Name of Subcontractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow five 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 and Construction Manager in writing within 5 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 management software. Software log with not less than the following:

1. Project name.
2. Name and address of Subcontractor.
3. Name and address of Architect and Construction Manager.
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.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

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 three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit 2020.

4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

- B. Web-Based Project Management Software Package: Use Construction Manager's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
 1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.

 2. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will 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, Construction Manager, 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. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. 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, Construction Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 45 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.

- d. Submittal of written warranties.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Construction Manager will conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, 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) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.

- 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Construction Manager will conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Daily construction reports.
4. Field condition reports.
5. Special reports.

- B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.
5. Division 1 Section "Closeout Procedures" for submitting Project Record Documents at Project closeout.

1.3 SUBMITTALS

- A. Preliminary Construction Schedule: Submit two printed copies; one a single sheet of reproducible media, and one a print.
- B. Contractor's Construction Schedule: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
- C. As the Work progresses, indicate Final Completion percentage for each activity
- D. Daily Construction Reports: Submit one copy at weekly intervals.

- E. Field Condition Reports: Submit one copy at time of discovery of differing conditions.
- F. Special Reports: Submit one copy at time of unusual event.

1.4 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination. "Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Discuss constraints, including phasing, storage areas.
 - 2. Review time required for review of submittals and resubmittals.
 - 3. Review requirements for tests and inspections by independent testing and inspecting agencies, If required
 - 4. Review time required for completion and startup procedures.
 - 5. Review and finalize list of construction activities to be included in schedule.
 - 6. Review submittal requirements and procedures.
 - 7. Review procedures for updating schedule.

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work including delivery of equipment from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for commencement of the Work or the Notice to Proceed to date of Substantial Completion.
- C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 3. Startup and Testing Time: Include days for startup and testing as required by the Electrical Consultant.
 4. 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.
- 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 or separate areas of the work,
 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Uninterruptible services.
 - c. Use of premises restrictions.
 - d. Provisions for future construction.
 - e. Seasonal variations.
 - f. Environmental control.
 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards, if any.
 - b. Submittals.
 - c. Purchases.
 - d. Fabrication.
 - e. Sample testing.
 - f. Deliveries.
 - g. Installation.
 - h. Tests and inspections.
 - i. Adjusting.
 - j. Startup and placement into final use and operation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Percentage completion milestones and Final Completion.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

2.2 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, if any.
 2. List of separate contractors at Project site where applicable
 3. Approximate count of personnel at Project site.
 4. High and low temperatures and general weather conditions.
 5. Accidents.

6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Emergency procedures.
10. Orders and requests of authorities having jurisdiction.
11. Change Orders received and implemented.
12. Construction Change Directives received.
13. Services connected and disconnected.
14. Equipment or system tests and startups.
15. Partial Completions.
16. Substantial Completions.

- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare 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.

2.3 SPECIAL REPORTS

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

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

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.

16. 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. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management 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.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

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

- g. Seal and signature of professional engineer if specified.
 2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Web-Based Project Management 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.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

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

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file 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.
- C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that

submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
 - a. Actions taken by indication on Project management software website have the following meanings:
 - 1) Final Unrestricted Release: Where the submittal is marked "No Exception Taken," the Work covered by the submittal may proceed, provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 - 2) Final-but-Restricted Release: Where the submittal is marked "Make Corrections Noted," the Work covered by the submittal may proceed, provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
 - 3) Resubmit: Where the submittal is marked "Exception Taken - Resubmit" do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 – QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REQUIREMENTS INCLUDED

- A. General Quality Control
- B. Workmanship
- C. Manufacturer's Instructions
- D. Manufacturer's Certificates
- E. Manufacturer's Field Services
- F. Testing Laboratory Services

1.3 RELATED REQUIREMENTS

- A. General Conditions: Inspection and testing required by governing authorities.
- B. Division One Section for Submittals: Shop Drawings, Product Data, Manufacturer's Instructions.

1.4 QUALITY CONTROL - GENERAL

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.5 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.6 MANUFACTURERS' INSTRUCTIONS

- A. Comply with instructions in full detail, including each step, in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

1.7 MANUFACTURERS' CERTIFICATES

- A. When required by individual Specifications Section, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

1.8 MANUFACTURERS' FIELD SERVICES

- A. When specified in respective Specification Sections, require supplier to provide qualified personnel to observe field conditions, quality of workmanship, as applicable, and to make appropriate recommendations.
- B. Representative shall submit written report to Engineer listing observations and recommendations.

1.9 TESTING LABORATORY SERVICES

- A. Owner will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by individual Specification Sections.
- B. Services will be performed in accordance with requirements of local jurisdiction having authority and with specified standards.
- C. Reports will be submitted to Owner in duplicate giving observations and results of tests, indicating compliance or non-compliance with specified standards and with Contract Documents.
- D. Contractor shall cooperate with Testing Laboratory personnel; furnish tools, samples of materials, mix design, equipment, storage and assistance as requested.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.
- D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
- J. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. 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 the requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Responsibility for temporary facilities will be assigned by the General Contractor to sub-contractors based upon areas of expertise.
- C. Temporary utilities include, but are not limited to, the following:
 - 1. Water service distribution.
 - 2. Sanitary facilities, including toilets.
 - 3. Ventilation.
 - 4. Electric power distribution service.
 - 5. Lighting.
 - 6. Telephone service.
- D. Support facilities include, but are not limited to, the following:
 - 1. Temporary signs.
 - 2. Waste disposal facilities.
 - 3. Field offices.
- E. Related Sections include the following:
 - 1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Division 1 Section "Execution Requirements" for progress cleaning requirements.
 - 3. Divisions 5 through 28 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Architect.
 - 2. Testing agencies.
 - 3. Personnel of authorities having jurisdiction.

- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 SUBMITTALS

- A. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. 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.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- A. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- B. Water: Potable.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
 - 1. Field Offices: Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading
- B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Connect to existing service in place
 - 1. Avoid interruptions in service to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.

2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of existing facilities will not be permitted while school is in session.
 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
 - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Provide one 100-W incandescent lamp per 500 sq. ft., uniformly distributed, for general lighting, or equivalent illumination.
 3. Provide one 100-W incandescent lamp every 50 feet in traffic areas.
 4. Provide one 100-W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
 5. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.
- A. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 2. Provide warning signs at power outlets other than 110 to 120 V.
 3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
 4. Provide metal conduit enclosures or boxes for wiring devices.
 5. Provide 4-gang outlets, spaced so 100-foot extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- B. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
 2. Provide voice-mail service or answering machine on Superintendent's telephone.
 3. Furnish superintendent with cell phone for use when away from field office.
- C. Internet connection on Site: Provide full e-mail service and internet connection on-site for use in electronic communications with Architect.

1. Provide service to permit electronic communication and electronic tele-transport of large volume drawing files with service sized at DSL and minimum 1.5Mbps service, to permit Web-Ex streaming for on-line meetings including video.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes complying with University's requirements. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
2. Prepare temporary signs to provide directional information to construction personnel and visitors.
3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood of at least one sheet of $\frac{3}{4}$ inch thick material. Support on posts or framing of preservative-treated wood or steel.
4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
5. Content and location of directional signs will be at the direction of the Owner.

C. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, and similar areas and areas of the facility affected by the Work.

D. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel at Project site. Keep office clean and orderly.

1. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.

E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.

F. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.

3.5 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. Protect from damage caused by freezing temperatures and similar elements.
 - 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.
 - 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- 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 the property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This 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 Sections include the following:
 - 1. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design", "Design Standard" or similar, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers submitted as an equal product.
- C. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 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. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 3. Initial Submittal: Within 5 days after date of commencement of the Work, submit 8 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 4. Completed List: Within 7 days after date of commencement of the Work, submit 8 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 5. Architect's Action: Architect will respond in writing to Contractor within 7 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
 6. Substitution Requests: Will not be considered due to the limited construction time frame of this Project.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
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 ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 5. Store products to allow for inspection and measurement of quantity or counting of units.
 6. Store materials in a manner that will not endanger Project structure.
 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named or an approved equal,
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements or an approved equal.
 3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirement or equal. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements, or equal.. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another equal product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements as an equal. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 7. Basis-of-Design Product: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" or "Design Standards" are included and also introduce or refer to a list

of manufacturers' names, provide either the specified 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 provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

8. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
9. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

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

- B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
3. Division 07 Section "Through Penetration Firestop Systems" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

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

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

1.5 QUALITY ASSURANCE

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

- B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. 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.

- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 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 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. 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.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. 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.
- D. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

3.6 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. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."
- E. Existing Mechanical/Electrical Systems: Where existing systems are required to be removed, relocated, or abandoned, bypass such systems before cutting to minimize interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. 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.
 5. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Where elements that are removed extend one finished area into another, patch and repair surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place materials and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 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. Utilize containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
 - B. Site: Maintain Project site free of waste materials and debris.
 - C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management"
 - H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.9 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
 - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

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

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.
- B. Processing Facility Records: Indicate receipt and acceptance of waste by processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices for products that may be recycled, if any.
- C. Landfill Disposal Records: Indicate receipt and acceptance of waste by landfills licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan.
 - 2. Review procedures for periodic waste collection and transportation to disposal facilities.
 - 3. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements of this Section. Plan shall consist of waste identification and analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Waste Management: If recycling is to be utilized for corrugated packaging or other salvable waste Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged or recycled.

3.2 DISPOSAL OF WASTE

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

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Sections:
 - 1. Division 01 Section "Execution" for progress cleaning of Project site.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Divisions 05 through 28 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems.

9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 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. Use CSI Form 14.1A, or other form or digital service, as agreed to by Owner, Architect and Contractor, or as required by Owner.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
4. Submit list of incomplete items in the following format (verify with Architect):
 - a. PDF electronic file.

1.6 WARRANTIES

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site in areas disturbed by construction activities of rubbish, waste material, litter, and other foreign substances.
 - b. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - c. Clean exposed interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
 - d. Remove debris and surface dust from limited access spaces, plenums, shafts and similar spaces.
 - e. Sweep concrete floors broom clean in unoccupied spaces.
 - f. Clean transparent materials, including glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish glass, taking care not to scratch surfaces.
 - g. Remove labels that are not permanent.
 - h. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
 - i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint droppings, and other foreign substances.
 - j. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - l. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - m. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.
 - n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

- o. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Divisions 05 through 28 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format (verify with Architect):
 - 1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.

- a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
2. TWO paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Agent will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Agent will return copy with comments.
1. Correct or modify each manual to comply with Architect's and Commissioning Agent's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Agent's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

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 Agent.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. 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: Enable bookmarking of individual documents based upon 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 upon opening file.
- F. Manuals, Paper Copy: Submit not more than 2 copies of manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-

- reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. 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.
- C. 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.
- D. 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.

2.4 OPERATION MANUALS

- A. 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 is 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.
- B. 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.
- C. 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.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. 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.

- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. 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 warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 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.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- 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. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

- 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. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

1. 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.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Sections:
 - 1. Division 01 Section "Execution" for final property survey.
 - 2. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 05 through 28 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal: Submit one paper copy set or PDF electronic files (verify with Architect) of marked-up record prints and one set of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal: Submit one paper copy set or PDF electronic files (verify with Architect) of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.
 - c. Final Submittal: Submit one paper copy set or PDF electronic files of marked-up record prints, one set(s) of record digital data files, and three set(s) of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy or annotated PDF electronic files (verify with Architect) of Project's Specifications, including addenda and contract modifications.

- C. Record Product Data: Submit one paper copy or annotated PDF electronic files and directories (verify with Architect) of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy or annotated PDF electronic files and directories (verify with Architect) of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 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.
 - a. Refer to Division 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- 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. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - 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.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file or paper copy. Verify with Architect.

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. Verify with Architect.
 - 1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

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. Verify with Architect.
 - 1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

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 modifications to project record documents as they occur; do not wait until the 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

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training DVDs.
- B. Related Sections:
 - 1. Divisions 05 through 28 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training DVDs: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:

- a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 3. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

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

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through the General Contractor with at least 14 days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING DVDs.

- 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. Video Recording Format: Provide high-quality color digital recordings with menu navigation in format acceptable to Architect.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

END OF SECTION 017900

SECTION 024120 - SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.

- B. Related Requirements:

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

1.4 PREINSTALLATION MEETINGS

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

- 1. Inspect and discuss condition of construction to be selectively demolished.
- 2. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
- 3. Review areas where existing construction is to remain and requires protection.

1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

1.6 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."

3.2 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Remove temporary barricades and protections where hazards no longer exist.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Exterior Wall and Brick Veneer. Provide shoring for existing exterior stud walls and brick to remain prior to cutting and removing walls and brick. Demolished brick to be salvaged per owner request.
- C. Exterior Storefront Windows. Windows to be removed shall be protected from damage during removal and given to the owner.
- D. Interior Chain Link Fence and Fence Gates. Fence and Fence gates to be removed and salvaged for subsequent use on this project where feasible.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them according to Section 017419 "Construction Waste Management and Disposal."

3.6 CLEANING

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

END OF SECTION 024119

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Butyl joint sealants.
 - 4. Latex joint sealants.
- B. Related Requirements:
 - 1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- 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. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- E. Field-Adhesion-Test Reports: For each sealant application tested.
- F. Sample Warranties: For special warranties.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- 1.6 FIELD CONDITIONS
- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
- 1.7 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: 20 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

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

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content: Verify sealants and sealant primers comply with the following:
 1. Architectural sealants have a VOC content of 250 g/L or less.
 2. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.
 3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 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, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf SCS2700.
 - c. Pecora Corporation; 890.
 - d. Tremco Incorporated; Spectrem 1.

2.3 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.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Dow Corning Corporation; 786-M White.
- b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
- c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
- d. Tremco Incorporated; Tremsil 200.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik, Inc.; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20.
 - c. Tremco Incorporated; Tremflex 834.

2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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 Construction Chemicals - Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.

B. 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.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 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 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

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

3.6 PROTECTION

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

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Building standard unless noted otherwise.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - b. Joints between walls and casework.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
- D. Joint-Sealant Application: Concealed mastics.
 - 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

- B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For firestop tracks post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645.
 - 1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, undefined:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich.
 - 3) MarinoWARE.
 - 4) SAFECO Steel Stud Company.
 - b. Minimum Base-Steel Thickness: 0.0296 inch.
 - c. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Manufacturers: Subject to compliance with requirements, undefined:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich.
 - 3) MarinoWARE.
 - 4) SAFECO Steel Stud Company.

- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Manufacturers: Subject to compliance with requirements, undefined:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich.
 - c. MarinoWARE.
 - d. SAFECO Steel Stud Company.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Steel Thickness: 0.064 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized at exterior wall applications.
 - 2. Minimum Base-Steel Thickness 0.0296 inch.
 - 3. Depth: As indicated on Drawings.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
 - 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 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. Armstrong World Industries, Inc.
 - b. Rockfon (Rockwool International).
 - c. USG Corporation.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

- D. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

- E. Z-Shaped Furring Members:
 - 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c. unless indicated otherwise on Drawings.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c.
 - 2. Furring Channels (Furring Members): 24 inches o.c.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
 - 3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum board, Type X.
 - 2. Interior trim.
 - 3. Joint treatment materials.
 - 4. Sound-attenuation blankets.
- B. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 GYPSUM BOARD, GENERAL

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

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.

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

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. 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 or drying-type all-purpose compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

- 1. Type X: As indicated on Drawings.

B. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
- 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

- 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

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

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 3. Level 5: At locations to be determined and to be coordinated with Branding.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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 exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
 - 3. Clips: Full-size seismic clips.
- E. Delegated-Design Submittal: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.

3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

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

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 15 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 15 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL PANELS

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Armstrong Ceiling & Wall Solutions; Lyra PB Vector
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

- C. Color: White.
- D. Light Reflectance (LR): Not less than LR 0.88
- E. Noise Reduction Coefficient (NRC): Not less than 0.90.
- F. Edge/Joint Detail: Flush
- G. Thickness: 7/8 inch.
- H. Modular Size: 48 by 48 inches.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Ceiling & Wall Solutions
- B. Narrow-Face, Capped, Double-Web, Steel Suspension System: 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 9/16-inch- (15-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - a. Basis-of-Design: Armstrong; Prelude
 - 4. Cap Material: Cold-rolled steel or aluminum.
 - 5. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 - 3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

- C. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- D. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 ACOUSTICAL SEALANT

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard

- suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders, penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

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

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

3.6 CLEANING

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

END OF SECTION 095113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel and iron.
 - 2. Gypsum board.
 - 3. Concrete floor.
- B. Related Requirements:
 - 1. Low VOC coatings complying with Utah Administrative Code R307-361 are required as work of this Section.
 - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 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.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Benjamin Moore & Co.
 2. Glidden Professional.
 3. PPG Architectural Coatings.
 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 100 g/L.
 3. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coating Foot Traffic: 100 g/L.
 9. Floor Coatings High Performance: 250 g/L.
 10. Shellacs, Clear: 730 g/L.
 11. Shellacs, Pigmented: 550 g/L.
- D. Colors: As indicated in a color schedule.

2.3 EPOXY FLOOR COATING, STATIC CONTROL

- A. Basis of Design – Sherwin Williams Resufloor Topcoat SDE
- B. Nominal 35 mil, electrostatic dissipative (ESD) epoxy flooring system
- C. Comprised of a three-component, high solids epoxy that contains conductive filler, applied 15-20 mils over an electrically insulating coat of epoxy. The system meets ANSI/ESD S20.20-2014 for floor resistance readings between 1x10⁵ and 1x10⁹ ohms and <100 volts Body Voltage Generation.

2.4 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

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

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Tanks that do not have factory-applied final finishes.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - f. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

- F. Concrete Sealers: Apply at rates indicated by manufacturer, and according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:

1. Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based.

- 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC.

- b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.

- c. Topcoat: Water-based acrylic, semi-gloss:

- 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat, <0 g/L.

2. Water-Based Dry-Fall System:

- a. Prime Coat: Primer, rust-inhibitive, water based.

- 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, <100 g/L VOC.
- b. Topcoat: Dry fall, acrylic, flat.
 - 1) S-W Low VOC Waterborne Acrylic Dryfall, Flat B42W81, <50g/L VOC.
- B. Gypsum Board Substrates:
 1. Latex over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 Series, 0 g/L VOC.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 5).
 - 1) S-W ProMar 200 Zero VOC Interior Latex, Semi-gloss, B31-2600 Series, 0 g/L VOC.
 2. Water-Based Epoxy System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 Series, 0 g/L VOC.
 - b. Intermediate Coat: Pre-catalyzed acrylic epoxy, matching topcoat.
 - c. Topcoat: Pre-catalyzed waterborne acrylic epoxy (MPI Gloss Level 5).
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-gloss, K46 Series, <50 g/L VOC.

END OF SECTION 099123

SECTION 22 0700 – INSULATION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. It is the intent of this section of the specifications that all heating water (above 105 deg. F.) surfaces of all piping and mechanical system components be insulated, unless specifically excluded herein.
- B. Systems to be insulated:
 - 1. New medium pressure supply air ductwork, and tie-ins to existing duct systems
 - 2. New heating hot water system, and tie-ins to existing piping systems
- C. The providing of all materials, supplies, equipment, tools, transportation, and facilities and performing all labor and service necessary to provide the work outlined above and as shown on the working drawings.

PART 2 – PRODUCTS

2.1 COMPLIANCE

- A. All insulation shall (as a minimum) conform to the requirements of the building code and have a flame spread rating of less than 25 and smoke developed less than 50.
- B. Insulation shall be manufactured by Johns-Manville, Owens-Corning, Knauf, Armstrong, or Certainteed.
- C. Duct insulation, pipe insulation & vapor barrier shall be run continuous thru all walls.

2.2 HEATING WATER PIPING

- A. All piping shall be insulated with 2-piece heavy density pipe insulation having an average thermal resistivity in the range of 4.0 to 4.6 Hr Deg. F. Ft²/BTU per inch of thickness on a flat surface at a mean temperature of 75 deg. F. Thickness of insulation shall be as follows:

MINIMUM PIPE INSULATION

INSULATION THICKNESS IN INCHES FOR PIPE SIZES**

PIPING SYSTEM TYPES	FLUID TEMP. RANGE, (deg. F)	CONDUCTIVITY (Btu-in./(h-ft ² -deg F))	<1"	1" TO <1 1/2"	1 1/2" TO <4"	4" TO <8"	8" TO >8"
HEATING HOT WATER	141-200	0.25-0.29	1.5	1.5	2.0	2.0	2.0

* Runouts not exceeding 12 feet in length to individual terminal units.

2.3 MEDIUM PRESSURE DUCTS

- A. Medium pressure ducts shall be externally insulated with 1 1/2" thick 1.0 lb. density mineral fiberglass insulation. Insulation shall be furnished with an integral FSK vapor barrier jacket. Insulation shall be applied with edges tightly butted and secured by impaling on pins welded to the duct or on metal clips, previously adhered to the ducts with manufacturer's adhesive. Pins or clips shall be spaced to hold insulated firmly against the duct surface. Where required, insulation on the underside of all horizontal ducts and sloping ducts shall be additionally secured by applying an adhesive. All penetrations shall be sealed with vapor barrier adhesive. All seams shall be covered with 2" wide strips of the same insulation facing material adhered with adhesive.
- B. All rectangular medium pressure supply air ducts shall be lined per 233000-8.2.35 requirements.

2.4 LOW PRESSURE ROUND DUCTS

- A. All round metal ducts shall be wrapped with 1" thick fiberglass duct wrap with factory-applied vapor barrier. All joints shall be sealed with mastic and taped to form a neat and complete insulation system.

PART 3 – EXECUTION

3.1 GENERAL

- A. The contractor shall provide a complete installation which is neat in appearance and functional.
- B. Remove all excess materials and packaging from job site.
- C. All insulation shall be continuous thru wall and ceiling openings and thru sleeves.
- D. Insulation on all cold surfaces where vapor barrier jackets are used will be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
- E. Valves and fittings inside the building shall be insulated as specified for the piping systems and covered with high temperature P.V.C. insulation fitting covers.
- F. Fittings and valves for pipe size smaller than 4" shall be insulated and finished with Insulating and Finishing Cement to a thickness equal to the adjoining pipe insulation. Fittings and valves for pipe sizes 4" and larger shall be insulated with segments of the molded insulation secured with No. 20 gage galvanized annealed steel wire finished with a smoothing coat of finishing cement. Vapor seal with a layer of glass fabric embedded between two 1/16" coats of vapor seal adhesive. Lap seal outer jacket at least 1" on itself adjoining insulation.
- G. All terminations of insulation ends shall be tapered and covered with finishing cement.
- H. In exposed areas, all fittings shall be additionally finished with FSK wrap smoothly adhered. Overlap the FSK wrap on itself and adjoining pipe insulation. Overlap to be at least 1" on pipe insulation below 4" and 2" on sizes 4" and above.

- I. Insulation inserts and shields for cold surface piping such as domestic cold-water piping shall be installed at all pipe hangers. Inserts between the pipe and pipe hangers shall consist of calcium silicate block insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

1/2" to 2-1/2" pipe size	6" long
3" to 6" pipe size	9" long
8" to 10" pipe size	12" long

- J. Rigid metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and length specified for the insulation hanger inserts.
- K. Vapor barrier wrap shall be sealed tight and not penetrated by the hanger or shield.
- L. Adhesives, mastics, and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.
- M. Where insulation pipes pass thru sound or fire-rated walls, floors, or ceilings, the insulation sleeves shall be sound or fire-rated to match rating of surface penetrated.

3.2 INSULATION WORKMANSHIP

- A. All insulation shall be applied by specialists experienced in the field and shall be neat in appearance. Neatness in appearance shall be equated to proper insulation application procedures, and sloppy workmanship will not be tolerated. Work which is deemed unacceptable shall be condemned, removed, and replaced at the contractor's expense.
- B. Protect floors, valve handle, accessories, etc., to keep paste off areas not being insulated.
- C. Splitting of longitudinal sections on flexible foam pipe insulation will not be permitted.
- D. Do not install insulation on pipes which require heat taping without coordinating with mechanical contractor.

3.3 CLEAN-UP

- A. The piping shall be cleaned and tested prior to installation of insulation.
- B. Fittings shall be cleaned after insulation is installed.

End of section 220700

BLANK PAGE

SECTION 23 0100 - GENERAL PROVISIONS

PART 1 – GENERAL PROVISIONS

1.1 GENERAL CONDITIONS

- A. The contractor shall carefully read the General Conditions of the Contract and all information to bidders which, with the following specifications for heating, and temperature control are a part of the Contract.

1.2 BASIC BID

- A. Shall include all labor and materials specified in this division. The term "furnish" and/or "install" or similar implication shall mean "furnish and install complete."

1.3 SCOPE OF WORK

- A. The work to be done under this section includes the furnishing of all labor, materials, equipment, controls and accessories required to complete all heating, air conditioning, ventilating, plumbing, drainage, heat recovery, and other mechanical systems as shown on plans and/or described in these specifications, including miscellaneous items required to provide a complete and functional facility.
- B. Work shall include, but shall not be necessarily limited to, the following:
 - 1. System demolition and removal of materials and equipment.
 - 2. System commissioning
 - 3. Testing
 - 4. Balancing
 - 5. Insulation systems
 - 6. Air distribution system
 - 7. Automatic control systems
 - 8. Heating water piping system
 - 9. Special systems
- C. The mechanical contractor shall provide all miscellaneous electrical work and control wiring for special systems where the wiring requirements are provided by the equipment manufacturers and/or suppliers, unless all of the required wiring is clearly shown on the electrical drawings to be provided by the electrical contractor.

1.4 CODES AND ORDINANCES

- A. All work shall be installed in accordance with the city, state, and local plumbing codes, and all other codes, ordinances, and regulations which govern the type of work covered by these specifications.
- B. All work performed shall be in strict compliance with the SLCDA regulations and requirements.
- C. Should the drawings conflict with the code, the code shall govern the proper installation of the work, and no extra charge shall be made for such change.
- D. Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, he shall bear all costs arising in correcting the deficiencies.

- E. Where the work required by the drawings and specifications exceeds the minimum code requirements, the work shall be done as shown or specified.
- F. NOTE: Code compliance, or similar terminology, shall be interpreted to mean "the interpretation of the code as enforced by the local building authority".

1.5 DRAWINGS AND SPECIFICATIONS

- A. These specifications are intended to cover all labor, material, and standards of mechanical workmanship to be employed in the work shown on the drawings, called for in these specifications, or reasonably implied by terms of same. The drawings and specifications are intended to supplement one another, and any part of the work that may be mentioned in one and not represented in the other shall be done the same as if it had been mentioned or represented in both.
- B. Large scale drawings shall take precedence over layouts and small-scale details.
- C. The mechanical drawings are schematic in nature, and show the general arrangement of all piping, ductwork, mechanical equipment, and appurtenances. They shall be followed as closely as the actual building construction, and the work of other trades will permit.
- D. ACAD or Revit drawing files will not be provided to contractor for use. PDF's of sheets may be provided by request for coordination purposes.
- E. Due to tight structural conditions and space limitations in selected areas the contractor should anticipate structural and space conflicts and shall make allowances for them in his bid. Until the steel fabrication shop drawings are submitted for review, the mechanical coordination cannot be completed.
- F. The architectural and structural drawings shall be considered part of the mechanical work insofar as these drawings furnish this Division with information relating to design and construction of the building. Architectural and structural drawings take precedence over the general building layouts and details shown on the mechanical drawings.
- G. The structural engineer and architect shall approve all attachments to or modifications of any structural members in the building required for installation of the mechanical systems.
- H. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which will be required. This contractor shall investigate the structural and finish conditions affecting the work and provide all necessary offsets, fittings, valves, trim, and accessories required to meet actual job-site conditions.
 - 1. Dimensions -
Verify dimensions governing mechanical work at the building. No extra compensation shall be claimed or allowed on account of differences between the actual job-site dimensions and those indicated on the drawings.
 - 2. Adjoining work -
Examine all adjoining work on which the mechanical work is dependent and report any work which must be corrected. No waiver of responsibility shall be claimed or allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.6 INTERPRETATION OF DRAWINGS AND DOCUMENTS

- A. If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications, or other proposed contract documents, or finds discrepancies in or omissions from the drawings or specifications, he may submit to the Owner's representative, a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the proposed documents will be made only by addenda duly issued, and a copy of such addenda will be mailed or delivered to each person receiving a set of such documents. The Owner will not be responsible for any other explanations or interpretations of the proposed documents. All questions shall be submitted at least seven days in advance of bidding.
- B. The Owner's representative will interpret the meaning of any part of the drawings and specifications about which any misunderstanding may arise, and his decisions will be final. Should there appear to be any error or discrepancy in or between the drawings and specifications, the contractor shall refer the matter to the Owner's representative for adjustment before proceeding with the work. Should the contractor proceed with the work without so referring to the matter, he does so on his own responsibility.

1.7 WORKMANSHIP

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative.

1.8 SUBSTITUTIONS

- A. See Special Conditions pertaining to Substitutions.
- B. Requests for prior approval must be submitted to the owner's representative a minimum of five working days prior to bid date.

1.9 FEES & PERMITS

- A. This contractor shall obtain all necessary permits and pay all fees required in connection with the work.

1.10 SITE INSPECTION AND EXAMINATION OF DRAWINGS

- A. The contractor shall carefully study all drawings and specifications pertaining to the work. If any of the work as laid out, indicated, or specified is contrary to or conflicts with any governing ordinances or regulations, the same shall be reported to the Owner's representative before submitting a bid. The Owner's representative will then issue instructions as to procedure.
- B. The contractor shall carefully examine the building site and compare the drawings with existing conditions. By the act of submitting a bid, the contractor shall be deemed to have made such examination, to have accepted such conditions, and to have made allowance therefore in preparing his bid.

1.11 VERIFICATION OF DIMENSIONS

- A. Before proceeding with any work, the contractor shall carefully check and verify all dimensions, sizes, etc., and shall assume full responsibility for the rigging and fitting-in of his ductwork, piping, and equipment. Where apparatus and equipment has been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated. The contractor shall carefully check the drawings to see that the equipment he is required to install will fit into the spaces provided and will allow for proper maintenance and service of the equipment.

1.12 COORDINATION

- A. This contractor shall coordinate his work with other specification divisions and shall provide all necessary specialty items, trim, and incidental 115 volt and 24-volt power and control wiring (which is not shown or specified under other divisions) required to provide a complete functional acceptable system.
- B. The Division 22, 23 & 25 contractor shall coordinate his work such that all slots and openings through floors, walls, ceilings, and roofs are properly located and shall do any cutting and patching caused by neglecting to do so.
 - 1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into the construction as the work proceeds.
 - 2. It is the responsibility of Division 22, 23 & 25 to locate these items and see that they are properly installed.
- C. The locations of all piping, ducts, apparatus, and equipment indicated on the drawings are approximate only, and shall be changed as required to meet the actual architectural and structural conditions at the job site. All changes shall be approved by the Owner's representative. Any change in work which has not been installed shall be made by the contractor without additional compensation, except changes which are caused by architectural and structural changes which substantially increase the size of any of the mains, or which substantially increase the number of fixtures or length of pipe runs. Any and all changes shall be made only upon approval of a written change order.
 - 1. Right of way - Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have right of way over lines whose elevations can be changed.
 - 2. Offsets, transitions, and changes in direction in pipes and ducts shall be made as required to avoid conflicts with building footings and foundations or other buried ducts or utilities, and to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, sanitary vents, and devices as required to affect these offsets, transitions and changes in direction.
- D. It shall be each contractor's responsibility to verify exact location, elevation, and/or route of the various mechanical system components with architectural details and with Owner's representative's personnel on job.
- E. Where deviations from locations and/or arrangements described are necessary to meet actual job conditions, the changes shall be made without cost to the Owner.
- F. The Owner's representative reserves the right to make any reasonable change in location of any outlet, piping, or equipment, before installation, without additional cost.

1.13 RECORD DRAWINGS

- A. The contractor shall maintain one set of record drawings. These prints shall show the location, elevations and details of all items of work installed under this contract. The completed set of record drawings must be submitted to the Owner's representative before the contractor is eligible to receive the final payment.
- B. An up-to-date record set of drawings shall be maintained during the progress of the project and be available to the Owner's representative upon request.

1.14 COORDINATION DRAWINGS

- A. The contractor shall provide coordination drawings, when requested by the Owner's representative, to ensure that the various mechanical system components are coordinated with each other, and with other building systems.
- B. The coordination drawings shall be drawn to scale (usually 1/4" = 1'-0") and shall show all systems as they relate to each other, especially in areas of potential conflict.
- C. This set of foundation coordination drawings shall be maintained in the construction trailer and shall be marked up daily to indicate the exact location and elevation of all buried piping and conduit systems.
- D. Coordination drawings shall be professionally drafted and shall be clear and concise in their presentation and clarity.
- E. All coordination drawings shall be prepared in digital format – Latest Version of Revit. Material shall be submitted in digital format.
- F. All ductwork and piping attachments to the building structure shall be detailed and shall be coordinated with the Owner's representative.

1.15 COOPERATION WITH OTHERS

- A. The contractor shall so organize the work that progress will harmonize with the work of all trades, so that all work may proceed as expeditiously as possible. The contractor shall be held responsible for any delays which might be caused by his negligence or failure to cooperate with other contractors or crafts.

1.16 FOREMAN

- A. A full-time foreman shall be designated by the contractor to the Owner's representative and shall be available on site for consultation. This individual, when appointed, will not be replaced without prior approval from the Owner's representative. The foreman shall be responsible for the coordination and correct placing of the work.

1.17 GUARANTEE

- A. By the acceptance of the contract award for the work herein described, the contractor assumes the full responsibility imposed by the guarantee as set forth herein and should protect himself through proper guarantee from equipment and specialty manufacturers and subcontractors as their interests may appear.

- B. All materials and equipment provided and installed under this division of the specifications shall be guaranteed for a period of one (1) year from the date of substantial completion and acceptance by the Owner, unless specifically noted elsewhere in the specification. Should any trouble develop during this period due to defective materials or workmanship, the contractor agrees to correct the trouble without any cost to the Owner, any defect noticed at the time of installation and/or during the guarantee period shall be corrected immediately to the satisfaction of the Owner.

1.18 SCHEDULES, MATERIALS AND EQUIPMENT

- A. As soon as practicable, and within 30 days after the date of award of contract, and before commencement of work, a complete schedule of equipment and materials proposed for installation shall be submitted to the Owner's representative. The schedule shall include catalogs, cuts, drawings, and such other descriptive data or samples that are requested by the Owner's representative. Schedules shall include all items of equipment used. No partial submittals will be accepted.
- B. Provide corrected copies of each required shop drawing or similar submittal to the Owner's representative for review and approval. DO NOT SUBMIT without the general contractor's signed stamp, indicating the general contractor has reviewed the submittal for completeness and conformance to the Contract Documents.
- C. Inform the Owner's representative by notation, or in the letter of transmittal, of any proposed deviation from the requirements of the Contract Documents.
- D. Provide required shop drawings or other submittals within time stipulated on approved progress schedule.
- E. Do not commence work requiring a shop drawing or other submittal until approval of the required submittal has been received. Such approval will be based upon a review only for conformance with the design concept of the project and with the information given in the Contract Documents and does not relieve the contractor from responsibility for errors or omissions in the shop drawings.
- F. Schedules shall be neatly bound in digital format. Schedules shall be completely indexed, and shall include the following items:
 - 1. Valves
 - 2. Piping systems
 - 3. Pipe supports & restraints
 - 4. Fan powered VAV re-heat boxes
 - 5. VAV boxes
 - 6. Low pressure flexible ducts
 - 7. Insulation systems
 - 8. Automatic temperature controls
 - 9. Air & water balance contractor qualifications
 - 10. Fire safing system with installation diagrams
 - 11. Other scheduled items
- G. Submittals received which do not contain all of the above items will be returned unchecked.

H. Purpose and Contractor's Responsibility:

1. The purpose of the final submittal is to "assist the contractor in selecting the equipment." The contractor shall review the submittals prior to submission to the Owner's representative to make sure that the submittals are complete in all details including the following items:
 - a. Manufacturers' names shall be mentioned in specifications as accepted by Owner at time of bidding.
 - b. Equipment dimensions shall be verified to fit the spaces provided with sufficient clearances, as may be required by the equipment or indicated on the drawings.
 - c. Equipment shall be reviewed with respect to schedules, specifications, plans and details.
 - d. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment.

I. Review:

1. Review and acceptance of submittal does not relieve the contractor of his responsibility to fulfill the contract requirements. Review and acceptance of the submittal will not be used as a means of changing the contract requirements. Items not covered in the accepted submittal, or items incorrectly covered but not recognized or identified, shall not be used when contrary to the requirements of the contract documents.

J. Acceptance of Substitute Equipment:

1. If the proposed installation is approved, this contractor shall make all incidental changes in piping, ductwork, supports, installation, wiring, heaters, panel boards, and as otherwise necessary. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for the proper operation of the system resulting from the contractor's selection of alternate equipment, including all required changes in the effected trades.

K. Owner's Refusal Right:

1. In the event that items submitted are substitutions for specified items and are found to be not acceptable, the right shall be reserved to require the specified items.

1.19 OPERATING INSTRUCTIONS AND CATALOG INFORMATION

- A. This prime Division 23 contractor shall compile in digital format catalogs of every product used by him and subcontractors in the completion of the work. The catalogs shall also include copies of the test data (Section 230501), balancing reports (Section 230593), and system commissioning data (Section 230800). Before final acceptance by the Owner's representative, he shall turn over to the Owner this compilation of catalog data. A double index shall be provided, one giving an alphabetical list of products for which catalogs are included, and one giving their addresses, whose products are included in the work. Provide data for each item of equipment listed in SCHEDULES, MATERIALS & EQUIPMENT, as shown in Section 230100. Provide copy of submittal data. All products shall be assembled by Division.
- B. (1) digital copy shall be delivered to the Owner's representative for his approval.
- C. Provide warranty schedule and schedule of overload protection as required in Section 230800.
- D. Manuals not in compliance will not be reviewed and will be rejected.

- E. Catalog shall be identified as listed.

SLCDA NWS-NOAA BUILDING VAV REPLACEMENT UPGRADE
OPERATING & MAINTENANCE MANUAL
2023-2024
SET #

PART 2 – PRODUCTS

2.1 MATERIALS, EQUIPMENT AND ACCESSORIES

- A. Unless otherwise specified, all equipment, accessories, and materials shall be new and undamaged, and the workmanship shall be of the best quality for the use intended and shall be acceptable to the Owner's Representative.
- B. Equipment, accessories, and materials shall be essentially the standard products of the manufacturer, or as specified herein. Where two or more units of the same class of new equipment are required, these units shall be products of a single manufacturer.
- C. Should mechanical equipment other than that used in the design be furnished, it shall be the responsibility of the mechanical subcontractor to provide large scale (1/2" = 1'-0") installation drawings, as required, showing service and maintenance points with proper clearance allowances for service.
- D. All equipment shall be selected to deliver full rated capacity at the job site elevation.

PART 3 – EXECUTION

3.1 FUNCTIONING AND OPERATION OF EQUIPMENT

- A. Contractor's Responsibility:

Installation and startup shall be so made that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order.

3.2 CLEANING AND PATCHING BY MECHANICAL CONTRACTOR

- A. The contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

3.3 INSTRUCTIONS TO OWNER'S REPRESENTATIVES

- A. The mechanical contractor shall provide, without expense to the Owner, competent instructors to train the Owner's representatives in the care, adjustment, maintenance, and operation of all parts on the heating, air conditioning, ventilating, plumbing, and automatic temperature control systems and equipment. Training shall be a minimum of 8 hours with no less than 4 hours for ATC training.

- B. An additional 4 hours shall be provided by all mechanical subcontractors to walk thru building with the owner's representative to verify operation of all Division 22, 23, & 25 items and control sequencing.
- C. Instruction date shall be scheduled with the owner at the time of final inspection. A written report specifying times, dates, and the name of personnel instructed shall be forwarded to the Owner's representative.
- D. No training shall begin until system commissioning is complete and accepted by the owner.

3.4 PROTECTION AGAINST THE ELEMENTS

- A. The contractor shall, at all times, take reasonable and adequate precautions to protect his work and all stored materials and equipment from damage by the elements, including flooding, windstorms, etc., and shall not expose the work of any other contractor to such damage.
- B. In addition to requirements specified in Division 01, stored material shall be readily accessible for inspection by the Owner's representative until installed.
- C. All items subject to moisture damage, such as controls, shall be stored in dry, heated spaces.
- D. Protect all bearings during installation, and thoroughly grease steel shafts to prevent corrosion.

3.5 REMOVAL OF DEBRIS, ETC.

- A. Upon completion of this division of the work, remove all surplus material and rubbish resulting from the work, and leave the premises in a clean and orderly condition.

3.6 SALVAGE ITEMS TO BE TURNED OVER TO OWNER

- A. The existing ATC air compressor and related filter dryer shall be removed in good working order and stored on a pallet at a location onsite TBD by owner.
- B. The owner will remove the equipment from the project site.

3.7 MOTORS & STARTERS

- A. This contractor shall furnish all motors required and necessary to operate equipment furnished by him. The voltage, phase, and horsepower of each motor shall be coordinated with the electrical contractor prior to ordering.

3.8 OPENINGS FOR MECHANICAL SYSTEMS

- A. All openings required for installation of mechanical systems shall be provided by the mechanical contractor. Any piece of equipment which is to be installed in any space of the building and which is too large to permit access through stairways, doorways or shafts shall be brought to the job by the Contractor involved and placed in the space before the enclosing structure is completed. Materials shall be delivered at such stages of the work as will expedite the work as a whole.

3.9 SAFETY REGULATION

- A. The contractor shall comply with all local and OSHA safety requirements in performance with this work. (See General Conditions). This contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

3.10 OWNER FURNISHED EQUIPMENT

- A. This contractor shall include in his bid the necessary labor and material to properly coordinate and install the required piping, trim, specialties, controls, ductwork, and other necessary utilities and services to equipment furnished by the Owner.
- B. This contractor shall relocate (where noted), rough-in and make final connections to owner furnished equipment.
- C. See bid documents for a list of owner furnished equipment which is not otherwise identified on the mechanical drawings or in the mechanical division of the specifications.

End of section 230100

SECTION 23 0501 – TESTING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The work outlined in this section shall be performed by the several trades involved.
- B. The mechanical contractor shall provide all supervision, labor, materials, tools, scaffolding, and equipment required to complete all system testing.
- C. The mechanical contractor shall remove and repair any defective component as indicated by the system tests and retest.
- D. The mechanical contractor shall test the operation of all safety and high limit controls to ensure proper installation and operation. Any defective devices shall be replaced.

1.2 TESTS AND ADJUSTMENTS

- A. Before any piping is covered, tests shall be made in the presence of the Owner's Representative, and any leaks or defective work corrected. No caulking of threaded work will be permitted.
- B. Before application of insulation covering, and as far as practical before concealing any piping, all piping shall be hydrostatically tested and proved tight.
- C. Stubs shall be capped, and all control valves shall be removed during the test.
- D. System may be tested in sections, providing connections to last section tested are included in each succeeding test.
- E. Following minimum pressures shall be used for testing:
 - 1. Medium pressure air ducts in accordance with SMACNA standards.
 - 2. Low pressure air ducts in accordance with SMACNA standards
 - 3. Heating hot water system piping at 150 psig for six hours.
- F. All valves and equipment which may be damaged shall not be subjected to the test pressure.
- G. 230501 contractor shall perform all duct pressure tests per specifications and owner requirements.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. The contractor shall furnish all necessary gauges, plugs, test fans, pumps, etc., as required to conduct the tests.

2.2 REPORTS

- A. The contractor shall give the Owner's Representative one week notice prior to performing the tests. All tests shall be recorded, and copies of reports bound in the O & M manuals and given to the Owner.

PART 3 – EXECUTION

3.1 PROCEDURE

- A. The contractor shall be responsible to conduct all tests in a safe manner, protecting the work of other trades from water or physical damage.
- B. The tests, as indicated, shall be in addition to any test, as required, by any governing agency. Submit all approved tests, as required, by any governing agency to the Owner's representative.
- C. Each test and any necessary repairs and retest shall be performed by the contractor which installed the system.

End of section 230501

SECTION 23 0593 – BALANCING

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. The mechanical contractor shall employ an independent technical firm to perform the checking, adjusting, and balancing (CAB) of the HVAC systems. This firm shall be one whose operations are limited to the field of professional CAB, and this firm shall meet the following qualifications:
1. The firm shall be a member of AABC and/or NEBB.
 2. The firm shall be one which is organized to provide professional services of this specific type.
 3. The firm shall have completed projects of similar scope within the past 12 months and shall be capable of performing the services specified at the location of the facility described within the time frame specified and following up the basic work as may be required.
 4. All personnel used on the job site shall be engineering technicians, who shall have been permanent, full-time employees of the firm for a minimum of six (6) months prior to the start of the work for this project.
 5. **Preferred contractors shall be Certified Test & Balance, Diamond Test & Balance, Independent Test & Balance, BTC Services, RSAnalysis and Bonneville test & Balance.**
- B. As a part of this contract, the mechanical contractor shall make all changes in the sheaves, belts, and dampers, including the addition of dampers required for correct balance as required by the CAB firm, at no additional cost to the Owner.
- C. The mechanical contractor shall provide, and coordinate services of qualified, responsible subcontractors, suppliers, and personnel as required to correct, repair, or replace any and all deficient items or conditions found during the testing, adjusting, and balancing period.
- D. In order that all systems may be properly checked, balanced, and adjusted as required by these specifications, the mechanical contractor shall operate said systems at his expense for the length of the time necessary to properly verify their completion and readiness for the CAB and shall further pay all costs of operation during the CAB period.
- E. The project completion schedule shall be coordinated with the CAB work to provide sufficient times to permit the completion of CAB services prior to Owner occupancy.

1.2 DOCUMENTS

- A. The Owner's representative will furnish, without charge to the CAB firm, one set of mechanical specifications, all pertinent change orders, and the following:
1. One complete set of plans less structural sheets.
 2. One set of mechanical floor plans of the conditioned spaces.
- B. All documentation shall be provided in digital format for review and incorporated into O&M Manuals.
- C. Approved submittal data on equipment installed to accomplish the test procedures outlined in paragraph "Services of the CAB Firm" of this specification will be provided by the mechanical contractor.

- D. The Owner's representative will transmit one copy of the following "Records for Owner" to the CAB firm for review and comments:
1. Record drawings
 2. Approved fixture brochures, wiring diagrams, and control diagrams.
 3. Shop drawings
 4. Instructions
 5. Motor and valve charts
 6. Operating and Maintenance Manuals

1.3 SERVICES OF MECHANICAL CONTRACTOR

- A. The mechanical contractor shall have all systems complete, calibrated, and in operational readiness prior to notifying the CAB firm that the project is ready for their services. The mechanical contractor shall coordinate system readiness with the system commissioning contractor and shall certify in writing to the Owner's representative that the system is complete and ready to balance.

1.4 SERVICES OF THE CAB FIRM

- A. The technical CAB firm shall submit biographical data on the individual proposed to directly supervise the CAB work. It shall also submit their record of specialized experience in the field of air and hydronic system balancing.
- B. Act as liaison between the Owner's representative and contractor and periodically inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems as the installation progresses. The inspection will cover only those parts of the systems relating to the checking and balancing.
- C. To check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building.
- D. Re-balance of existing equipment and air systems.
- E. Re-balance of existing supply air diffusers and related new VAV boxes or fan power VAV re-heat boxes.
- F. Re-balance of new fan powered VAV re-heat valves and existing heating water pumps.
- G. Prepare and submit to the Owner's representative, complete reports on the balance and operations of the systems.
- H. The CAB firm shall be responsible for inspecting, adjusting, balancing, and logging the data on the performance of the following general systems, including all components.
1. Heating water systems, including existing pumps, new coils, controls, etc.
 2. Existing supply air distribution systems as noted.
 3. New fan powered VAV re-heat boxes. Air flow, water flow and controls.
 4. New VAV boxes.
 5. The new temperature control system in its entirety, includes the verification of all control sequences and safety devices.
- I. Before any adjustments are made, the air systems are to be checked for such items as dirty filter, duct leakage, damper leakage, equipment vibrations, correct damper operations, etc.

- J. Before any adjustments are made to water systems, the new and existing strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, etc.
- K. It shall be the responsibility of the CAB personnel to check, adjust, and balance the components of the various systems as listed above using an applicable "proportionate balance procedure" in order that each of them will operate under optimum noise, temperature and air flow conditions in the conditioned spaces in the building "while simultaneously operating at the most energy efficient condition."
- L. During the balancing process, if abnormalities or malfunctions of equipment or components are discovered by the CAB personnel, the owner's representative shall be advised promptly so that the condition may be corrected by the project contractor. Data from malfunctioning equipment or components shall not be recorded in the final CAB report.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND INSTRUMENTS

- A. This contractor shall provide all necessary labor, equipment, scaffolding, instruments, and materials required to adjust, balance, and check all systems.

PART 3 – EXECUTION

3.1 REPORT

- A. The activities, as described hereinbefore, will culminate in a report to be provided to the Owner's representative. This report shall be furnished in a digital format. A copy shall be bound in the digital O & M manual. The intent of the final report is to provide a reference of actual operating conditions for the building operating personnel.
- B. The CAB report shall include the following as a minimum:
 - 1. Preface:

A general discussion of the systems, any idiosyncrasies, any problems encountered, an outline of normal sequence of operation for the HVAC system cycles, any un-corrected noise problem.
 - 2. Pitot Tube Traverses:

For use in future trouble-shooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts will have air velocity and volume measured and recorded by the traverse method. Locations of these traverse test stations will be described on the sheet containing the data.
 - 3. Temperature Tabulation:

Of all conditioned spaces on a room-by-room basis, a total of at least three readings will be taken of each room on successive days. Record outside ambient temperature at two-hour intervals. The total variation in conditioned space temperatures shall not exceed 2 deg. variance from the thermostat settings.

4. Air Volumes and Velocities:

As measured at each supply grille, return air grille, and exhaust air grille or air handling device. In all fan systems, the air quantities indicated on the plans may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the contractor to furnish or revise fan drive and/or motors, if necessary, without cost to the Owner, to attain the specified air volumes.

5. Air Pressure:

As measured across each supply fan, cooling coil, heating coil, air handling unit filter and exhaust fan. Relate these readings to the particular fan curve in terms of CFM handled at the various static pressures, and their relationship to fan power and fan instability.

6. Electrical Current/Voltage:

Measurements to be taken at the drive motor on each piece of equipment.

7. Fan Speeds:

To be measured in RPM.

8. Instrumentation List:

A list of instruments by type and make used in gathering the CAB data.

9. Drawings:

The CAB contractor's working drawings shall have the VAV, and supply air openings numbered and/or lettered to correspond to the numbers and letters used on the report data sheets so that data in the report can be correlated with each specific supply air opening in the building. If room numbers actually used in the building differ from those on the plans, the building room numbers shall be marked on these plans. Only one such marked-up set of drawings need be provided with the six copies of the CAB report.

- C. Before final acceptance of the CAB report, the report data, at the discretion of the Owner's representative, shall be verified one time on the job site, by selection of check points (not to exceed 10 percent of total) at random, in the presence of the Owner's representative. Representatives of the testing firm doing the work shall be present and provide the necessary equipment for test data verification.
- D. The firm shall be responsible for inspecting, adjusting, balancing, and logging the data on the performance of fans, all dampers in the duct system, all air distribution devices, the flows of freon or water thru all coils, and the power consumption of all motors.
- E. During the CAB work, the temperature regulation will be adjusted for proper relationship between controlling instruments. The Owner's representative will be advised of any instruments out of calibration so that the controls subcontractor may come in and recalibrate, using data supplied by the balancing firm.
- F. Make a total of two inspections within ninety (90) days after occupancy of the building to ensure that satisfactory conditions are being maintained throughout and to satisfy and unusual conditions.

- G. An additional inspection in the building shall be made by the firm during the season opposite that in which the initial adjustments were made. At that time, any necessary modifications to the initial adjustment required to produce optimum operation of the system components shall be made to produce the proper seasonal conditions in each conditioned space.
- H. At the time of opposite season checkout, the Owner's representative shall be given timely notification before any readings or adjustments are made so that they may participate in the checkout.

End of section 230593

BLANK PAGE

SECTION 23 0900 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the basic materials and methods to be used in Division 22, 23 & 25 work.

1.2 MATERIALS & EQUIPMENT

- A. All materials shall be new and undamaged. Protect all stored materials and equipment from damage by the elements, including exposure to excessive heat, flooding and rain, windstorms, etc.
- B. All materials and equipment shall be installed in strict compliance with the manufacturer's recommendations.

1.3 CUTTING AND PATCHING

- A. Any cutting, patching, or filling necessary for the proper execution of this work, except as noted in the drawings, shall be done by this contractor.
- B. No rough or unsightly work will be allowed. Cutting of structural members shall be done only on approval of the Owner's representative.

1.4 PIPING & DUCTWORK SUPPORT

- A. Steel roof deck shall not be used to support loads from plumbing, HVAC ducts, light fixtures, architectural elements or equipment of any kind, unless specifically noted otherwise. Lightweight suspended acoustical ceilings with a total weight per wire not exceeding 50# may be hung from the steel roof deck. The hangers should be staggered to distribute the load over multiple deck flutes.
- B. Bracing of miscellaneous items (mechanical, electrical, plumbing, etc.) to the bottom chord of joists or girders will not be allowed in any instance. All lateral braces must connect to the top flange/top chord of the framing member above unless noted otherwise on the structural drawing.
- C. It is essential that all piping be supported from roof structure at joist within 6" of panel point location and from top or bottom chord of floor or roof joist.

1.5 PIPE LOCATION AND ARRANGEMENT:

- A. All piping shall be properly racked and supported to run straight and true.
- B. All changes in direction shall be made with approved fittings. Pipes shall not be bent to change direction.
- C. All piping shall be racked and run to facilitate maintenance work. Under no circumstances shall valves, shock absorbers, drip traps, or piping specialties be installed in a "closed space" without proper access provided for future maintenance. See "Access Doors" section of specifications.
- D. NOTE: All piping shall be capped or plugged at the end of each work shift and when not being extended, to prevent the entry of rocks and debris.

- E. Any timelines are broken or disconnected, they shall be capped immediately after flushing to remove rock and debris from pipes. If rocks or other foreign materials are found in the system after it has been closed, the contractor shall stand the expense of their removal.
- F. All valves, piping, and equipment to be installed to permit disassembly for maintenance purposes.
- G. Provide drain valves at all low points in piping systems. Run to floor drain where possible, otherwise

1.6 PIPE JOINING

- A. **All steel pipe under 2" in size shall be joined by screwed connections. Heating hot water piping shall be welded if pipe size is over 2" in size.**
- B. Welded ends shall be plain beveled. Welding fittings must be employed if welding is used. Small (1-1/2" and smaller) branch connections may be made with Weldolets or Thredolets provided the main is at least 2" dia., and not less than two pipe sizes larger than the branch. Where these connections are used, the pipe opening in the main shall be cut to insure a full inside pipe diameter at the branch connection. Slag and spelter resulting from the hole cutting shall be removed from the main piping.
- C. All joinings shall be made to maintain the full metal strength of the pipe, with neat and workmanlike appearance.
- D. All piping must be perfectly clean before the system is filled.
- E. When valves are being installed in copper piping, the non-metallic parts shall be removed to prevent the heat of soldering from damaging the valves. No heat shall be applied near where an excessive temperature may cause damage.
- F. All HVAC copper piping 3" and larger shall be brazed.
- G. Qualification of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."
- H. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.
- I. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.
- J. Welders shall be tested and certified for all positions.
- K. Submit identifying stenciled test coupons made by each operator.
- L. Any or all welders may be required to retake welding certification tests without additional expense. When requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.
- M. Recertification of the welder shall be made after the welder has taken and passed the required tests.

- N. Where piping 1-1/2 inches and smaller is to be butt or socket welded, submit 3 samples of test welds for approval.

1.7 SCREWED CONNECTIONS

- A. All pipe shall be reamed at the ends and free of all inside scale or burrs. Threads shall be cut clean and sharp, and to a length equal to 1-1/8 the length of the female thread receiving the pipe. The pipe shall be screwed in the full length of the female thread.
- B. Pipe shall be made tight with teflon thread tape or thread lubricant worked into male thread only. Surplus material shall be wiped off and the joint left neat and clean. Lubricant shall be powdered graphite and linseed oil, or plumbage and linseed oil.

1.8 PIPE GRADING

- A. Piping shall be uniformly graded in direction of flow as noted below:

PIPING	FALL/RISE	DIRECTION	PER/RUN
Heating Water	1"	Up	40'

PART 2 – PRODUCTS

2.1 PIPING SYSTEMS

- A. Heating hot water piping system above grade shall be Schedule 40 black steel pipe. All piping 2-1/2" and larger shall be welded.
- B. Piping & fittings shall be of U.S. origin and manufacturer.

2.2 HANGERS AND SUPPORTS

- A. Vertical Piping:
 - 1. Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and to carry the weight of the pipe and contents.
- B. Copper tubing shall be supported at each story for piping one and one-half (1-1/2) inches in diameter and at not more than six (6) foot intervals for piping one and one-quarter (1-1/4) inches in diameter and smaller. Piping shall be wrapped with three wraps of vinyl tape to isolate pipe from ferrous pipe supports.
- C. Horizontal Piping:
 - 1. Under no circumstances shall piping be supported from the roof deck.
- D. It is essential that all piping be supported from the top chord of roof structure at joist panel point locations. Coordinate with structural requirements.
- E. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
- F. Screwed pipe (IPS) shall be supported at approximately 12-foot intervals.

- G. Copper tubing shall be supported at approximately 6-foot intervals for piping one and one-half inches and smaller in diameter and at 10-foot intervals for piping two inches and larger in diameter.
- H. Where piping is run adjacent to walls or steel columns, it shall be supported from steel brackets or vertical channel hangers. Brackets shall be Grinnell Figure PS 732 or PS 3282 as directed, or approved substitute. Channel systems shall be approved for each condition on an individual basis.
- I. Furnish all hangers, inserts, brackets, anchors, guides, sliding supports, etc., and all auxiliary steel necessary for the installation. All supports shall be designed in accordance with the AISC Steel Handbook and painted with one shop coat of primer paint.
- J. Insulation inserts and shields for cold surface piping will be provided under Section 220700 of these specifications.
- K. All copper, fiberglass, or plastic piping shall be securely supported from the building structure at intervals specified and/or as recommended by the pipe manufacturer. Hanger shields for suspended piping shall be functionally similar to isolators with Grinnell Fib. 97. Non-ferrous piping shall be isolated from contact with ferrous supports with three wraps of vinyl tape.
- L. Plumbers' tape, chain, or wire will not be permitted for pipe support.

2.3 HEATING WATER VALVES AND STRAINERS

- A. All valves and strainers shall be by one manufacturer. Approved valve manufacturers are Crane, Stockham, W. C. Norris, Grinnell, or Powell. Crane numbers are used for convenience.
- B. Gate Valves:
 - 1. Valves 2" and smaller shall be Crane No. 428, bronze, screwed, 200# WOG gate valve with solid wedge disc and rising stem.
- C. NOTE: If unable to use a rising stem valve because of insufficient clearance, use a Crane No. 438 non-rising stem valve.
- D. Check Valves:
 - 1. Valves 1-1/2" and smaller shall be Crane No. 37, bronze, screwed, Y-pattern 200# WOG swing check valve. Valves 2" and larger shall be Crane No. 373.
- E. Ball Valves:
 - 1. For hot and cold domestic water service: Valves 2" and smaller shall be Crane No. 2190H bronze, screwed, 200# WOG, Gem ball valve with Buna-N rubber capsule. Watts B6000 or Apollo 70-100.
- F. Strainers:
 - 1. Strainers 1-1/2" and smaller shall be Crane No. 988-1/2, iron body, screwed Y-pattern, 200# WOG, sediment separators with a 20-mesh Monel screen.
- G. All strainers shall be installed with fine mesh supplementary "construction screens" which shall remain in place while the system is flushed and chemically cleaned. The "construction strainer" basket shall be removed just prior to balancing the water systems.
- H. Provide blow-down ball valve on all strainers same size as strainer tapping.

2.4 NON-SLAMMING OR SPRING-LOADED CHECK VALVES

- A. Types: Provide valves of the fully guided or cone-and-diaphragm types.
- B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 126, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.
- C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250 degrees F. minimum continuous working temperature or not less than 50 degrees F. above the operating temperature of the system, whichever is higher.
- D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.
- E. Pressure Loss: Pressure loss through the valves, measured in feet of water, shall not exceed 6/10 of the water velocity in feet per second.
- F. Bubble-Tight: Non-slamming and spring-loaded check valves shall provide bubble-tight shut-off when handling water up to 250 degrees F. and 125 pounds per square inch differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.5 GENERAL DUTY VALVES & SPECIALTY COCKS

- A. Cocks:
 - 1. Balancing cocks 1-1/2" and smaller shall be Crane No. 80E, bronze, screwed, 200# WOG.
 - 2. Balancing cocks 2" and larger shall be Crane No. 325, all iron, flanged 125# WOG.
 - 3. Gage cocks shall be Crane No. 744, 1/4", bronze, screwed.
 - 4. Petcocks shall be Crane No. 702, 1/4", bronze, screwed with lever handle.
 - 5. Trycocks shall be Crane No. 734, 3/8", bronze, screwed, 250# rated with stuffing box.
 - 6. Provide two complete sets of wrenches for all cocks and stops.

2.6 AUTOMATIC VALVES AND WELLS

- A. The mechanical subcontractor shall install the automatic temperature control valves, temperature sensing wells, and flow switches, as directed by the automatic temperature control subcontractor.

2.7 UNIONS

- A. Ground joint unions shall be installed on pipe 2-1/2" and under where indicated on drawings. Whenever piping is connected to a major piece of apparatus, unions shall be provided as near as practical on each side of the apparatus.

2.8 ISOLATION FITTINGS

- A. Approved isolation fittings shall be installed at the junction of all copper and steel piping to prevent electrolytic action. Fittings shall be NZR Brass unions or fittings.
- B. This shall be a coordinated system with individual Venturi Flow Stations supplied by one manufacturer and each individual calibrated orifice supplied by one manufacturer.

- C. On pipe sizes 3/4-inch diameter and smaller, provide calibrated balancing valves on runouts to fan coil units, fin tube radiation, convectors and reheat coils.
- D. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.
- E. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.
- F. Provide a graduated dial or other device to indicate the valve setting.
- G. Gland shall permit packing under pressure.
- H. Materials and construction shall be as specified for water valves sizes 1-1/2-inch and smaller.
- I. On sizes 3/4-inch and smaller ends may be sweat or compression type.

2.9 PRESSURE & TEMPERATURE TEST PLUGS

- A. Plugs shall be brass body type with Neoprene, Nordel, or Vitron self-closing valve (to suit temperatures of fluid in pipe). Test plugs shall be Pete's Plug or approved substitute. Furnish six pressure and six temperature instruments to Owner to permit reading pressures and temperatures.

2.10 FLOW MEASURING AND BALANCING SYSTEMS

- A. Furnish and install complete the Venturi and calibrated orifice Flow Metering Systems as shown on the drawings.
- B. This shall be a coordinated system with individual Venturi Flow Stations supplied by one manufacturer and each individual calibrated orifice supplied by one manufacturer.
- C. On pipe sizes 3/4-inch diameter and smaller, provide calibrated balancing valves on runouts to fan coil units, fin tube radiation, convectors and reheat coils.
- D. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.
- E. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.
- F. Provide a graduated dial or other device to indicate the valve setting.
- G. Gland shall permit packing under pressure.
- H. Materials and construction shall be as specified for water valves sizes 1-1/2-inch and smaller.
- I. On sizes 3/4-inch and smaller ends may be sweat or compression type.
- J. Each station shall be complete with quick disconnect valves and safety shut-off valves, metal identification tag on chain giving pipe size, meter series, station identification, and meter reading at specified flow rate. Metering stations shall be selected so that design flow rate shall be between 10 and 40 inches of water pressure differential with permanent pressure loss of not more than 25% of indicated flow rate differential pressure.

- K. The calibrated flow metering valves shall be selected to deliver the rated flows at the mid-point of their set-point range.
- L. A master meter shall be furnished to the owner for maintenance purposes.
- M. Venturi Flow Metering System shall be by Barco Engineering Company or Robertson. Calibrated orifice system shall be Bell & Gossett or Armstrong.

2.11 CHEMICAL CLEANING

- A. Prior to operating any heating system, all piping systems and components shall be chemically cleaned and flushed by an experienced chemical cleaning service approved by the Engineer.
- B. Pipe Exterior: Wash and wipe pipe exterior to remove construction dirt, loose scale and flux.
- C. Pipe Interior: Flush pipe interior with clean water. Continue flushing until the piping system runs clean. After flushing, inspect strainer screens, refrigeration machine water boxes, piping low points, and tank drains to determine the presence of construction debris. If debris is found, disassemble equipment and remove debris. Re-flush the system and re-inspect.
- D. All existing and new heating water piping systems and strainers shall be thoroughly cleaned and flushed prior to start-up of any existing or new equipment.
- E. Do not operate existing centrifugal pumps until the system has been cleaned and flushed.

2.12 EXISTING HEATING WATER

- A. It is the responsibility of this contractor to drain the existing heating water as required for demolition and installation of all work required.
- B. It is the responsibility of the contractor to provide new chemicals for water treatment as required for the system and SLCDA standards.
- C. It is the responsibility of this contractor to ensure that the heating water system is full and all air is bled from system prior to Test & Balance.

2.13 PAINTING

- A. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match the original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.
- B. Mechanical Contractor: Spot painting for application of pipe and equipment identification markers. All piping exposed to weather.
- C. Painting Contractor: All insulated piping and all piping in equipment rooms of finished areas shall be painted, as required by the painting specifications. Colors to be selected by owner.

D. Coding, Pipe Identification & Painting:

1. All pipes are to be labeled and color coded with contents clearly identified and arrows indicating direction of flow. Pipes shall be identified at the following locations:
2. Adjacent to each valve.
3. At every point of entry and exit where piping passes thru wall or floor.
4. Every 50 feet on long continuous lines.
5. On each riser and junction.
6. Adjacent to all special fittings or devices (regulating valves, etc.)
7. Connection to equipment.

E. Apply markers to they can be read from floor.

F. Labels and markers shall be of the self-sticking, all temperature permanent type as manufactured by W. H. Brady Co., 727 West Glendale Avenue, Milwaukee, Wisconsin, or Seton Name Plate Corp., 592 Boulevard, New Haven, Connecticut.

G. Pipe color coding shall be uniform throughout.

H. Background colors shall be as follows:

Yellow:	Dangerous Materials (natural gas condensate, etc.)
Bright Blue:	Protective Materials (filtered water)
Green:	Safe Materials (chilled water, cold water, instrument air, sanitary sewer, etc.)

I. Letters of identification legend shall be 2" high for pipes 3" and larger, and 1" high for pipes 2-1/2" and under.

J. Markers shall be installed in strict accordance with the manufacturer's instructions.

K. On chalky and loose insulation, soft, porous, fiber-filled or fiberglass coverings, a spiral wrap of pipe banding tape shall be made around the circumference of the pipe. Sufficient spiral wraps shall be made to accommodate the horizontal dimension of the pipe marker.

L. On bare pipes, painted pipes, and pipes insulated with a firm covering, pipe banding tape matching the background color of the marker shall be used for 360 deg. color coding. After applying pipe markers, wrap pipe banding tape around pipe at each end of marker. Tape should cover 1/4" to 1/2" of each end of marker and should overlap approximately 1/2" to 1" on itself. Be sure pipe surface is dry and free of dirt or grease before applying markers or banding tape.

M. Stenciling may be used in lieu of the above labels and markers if finished application gives the same overall appearance, that is that stenciling is applied over a background color. If stenciling is used, letter heights, background colors, banding, and arrow shall be as specified above. Submit sample to Owner's representative before proceeding with work.

N. Ceiling Markers:

Use stick on ceiling markers on all accessible ceiling grid to indicate location of VAV boxes, valves, and dampers.

O. Color code as follows:

Yellow	HVAC
Green	Plumbing
Blue	Air
White	Duct valves
Orange	Electrical devices
Red	Fire

PART 3 – EXECUTION

3.1 COORDINATION

- A. All equipment and piping shall be arranged to allow for easy maintenance and access to service valves.
- B. Provide valves and unions or flanges at all pieces of equipment to allow maintenance.
- C. Install all automatic valves, sensor well, flow switches, etc., as directed by the control contractor.

3.2 TESTING

- A. All piping shall be tested in accordance with Section 230501 prior to applying insulation or concealing in partitions, wall, etc.

3.3 ACCESS

- A. All valves and equipment shall be located to allow easy access for inspection, service and maintenance, test and balance, and operation. If valves are installed in inaccessible locations, it shall be this contractor's responsibility to furnish and install access doors of a type approved by the owner's representative.
- B. Locate piping, valves, etc., to allow easy access to and maintenance of equipment. Do not block walkways, filter access, maintenance access, or tube-pull space in equipment rooms.

3.4 LOCATIONS & ARRANGEMENTS

- A. All pressure gages shall be so installed as to be easily readable from an eye level 5' -6" above the floor.
- B. Test plugs on flow measuring stations shall be unobstructed and shall be arranged in the piping per manufacturer's recommendations.
- C. All equipment and accessories shall be installed to facilitate proper service and maintenance in compliance with the manufacturer's recommendations.

3.5 WIRING BY THE ELECTRICAL CONTRACTOR

- A. It is the intent of these specifications that all line voltage electrical power wiring and power connections to equipment be furnished and installed by the electrical contractor, unless otherwise specified or shown on the drawings.
- B. The mechanical contractor shall coordinate actual job-site power requirements with the electrical contractor prior to installation of power wiring and electrical equipment.

- C. The electrical contractor shall provide necessary wiring to electric heat tape as required and shall coordinate with the mechanical contractor the location and capacity of required circuits.
- D. When mechanical system components are furnished with remote mounted control panels, alarm bells, alternators, etc. the electrical contractor shall run all required line voltage power wiring as directed by the mechanical contractor. It shall be the mechanical contractor's responsibility to coordinate the work and provide the necessary wiring diagrams.
- E. When exhaust fans are provided which are not controlled by the ATC contractor, they shall be wired to local line voltage wall switches. The wall switch locations shall be coordinated with the owner's representative.
- F. Line and low voltage control wiring will be furnished and installed by the ATC contractor in accordance with NEC and Division 26. Minimum 3/4" EMT conduit.

3.6 INSTALLATION OF ABOVE GROUND PIPING

- A. Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.
- B. Install piping systems in conformance with ANSI B31.
- C. Install piping to allow for expansion and contraction of the piping systems. Provide offsets and swing joint connections at coils, pumps and other equipment to eliminate undue strain to the equipment connections.
 - 1. Perform welding in conformance with ANSI B31.1.
 - 2. Perform welding in ambient temperatures above 0 degrees F.
 - 3. Ream and clean ends of piping.
 - 4. Support piping align and tack weld making allowance for pipe pitch and insulation. Temporarily block piping at hangers.
 - 5. Use welding pipe clamps on piping 4-inch diameter and larger and verify alignment before welding.
 - 6. Connect flanges and tack weld piping systems in place before full circumferential welds are made.
 - 7. Springing of piping at equipment connections will not be permitted.
 - 8. The use of "cold-spring" is not permitted.
- D. Branch connections to up feed systems shall be made at the top or at a 45-degree angle above the centerline. Branch connections for down feed systems shall be made at the bottom or at a 45-degree angle below the centerline.
- E. Install water piping with a pitch or slope of not less than 1-inch in 40 feet.
- F. All installed pipelines shall be straight, free from dents, scars and burrs, with ends reamed smooth and shall remain straight against strains tending to cause distortion during system operation. The Contractor shall make proper allowance for pipeline expansion and contraction so that no unsightly distortion, noise, damage or improper operation will occur.
- G. Piping shall be run in a neat and efficient manner and shall be neatly organized. Piping shall be run parallel or at right angles to the building walls or construction. The Contractor shall study the general, electrical, and other drawings to eliminate conflict of piping with structure, sheet metal, lighting, or other services. Unless specified otherwise, no piping shall be exposed in a finished room, all changes in direction shall be made with fittings.
- H. All piping shall be clean and free from acids and loose dirt when installed.

- I. Temporary pipe plugs of rags, wool, cottons, waste or similar materials shall not be used.
- J. All piping shall be so arranged to not interfere with removal of other equipment or devices and shall not block access openings, etc.
- K. Piping shall be arranged to facilitate equipment maintenance.
- L. Flanges or unions shall be provided in the piping at connections to all items of equipment.
- M. All piping shall be so installed to insure noiseless circulation.
- N. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated and adjusted at the completion of the work.

3.7 VALVE INSTALLATION

- A. After the piping system has been tested and put into service, but before final testing, adjusting and balance, inspect each valve for possible leak. Open and close each valve to verify proper operation.

End of section 230900

BLANK PAGE

SECTION 23 3000 - AIR DISTRIBUTION

PART 1 – GENERAL

1.1 SCOPE

- A. Work shall include the air distribution duct systems, and all materials, equipment, and labor required to complete the systems shown on plans and specified herein.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Construct all ducts, plenums, etc., of the gauges specified in the latest editions of the applicable SMACNA manuals, unless otherwise shown. Sheets shall be free from blisters, slivers, pits, and imperfectly galvanized spots.
- B. Duct construction and installation details shall comply with the latest edition of the SMACNA Duct Construction Standards.
- C. Ducts from the fan unit discharge to VAV terminal boxes shall be constructed to meet the requirements of a +4-inch pressure class. All other supply air ducts shall be designed to meet the requirements for +2-inch pressurized ducts. All exhaust ducts shall be -2-inch suction ducts.
- D. All supply air ducts shall be designed to meet the requirements for +2-inch pressurized ducts. All exhaust ducts shall be -2-inch suction ducts.

2.2 +4" PRESSURE CLASS DUCTWORK

- A. All ductwork on the discharge side of Air Conditioning units to the terminal boxes shall be +4" pressure class duct. It is the essence of the duct system to have a minimum pressure loss. Therefore, ducts shall be run in a straight line and shall be run so that the lowest beam or obstruction shall generally determine the centerline of the straight run. Eccentric reducing transition shall be avoided but may be used where space is a determining factor. Bends and elbows other than those shown on the drawings shall have the approval of the Owner's representative before installation. No pipes, conduits, or any other obstructions shall be run through +4" P.C. ductwork.

2.3 ROUND DUCTWORK +4" PRESSURE CLASS

- A. The round +4" P.C. HVAC ductwork, fittings, and accessories shall be factory fabricated, spiral conduit. Ductwork may, when approved by the owner's representative, be fabricated in a 26 ga. standing rib configuration. The ducts shall be constructed of rust-resistant zinc-coated steel and shall be of the sizes called for on the drawings.
- B. All fittings in the round ducts shall be factory fabricated to match the spiral ducts and shall be of the same manufacturer.
- C. Round duct joints in diameters through 50 inches shall be sealed as follows:

- D. Approved sealer equal to "Hard Cast" shall be applied to the coupling and fittings. Sealer is applied to the outside of the joint, extending 1 inch on each side of the joint bead and covering all screw heads. Plastic backed tape is immediately applied over the wet sealer.
- E. The duct sealer must be specifically formulated for the job sealing the field joints for high-pressure systems. The sealer shall be compatible with plastic-backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the Owner's representative for approval.
- F. Flanged joints shall be sealed by Neoprene Rubber Gaskets.

2.4 ACCESS DOORS AND PANELS

- A. Location: Provide access doors in casings, plenums, and ducts where shown on the drawings and where specified for ready access to operating parts including fire dampers, smoke dampers, valves, and concealed coils.
- B. Pressure Clarification: Construct and install access doors in accordance with SMACNA Standards to suit the static pressure classifications and the locations where installed.
- C. Access Doors in Ducts: Provide and size doors as follows:
 - 1. Minimum 24-inch by 24-inch clear opening.
 - 2. When field conditions require an access opening smaller than 16-inch by 12-inch, provide a 24-inch long removable section of casing or duct, secured with quick acting locking devices, 6 inches on centers, to permit ready access without dismantling other equipment.
- D. Door Requirements: Provide doors in casings and duct as follows:
 - 1. Arrange doors so that system air pressure will assist closure and prevent opening when the system is in operation.
 - 2. Coordinate doors and equipment to provide unrestricted passage through clear door opening, without removal of any equipment.
 - 3. Where pressure regulating dampers are installed in ducts or plenums, provide access doors with a clear wire glass observation port, 6-inch by 6-inch minimum size. Anchor port with structural metal frame, resilient gaskets and stainless-steel bolts.
 - 4. Hinges for doors in zinc coated or aluminum construction shall be steel or iron, zinc coated with brass pins.
 - 5. Hinges for doors in copper, copper nickel alloy construction shall be all brass.

2.5 CLOSURE COLLARS

- A. A duct ending at a wall or partition shall have the edge turned back to form a closure collar and flanged tight to the wall or partition so that no sharp or ragged edge appears.

2.6 TEST HOLES IN DUCTWORK

- A. Test holes for testing air quantities in ducts shall be installed at locations to be specified by the Balancing Contractor. Rubber stoppers shall be provided for closing the test holes. Where these holes are installed in insulated ductwork, a removable plug of approved insulation material shall be provided. An instrument port shall be provided in the following locations for each fan system.

1. Return air shaft and/or duct upstream of sound traps:

- a. Return air fan plenum
- b. Main return air duct upstream of fresh air dampers
- c. Mixed air plenum
- d. Supply fan plenum

B. Additional ports are to be installed in locations determined by the Owner's representative.

C. Instrument ports shall be die cast with screwed cover for the insulation thickness specified. Ports shall be located outside of the plenum with 20-gauge sheet metal sleeve of the same size as the port opening, passing through insulation where ducts have interior insulation.

2.7 CLEANOUT OPENINGS

A. Duct systems shall have cleanout openings equipped with tight fitting sheet metal doors. Doors shall be tightly latched without the use of tools.

2.8 FIRE-RESISTIVE ACCESS OPENING

A. When cleanout openings are located in ducts within a fire-resistive shaft or enclosure, access openings shall be provided in the shaft or enclosure at each cleanout point.

B. These access openings shall be equipped with tight-fitting sliding or hinged doors which are equal in fire-resistive protection to that of the shaft or enclosure.

2.9 CLEARANCES

A. Duct systems shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than three inches, provided the combustible material is protected with materials approved for one-hour fire-resistive construction on the duct side.

2.10 BRANCH TAKEOFFS

A. Branch takeoffs shall be as shown on the drawings, and shall be fitted with adjustable lock balancing dampers, complete with locking quadrants. Where dampers are not accessible for adjustment from above, concealed ceiling regulators with adjustable chrome-plated covers shall be provided.

2.11 WALL PENETRATIONS

A. All ducts penetrating structural or architectural walls shall be sealed air and sound tight.

2.12 FIRE RATED SURFACE PENETRATIONS

A. All ducts penetrating fire rated surfaces shall be sealed as directed in 230900.

2.13 DUCTWORK

A. All duct work shall be fabricated and installed in compliance with the latest SMACNA duct manuals.

B. Sheet metal ducts shall be properly braced and reinforced with and, where they protrude above roof, they shall be properly flashed.

2.14 DUCT JOINTS

- A. All duct joints must be sealed airtight as required by Table 1-2 "SEAL CLASSIFICATION" of the "HVAC Duct Construction Manual". The term "seal" or "sealed" means use of mastic or mastic plus tape or gasketing as appropriate.

2.15 DIMENSIONS

- A. Ducts, unless otherwise approved, shall conform accurately to the dimensions indicated on the drawings, and shall be straight and smooth on the inside with joints neatly finished. All duct sizes shown on the drawings are free area inside dimensions. Acoustically-lined ducts shall have outside dimensions increased as required to accommodate the acoustic lining specified and still maintain the free area inside dimensions shown on the drawings.
- B. Under no circumstances shall the cross section of any duct be decreased by dents, pipes, or hanger rods running through it unless otherwise indicated on the drawings. Neither shall the shape be changed without approval. No abrupt transitions that restrict the area shall be used. Where necessary to gain clearance, the duct seams may be turned inside. Structural and Architectural drawings shall be consulted for areas with restrictive clearances.

2.16 FIELD VERIFICATION

- A. No ductwork shall be fabricated without first field verifying that the available space (under actual job conditions) will permit installation of the ductwork without structural or other conflicts.

2.17 PRE-MANUFACTURED DUCTS

- A. Runouts above ceiling from primary supply air ducts to VAV terminal boxes shall be rigid conduit.
- B. Runouts above ceiling from the terminal boxes to the ceiling diffusers shall be similar to "Genflex - Type IL". Maximum allowance length is 5'-0" in any given duct run. Duct to be factory fabricated with spring steel wire helix and 1" thick glass fiber insulation covered with external vapor barrier and lined with continuous non-perforated inner sleeve.
- C. Material shall comply with IMC Standard 10-1.

2.18 AIR FLOW MEASURING DEVICES

- A. The sheet metal contractor shall install the air flow measuring devices as specified in Section 251000. The devices will be furnished by the control contractor.

2.19 RECTANGULAR DUCT LINING

- A. The interior surface of all rectangular supply, return, fresh, relief, and exhaust air ducts (except where noted otherwise), shall be lined with 1" thick fiberglass dual density duct liner, having an average "K" factor of .24 BTU at 75 deg. F mean. The liner shall meet standards NFPA No. 90A and No. 90B and shall have the Underwriters' Laboratories, Inc., label.

- B. Duct liner shall be applied to the flat sheet with a 100% coverage of duct adhesive. The duct liner shall be cut to assure snug corner joints. The black surface of the liner shall face the air stream. On horizontal runs, tops of ducts over 12" in width and sides over 16" in height shall be additionally secured with welded pins and speed clips on a maximum of 15" centers. On vertical runs, gripnails or welded pins and speed clips shall be spaced on a maximum of 15" centers on all width dimensions over 12". Pins shall start within 2" of all cross joints within the duct section.
- C. Welded pins shall be cut virtually flush with the liner surface. Clips should be drawn down flush only and not so as to compress the liner and cause the leading edge of raise. All exposed edges and the leading edge of all cross joints of the liner shall be coated with adhesive.
- D. Material shall comply with IMC Standard 10-1.

2.20 DAMPERS - GENERAL

- A. Damper frames shall be of not less than 18-gauge galvanized steel, formed for extra strength, with mounting holes for enclosed duct mounting.
- B. All damper blades shall be of not less than 16-gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must be of not over 6" in width. Blades shall be secured to 1/2" diameter zinc-plated axles by zinc-plated bolts and nuts. All blade bearings shall be nylon. Blade side edges shall seal off against spring stainless steel seals. Teflon-coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and insure smooth operation. All blades linkage hardware shall be constructed of corrosion-resistant, zinc-plated steel and brass.

2.21 FAN POWERED VARIABLE AIR VOLUME RE-HEAT BOXES:

- A. Approved manufacturers: Price, Nailor, Titus or approved equal.
 - 1. Pressure Independent Variable-Volume Series Fan-Powered Unit: FDC (direct digital controls).
- B. Performance Requirements:
 - 1. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. Sound ratings of air distribution assemblies shall not exceed 20 NC at scheduled inlet static pressure,
 - 2. Use attenuation values found in AHRI 885 Appendix E.
- C. General:
 - 1. The manufacturer shall supply factory-assembled and wired, AHRI 880 rated, horizontal fan-powered terminal units with blower, motor, mixing plenum, and primary air damper contained in a single unit housing.
- D. Description:
 - 1. Furnish and install Price model FDC series fan powered terminal unit in the sizes and configurations as indicated on the plans.
- E. Unit Casing:
 - 1. The unit casing shall be constructed of galvanized steel with a minimum material thickness of 20 gauge. The discharge panel shall be constructed of 18-gauge galvanized steel for increased rigidity and sound attenuation.
 - 2. Primary air inlet collar: Manufacturer shall provide round inlet collars, suitable for standard flexible duct sizes.

3. Unit Discharge: Manufacturer shall provide rectangular unit discharges, suitable for flanged duct connection.
 4. Liners:
 - a. Standard:
 - 1) Fiberglass Liner - FG.
 - a) Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
 - b) The insulation shall be secured with adhesive.
 - c) Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
 - d) Insulation thickness shall be 1 inch thick, R-value of 4.1.
- F. Primary Air Damper Assembly:
1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bushings.
 2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
 3. The damper shaft shall be mounted on the [left], or [right] of the damper when looking in the direction of airflow.
 4. The low leakage 18-gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
 - a. Air leakage past the closed damper shall not exceed two percent of the unit maximum airflow at 3-inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.
 - b. The damper, seal and bushing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.
 5. Airflow Sensor:
 - a. The airflow sensor shall be a differential pressure airflow device measuring total and static pressure and shall be mounted to the inlet valve.
 - b. Plastic parts shall be fire-resistant, complying with UL 94.
 - c. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Materials containing polybrominated compounds shall not be acceptable.
 - d. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
 - e. The airflow sensor shall be furnished with a minimum of twelve total pressure sensing ports and four static sensing ports and shall include a center averaging chamber that amplifies the sensed airflow signal.
 - f. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.
 6. Inlet Valve:
 - a. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
 - b. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
 - c. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
 - d. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the open and closed position.

G. Fan: The terminal unit shall be supplied with a forward curved, centrifugal type fan.

H. Fan Motor:

1. The fan motor shaft shall be directly connected to the fan.
2. The fan shall be isolated from the casing to prevent transmission of vibration, with the following motor type (select one):
 - a. Permanent Split Capacitor (PSC):
 - 1) Thermally protected, single speed, multi-voltage (120, 208/240, 277), 60 cycle, single phase, energy efficient design, permanently lubricated, using permanent split capacitor type for starting and specifically designed for use with a SCR (Silicon Controlled Rectifier) fan speed controller.
 - b. Electrically Commutated Motor (ECM):
 - 1) Brushless DC controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator. The motor shall be supplied with a speed controller. The speed controller shall have dual outputs to control up to two motors, and allow for manual dial motor speed adjustment, or a [2-10 VDC] or [4-20 mA] signal for variable speed control.
 - 2) Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
 - 3) Designed to maintain a minimum of 70 percent efficiency over the entire operating range.
 - 4) The ECM shall be furnished with factory programming (**select one**):
 - a) High Turndown Program
 - i. A high turndown program shall be provided to allow the ECM to operate with constant torque to vary the airflow with fluctuations in external static pressure.
 - ii. The motor shall be capable of operating at low speeds to accommodate an increased turndown ratio, a wider airflow range, and decreased energy consumption as compared to typical pressure independent motor programs.
 - b) Pressure Independent Program
 - i. A pressure independent program shall be provided to allow the ECM to compensate for fluctuations in external static pressure, providing constant airflow.
 - ii. The air volume flow rate shall be maintained to within five percent of desired flow in a system with up to 0.50 inches water gauge of external static pressure.

I. Electrical Requirements:

1. Fan powered terminal units shall be provided with single-point power connection.
2. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.

J. Controls:

1. See Section 25 1000 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.

K. Controls Sequence:

1. See Section 25 1000 - Sequence of Operations for HVAC Controls for controls sequence requirements.

L. Hot Water Heating Coil:

1. The hot water coil casing shall be constructed from a minimum 22-gauge, 0.032-inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.
 - a. An optional gasketed and insulated access door shall be provided, located on the bottom of unit.
 - b. Coil handing shall be identical to unit handing.
2. The water coil fins shall be 0.0045-inch aluminum fins, mechanically bonded to seamless 0.50 by 0.016-inch copper tubes.
 - a. Fins shall be formed in a high heat transfer sine wave configuration.
 - b. Standard coil shall be constructed with 10 fins-per-inch fin spacing.
 - c. High-capacity coil shall be constructed with 12 fins-per-inch fin spacing and larger casing to increase capacity.
3. All water coils shall be hydrostatically tested to a minimum of 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
4. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.

M. Plenum Return Filter:

1. The plenum return shall be supplied with fiberglass filters.
2. When tested in accordance with ASHRAE 52.2, the filter shall have a Minimum Efficiency Reporting Value of (**select one**):
 - a. MERV 3 filter.

N. Sound Attenuation:

1. Discharge Silencer (SLR):
 - a. The manufacturer shall provide an AHRI certified assembly complete with an acoustically tuned silencer.
 - b. The silencer shall be available with the following acoustical media options:
 - c. Fiberglass - FG
2. Installation:
 - a. Install the terminal units in accordance with the manufacturer's instructions.
 - b. Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.
 - c. See drawings for the size(s) and duct location(s) of the air terminal units.
 - d. Support the terminal units individually from the structure in accordance with manufacturer's recommendations.
 - e. Embed anchors in concrete in accordance with ASTM E488/E488M.
 - f. Do not support the terminal units from the ductwork.
 - g. Connect the terminals to the ductwork in accordance with Section 233000.
 - h. Install heating coils in accordance with Section 2330000..
 - i. Verify that electric power is available and of the correct characteristics.
 - j. Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

2.22 VARIABLE AIR VOLUME BOXES:

- A. Casings shall be 26 gauge galvanized with flange rectangular discharge duct connection. A one-piece aluminum backdraft damper shall be provided on the fan discharge. The damper shall be factory set and aligned to insure a precise seal. Leakage rate shall not exceed 2 percent of rated capacity at 0.5" static pressure.

- B. Automatic damper operators and controllers shall be furnished by the ATC contractor and installed by the VAV box manufacturer. Boxes to be c/w paint tie-in for interface with room occupancy sensors. Provide sheet metal enclosure around damper operator/controller.
- C. The VAV box manufacturer shall furnish and install an approved cross flow sensor with a gain factor of not less than three (3).
- D. VAV boxes shall be provided with a pressure independent 3-position volume regulator which operates thru a thermostatically reset velocity controller to provide constant air delivery within plus or minus 5 percent of rated flow, and down to 25 percent of the VAV box rated CFM. Factory calibrated field adjustable setpoints shall be provided to set maximum and minimum CFM.
- E. Control enclosure shall be on same side of the coil connections.
- F. Contactor is responsible to coordinate coil and control LH or RH with supplier prior to ordering of boxes.
- G. 30" minimum shall be kept clear at valve and control side of box from all piping, lighting, structure, etc. for ease of service.
- H. The entire unit shall be serviceable from a single ceiling access door.
- I. Units shall be Price, Nailor, Titus, or approved equal.

2.23 CROSS FLOW PRESSURE SENSORS FOR VAV BOXES

- A. Sensors shall be aluminum corrosion resistant of the crossflow type with ported tubes and baffle mounted to a center manifold. The center manifold shall have 1/4" barb fittings for FRPE tubing and shall provide a differential pressure proportional to the average velocity of air moving through duct.
- B. The sensors shall have an amplification factor (gain) of at least three and flow coefficient as follows:

Size	Cv
4	209
5	315
6	462
7	612
8	817
10	1250
12	1792

PART 3 – EXECUTION

3.1 JOB SITE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations in the approved shop drawings.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy, until all such discrepancies have been fully resolved.

3.2 INSTALLATION OF EQUIPMENT

- A. Install all equipment with adequate space for service and maintenance. **Minimum of 24” clearance for all service and control access.**
- B. VAV boxes which require periodic service and maintenance shall be installed in plenum space within 2 ft. of finished ceilings, or within 2 ft. of the bottom chord of the structure.
- C. VAV box service areas shall be clear of all light fixtures and piping.
- D. Care shall be taken to avoid interference with structure and the work of other trades. Do not cut into load carrying members without the approval of the Owner's representative.

3.3 INSTALLATION OF DUCTS

- A. All ducts shall be installed in compliance with the latest editions of the SMACNA manuals.
- B. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All changes, however, must be approved and installed as directed.
- C. Pre-manufactured ducts shall be connected to rigid ducts and equipment with solid wraps of fabric duct tape and tyton bands drawn tight to form an airtight joint.
- D. During the installation, the open ends of all ducts shall be protected by covering with plastic sheet tied in place to prevent debris and dirt from entering.
- E. Install this work in cooperation with other trades so that there will be no delay in the progress of construction work. It is extremely important that the duct system be clean before connections are made to the VAV boxes.
- F. The contractor shall take special care when running exposed ductwork to ensure that the final installation is neat in appearance.

- G. Under no circumstances shall ductwork be supported from the metal roof deck. (See general requirements 230100 & 230900)
- H. Ceiling outlets shall be rigidly supported from the overhead structure with G.I. wires or straps, or from rigid galvanized iron ductwork. Outlets shall not be supported from T-bar ceilings or metal roof deck.
- I. Hanger and Supports:
 - 1. Hangers for ducts up to 18" in width shall be placed on not more than 8'-0" centers. Ducts 19" and over in width shall be supported on not more than 4'-0" centers. Hangers shall be placed plumb and present a neat appearance. Construct hangers from galvanized band iron 1" x 1/8" for duct up to 36" wide. Hangers shall extend down the sides of the ducts not less than 9". On ducts less than 9" in depth, hangers shall extend the full depth of the ducts. Attach hangers to ducts using not less than three rivets or parker screws of appropriate sizes. It is essential that all ducts be rigidly supported. Where vertical ducts pass thru floors or roofs, supporting angles shall be rigidly attached to ducts and to the structure.
Angles shall be galvanized and of sufficient size to support the ductwork rigidly. Place supporting angles on at least two sides of the duct. For round ducts, strap hangers shall extend completely around ducts.
 - 2. Ceiling outlets shall be rigidly supported from the overhead structure with G.I. wires on straps, or from rigid galvanized iron ductwork. Outlets shall not be supported from T-bar ceilings unless approved by the owner's representative.

3.4 STORAGE OF DUCTS

- A. Ductwork shall be stored in a protected area to prevent physical damage to the duct liner, and to ensure that the duct liner is not exposed to excessive heat or moisture which would deteriorate the air side surface.
- B. Ductwork which has been improperly stored and/or sustained physical damage will be rejected and shall be removed from the job site as directed by the Owner's representative.

3.5 CLEANING OF DUCTS

- A. Before ducts are insulated and before the ceiling is installed and final connections made to the terminal boxes, the fans shall be operated at full capacity to blow out any dirt and debris from ducts. If it is not practical to use the main supply blower for this cleaning, the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned and initially pressure tested, the final connection shall be made to the terminal boxes.

3.6 TESTING OF DUCTS

- A. Supply, return, and exhaust ducts, plenums, and casings operating at duct pressures from +2" to -2" shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean a leakage rate less than 5% of the rated airflow.
- B. Supply air ducts operating at pressures above +2" shall be tested and made substantially airtight. Leakage shall be less than 1% of the rated air flow.

- C. Ducts including all flexible runouts shall be tested in accordance with SMACNA Duct Construction Standards.

- D. After the vertical duct risers or branch ducts have all been tested and tied into the mains, and after the central station air handling apparatus has been installed, the mains shall be tested in accordance with SMACNA Duct Construction Standards.

End of section 233000

SECTION 25 0130- BAS INTERFACE REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section defines product requirements and documentation to be provided for devices which are a part of, or communicate with the Building Automation System (BAS) through a network connection.
- B. Related Requirements:
 - 1. Section 25 01 25 "Building Automation System"

1.3 DEFINITIONS

- A. BAS: Building Automation System.
- B. BACnet Specific Definitions:
 - 1. BACnet: Building Automation Control Network Protocol, ANSI/ASHRAE 135.1. A communications protocol allowing devices to communicate data and services over a network.
 - 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
 - 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
 - 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
 - 5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- C. BTL: BACnet Testing Laboratory.
- D. Device: any physical object that is controlled, monitored or otherwise communicates with the BAS.
- E. Gateway: Bidirectional protocol translator that connects control systems using different communication protocols.
- F. MODBUS/RTU: A serial data communication protocol.
- G. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- H. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- J. Third-Party Device: A device not manufactured specifically for or manufactured by a supplier.

1.4 PRODUCT REQUIREMENTS

- A. Any system or device which is part of, connected to, monitored by or communicates with the BAS through a network connection must use either MODBUS or BACnet protocol. All cabling required to support the network connection shall be installed in accordance with Division 27 requirements.
- B. BACnet Requirements
 - 1. BACnet systems or devices must be certified by BTL and must carry a "BTL Mark" signifying compliance with ANSI/ASHRAE 135.1.
 - 2. All systems and devices shall use BACnet/IP or MSTP protocol.
 - 3. Devices shall communicate peer-to-peer with other devices.
 - 4. Devices shall be able to use local broadcasts received by all peer devices on the network.
 - 5. Devices shall be able to send remote broadcasts to devices residing on networks having different network numbers.
 - 6. Devices shall be capable of data sharing to include BACnet priority, change of value, trending, scheduling, alarm/event management, device and network management.
 - 7. Devices shall conform to the BACnet PICS.
 - 8. All devices shall be certified, listed and stamped by the BTL.
- C. MODBUS Requirements:
 - 1. Devices shall adhere to MODBUS TCP/IP or MODBUS RTU protocol.
 - 2. Devices shall follow the client/server model for communication between devices. The client initiates the transaction, the server responds to complete the transaction.
 - 3. Devices which translate any protocol to MODBUS shall not be used.
- D. Gateways shall not be used.

1.5 SUBMITTALS

- A. Action Submittals
 - 1. Product Data: For each type of product demonstrating compliance with this specification including the following:
 - a. Product description with complete technical data and product specification sheets.
 - b. Installation, operation and maintenance instructions.
 - c. BACnet specific information:
 - 1) PICS data sheet.
 - 2) BIBB document.
 - 3) Functional Specification Document (FSD) describing how the device will provide the specified BAS interface.
 - d. MODBUS specific information:
 - 1) Configuration guide including a register of all system points.

B. Informational Submittals:

1. Data Communications Protocol Certificates: Certifying that each proposed BACnet system component complies with ASHRAE 135.

1.6 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. MODBUS devices shall be installed, configured, and programmed by technicians or application engineers certified by the manufacturer for MODBUS products.

PART 2 – EXECUTION

2.1 INTEGRATION RESPONSIBILITIES

A. BAS responsibility for systems integration:

1. Provide the necessary server and software to act as a BACnet or Modbus client.
2. Verify that the Source device is communicating with the BAS.
3. Configure all points provided by the third-party system (Source) as BACnet or Modbus objects.
4. Represent the integrated points on BAS graphics.
5. Display and update objects, including alarms, using COV or polling mechanism of the Source. Data will be represented as received from the Source. No additional processing will be performed.
6. Provide Source with necessary addressing and network information for Source programming.

B. Third-party (Source) responsibility for systems integration:

1. Program intrinsic reporting of alarms and events as Notification Class objects.
2. Provide Device ID, Name, Object ID, Object Type, Description and other parameters as a electronic file of the proper type.
3. Install source communication device and configure settings to communicate with the BAS.
4. Program Device ID, Port Numbers, and Network Numbers into Source device, based on information provided by BAS.
5. Program IP addresses into all Source IP devices.
6. Provide BACnet PICS or equivalent Modbus information for Source.
7. Provide necessary Source equipment.
8. Verify that the Source device is communicating with the BAS.
9. Provide support for integration, startup, testing and commissioning.
10. Coordinate with Division 27 contractor to provide all horizontal cabling for any BAS device that requires an Internet Protocol (IP) network connection. All horizontal cabling shall be installed in accordance with Division 27 specification requirements.

2.2 ACCEPTANCE TESTING

- A. Acceptance testing for any system or equipment with network connection to BAS shall include demonstrating that all points required by the contract documents are properly originated (by the Source or BAS) and received (by the BAS or Source).
- B. Systems or equipment will not be accepted until the network communication is functional.

End of Section 250130

BLANK PAGE

SECTION 25 02 05 - FIELD DEVICES FOR BUILDING AUTOMATION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Air-temperature sensors.
2. Space-temperature sensors
3. Space Carbon Dioxide sensors
4. Space occupancy sensors
5. Air-pressure sensors
6. Air-pressure switches
7. Air-pressure transmitters
8. Air-pressure indicating transmitters
9. Airflow sensors
10. Control dampers
11. Damper actuators
12. Control valves
13. Valve actuators
14. Current sensors
15. Level Transmitters

1.3 SUBMITTALS

- A. Action Submittals

1. Product Data: For each type of the product, including the following:
 - a. Field device matrix: provide a matrix of all field devices including generic description, specification reference, model number and application. This must be submitted with the product information. Product information will not be reviewed without this matrix. To facilitate submittal review, indicate whether each device is the same as submitted for DP16, different from DP16, or new field device.
 - b. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - d. Product description with complete technical data, performance curves, and product specification sheets.
 - e. Installation operation and maintenance instructions, including factors affecting performance.

B. Informational Submittals

1. Product Certificates: For each product requiring a certificate.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2.2 AIR-TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 1000 ohms at zero deg. C and a temperature coefficient of 0.00385 ohm/ohm/deg.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:
 - a. Range: Minus 50 to 275 deg F.
 - b. Accuracy: Plus or minus 0.2 percent at calibration point.
 - c. Repeatability: Within 0.5 deg F.
 - d. Self-Heating: Negligible.

B. Platinum RTD, Single-Point Air Temperature Duct Sensors:

1. Probe: Single-point sensor with a stainless-steel sheath.
2. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.
3. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
4. Gasket for attachment to duct or equipment to seal penetration airtight.

C. Platinum RTD, Air Temperature Averaging Sensors:

1. Multiple sensors to provide average temperature across entire length of sensor.
2. Rigid probe of aluminum or stainless-steel sheath.
3. Flexible probe of aluminum or stainless-steel sheath and formable to a 4-inch radius.
4. Length: As required by application to cover entire cross section of air tunnel. Minimum length is 1 linear foot per 1 square foot of face area.
5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.

D. Platinum RTD Outdoor Air Temperature Sensors:

1. Probe: Single-point sensor with a stainless-steel sheath.
2. Solar Shield: Stainless steel.

3. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.

2.3 AIR-TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Description:

- a. Two-position control.
- b. Field-adjustable set point.
- c. Manual reset.
- d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Performance:

- a. Range: 35 to 45 deg F.
- b. Enclosure Ambient Temperature: 0 to 140 deg F.
- c. Sensing Element Maximum Temperature: 250 deg F.
- d. Voltage: 120-V ac.
- e. Current: 16 FLA.
- f. Switch Type: Two SPDT snap switches operate on coldest 12-inch section along element length.

3. Construction:

- a. Vapor-Filled Sensing Element: Nominal 20 feet long.
- b. Dual Temperature Scale: Fahrenheit visible on face.
- c. Set-Point Adjustment: Screw.
- d. Enclosure: Painted metal, NEMA 250, Type 1.
- e. Electrical Connections: Screw terminals.

2.4 SPACE TEMPERATURE SENSORS

A. Temperature Sensors for Unit Controllers: Each unit controller shall be provided with a matching room temperature sensor.

1. Auxiliary Communication Port. Each space temperature sensor shall include an integral terminal jack used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from a portable operator's terminal.

2. Plain Space Temperature Sensors: Where called for on the drawings, provide sensors with plain covers.

- a. The sensing element for the space temperature sensor shall be thermistor type providing the following.

- 1) Element Accuracy: $\pm 1.0^{\circ}\text{F}$
- 2) Operating Range: 55 to 95^o F
- 3) Set Point Adjustment Range: 55 to 95^o F

- 4) Calibration Adjustments: None required
 - 5) Installation: Up to 100 ft. from controller
3. Digital display temperature sensor:
- a. As called for on the drawings, provide temperature sensors with digital displays.
 - b. The sensing element for the space temperature sensor must be IC-based and provide the following.
 - 1) IC Element Accuracy: +/- 0.9°F
 - 2) Operating Range: 55 to 95 °F
 - 3) Setpoint Adjustment Range: User limiting, selectable range between 55 and 95 °F
 - 4) Calibration: Single point, field adjustable at the space sensor to +/- 5°F
 - 5) Installation: Up to 100 ft. from controller
 - 6) OLED Temperature Display
 - 7) Display of temperature setpoint with numerical temperature values to one decimal place.
 - 8) Display of temperature setpoint graphically, with a visual Hotter/Colder setpoint indication
4. Provide the following options as they are called for on the drawings:
- a. Setpoint Adjustment. The setpoint adjustment function shall allow for modification of the temperature by the occupant or building operator. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an operator at any workstation, Building Controller, room sensor two-line display, or via a portable operator's terminal.
 - b. Override Switch. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an operator at the operator interface, Building Controller, room sensor two-line display or via a portable operator's terminal.

2.5 AIR-PRESSURE SENSORS

A. Duct Insertion Static Pressure Sensor:

1. Sensor probe with two opposing orifices designed to reduce error-associated air velocity.
2. Sensor insertion length shall be 4 inches or 8 inches.
3. Construct sensor of Type 304 stainless steel.
4. Sensor probe attached to a mounting flange with neoprene gasket and two holes for fasteners.
5. Mounting flange shall suitable for flat oval, rectangular, and round duct configurations.
6. Pressure Rating: 10 psig

B. Outdoor Static Pressure Sensor:

1. Provides average outdoor pressure signal.
2. Sensor with no moving parts.
3. NEMA 250, Type 4X enclosure.
4. Pressure Connection: Brass barbed fitting.
5. Conduit fitting around pressure fitting for sensor support and protection to pressure connection.

2.6 AIR-PRESSURE SWITCHES

A. Air-Pressure Differential Switch:

1. Diaphragm operated to actuate an SPDT snap switch.
 - a. Fan safety shutdown applications: Switch with manual reset.
2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
3. Enclosure Conduit Connection: Knock out or threaded connection.
4. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
5. Enclosure:
 - a. Dry Indoor Installations: NEMA 250, Type 1.
 - b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
6. Operating Data:
 - a. Electrical Rating: 15 A at 120- to 480-V ac.
 - b. Pressure Limits:
 - 1) Continuous: 45 inches wg.
 - 2) Surge: 10 psig.
 - c. Temperature Limits: Minus 30 to 180 deg F
 - d. Operating Range: Approximately twice set point.
 - e. Repeatability: Within 3 percent.
 - f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 AIR-PRESSURE TRANSMITTERS

A. Air-Pressure Differential Transmitter:

1. Performance:
 - a. Range: Approximately 2 times set point.
 - b. Accuracy: Within 0.5 percent of the full-scale range.
 - c. Hysteresis: Within 0.10 percent of full scale.
 - d. Repeatability: Within 0.05 percent of full scale.
 - e. Stability: Within 1 percent of span per year.
 - f. Overpressure: 10 psig.
 - g. Temperature Limits: Zero to 150 deg F.
 - h. Compensate Temperature Limits: 40 to 150 deg F.
 - i. Thermal Effects: 0.033 percent of full scale per degree F.

- j. Shock and vibration shall not harm the transmitter.
- 2. Output Signals:
 - a. Analog Current Signal:
 - 1) Two-wire, 4- to 20-mA de current source.
 - 2) Signal capable of operating into 800-ohm load.
- 3. Operator Interface: Zero and span adjustments located behind cover. Construction:
 - a. Plastic casing with removable plastic cover.
 - b. Screw terminal block for wire connections.
 - c. Vertical plane mounting.
 - d. NEMA 250, Type 4.
 - e. Provide mounting bracket suitable for installation.

2.8 AIR-PRESSURE INDICATING TRANSMITTERS

A. Air-Pressure Differential Indicating Transmitter, Switch and Controller:

- 1. Basis of Design: Dwyer Instruments, Inc.; Series DH3 Digihelic.
- 2. Description:
 - a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
 - b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
 - c. Select instrument range based on application. Range shall be approximately 2 times set point.
- 3. Performance:
 - a. Accuracy Including Hysteresis and Repeatability:
 - 1) Within 1 percent for ranges less than 5 in. wg.
 - 2) Within 0.5 percent at 77 deg F for other ranges.
 - b. Stability: Within 1 percent per year.
 - c. Response Time: 250 ms.
 - d. Overpressure: 5 psig for instrument ranges less than 50 in wg and 9 psig for 100 in. wg range.
 - e. Temperature Limits: 32 to 140 deg F.
 - f. Thermal Effects: 0.020 percent per degree F.
 - g. Warm-up Period: One hour.

4. Controller Programming through Menu Keys to Access Five Menus:

- a. Security level.
- b. Pressure, velocity, or flow application.
- c. Engineering units.
- d. K-factor for use with flow application.
- e. Set-point control only; set-point and alarm operation; and alarm operation as high, low, or high/low with manual or automatic reset and delay.
- f. View high and low readings.
- g. Digital dampening for smoothing erratic applications.
- h. Scaling of analog output to fit range and field calibration.

5. Display:

- a. Digital, four-digit display with backlight, with 0.4-inch- high alphanumeric characters.
- b. Four indicators; two for set point and two for alarm status.

6. Operator Interface:

- a. Set-point adjustment through keypad on face of instrument.
- b. Zero and span adjustments accessible through menu.
- c. Programming through keypad.

7. Analog Output Signal:

- a. Two-wire, 4- to 20-mA de current source.
- b. Signal capable of operating into a 900-ohm load.

8. Digital Output Signal:

- a. Two SPDT relays.
- b. Each rated for one amp at 30-V ac or de.

9. Construction:

- a. Die cast-aluminum casing and bezel.
- b. Threaded, NPS 1/8 connections on side and back.
- c. Vertical mounting.
- d. NEMA 250, Type 1.
- e. Nominal 4-inch- diameter face.

2.9 CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers:

1. Ruskin CD50

2. Performance:

- a. Leakage: AMCA 511, Class IA. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
- b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
- c. Velocity: Up to 6000 fpm.
- d. Temperature: Minus 40 to plus 185 deg F.
- e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

- 1) Material: ASTM B 211, Alloy 6063 *TS* extruded-aluminum profiles, 0.07 inch thick.
- 2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
- 3) Width not less than 5 inches.

b. Blades:

- 1) Hollow, airfoil, extruded aluminum.
- 2) Parallel or opposed blade configuration as required by application.
- 3) Material: ASTM B 211, Alloy 6063 *TS* aluminum, 0.07 inch thick.
- 4) Width not to exceed 6 inches.
- 5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:

- 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
- 2) Jams: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter stainless steel, mechanically attached to blades.

e. Bearings:

- 1) Molded synthetic or stainless-steel sleeve mounted in frame.
- 2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

- 1) Concealed in frame.
- 2) Constructed of aluminum and stainless steel.
- 3) Hardware: Stainless steel.

g. Transition:

- 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
- 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
- 3) Damper size and sleeve shall be connection size plus 2 inches.
- 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
- 5) Sleeve material shall match adjacent duct.

C. Round Dampers:

1. Ruskin CDRS25

2. Performance:

- a. Leakage: Leakage shall not exceed 0.15 cfm/in. of perimeter blade at 4-in. wg differential static pressure.
- b. Pressure Drop: 0.02-in. wg at 1500 fpm across a 12-inch damper when tested according to AMCA 500-D, figure 5.3.
- c. Velocity: Up to 4000 fpm.
- d. Temperature: Minus 25 to plus 200 deg F.
- e. Pressure Rating: 8-in. wg for sizes through 12 inches, 6-in. wg for larger sizes.

3. Construction:

a. Frame:

- 1) Material: Galvanized stainless steel, to match duct material, 0.04 in thick.
- 2) Outward rolled stiffener beads positioned approximately 1 inch inboard of each end.
- 3) Sleeve-type connection for mating to adjacent ductwork.
- 4) Size Range: 4 to 24 inches.
- 5) Length not less than 7 inches.
- 6) Provide 2-inch sheet metal stand-off for mounting actuator.

b. Blade: Double-thickness circular flat blades sandwiched together and constructed of galvanized steel.

c. Blade Seal: Polyethylene foam seal sandwiched between two sides of blades and fully encompassing blade edge.

d. Axle: 0.5-inch- diameter stainless steel, mechanically attached to blade.

e. Bearings: Stainless-steel sleeve pressed into frame.

2.10 CONTROL DAMPER ACTUATORS

A. General Requirements

1. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

2. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
 3. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
 4. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
 5. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
 6. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
 7. Provide mounting hardware and linkages for connecting actuator to damper.
 8. Select actuators to fail in desired position in the event of a power failure.
- B. Type: Motor operated, with or without gears.
- C. Construction:
1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- D. Field Adjustment:
1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
 2. Control Input Signal:
 - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
 - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 4- to 20-mA signals.
- G. Air Terminal Unit Damper Actuators:
1. Capable of stopping at all points across full range, and starting in either direction from any point in range.

2. Control Input Signal:

- a. Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.

H. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and closed position.
2. Where indicated, equip modulating actuators with position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

I. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

J. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

K. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

L. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.

M. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.

N. Stroke Time:

1. Operate damper from fully closed to fully open within 90 seconds.
2. Operate damper from fully open to fully closed within 90 seconds.

3. Move damper to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

2.11 CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:

1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
3. Close-off Pressure: 200 psig.
4. Process Temperature Range:
 - a. Building Chilled and Heating Water, PCA Plant Hot Propylene Glycol Water, 35 deg F to 250 deg F.
 - b. PCA Plant Chilled Propylene Glycol Water, Zero to 212 deg F.
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass
6. End Connections: Threaded (NPT) ends.
7. Ball: 300 series stainless steel.
8. Stem and Stem Extension:
 - a. Material to match ball.
 - b. Blowout-proof design.
 - c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristic: Equal percentage.

B. Ball Valves that operate in two positions only and do not modulate:

1. 2-inch and smaller: Two-Piece Brass Ball Valves with Full Port and Stainless-Steel Trim:
2. Manufacturer: Subject to compliance with these specifications, manufacturer shall be one of the following:
 - a. Apollo
 - b. Nibco
 - c. Hammond
 - d. Milwaukee Valve
 - e. Watts

3. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig
- c. CWP Rating: 600 psig
- d. Body Design: Two piece.
- e. Body Material: Bronze or forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

C. Butterfly Valves:

1. Performance:

- a. Bi-directional bubble tight shutoff at 250 psig.
- b. Comply with MSS SP-67 or MSS SP-68.
- c. Rotation: Zero to 90 degrees.
- d. Linear or modified equal percentage flow characteristic.

2. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.

3. Disc: 316 stainless steel.

4. Shaft: 316 or 17-4 PH stainless steel.

5. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.

6. Shaft Bushings: Reinforced PTFE or stainless steel.

7. Replaceable seat, disc, and shaft bushings.

8. Corrosion-resistant nameplate indicating:

- a. Manufacturer's name, model number, and serial number.
- b. Body size.
- c. Body and trim materials.
- d. Flow arrow.

D. Globe-Style Valve Requirements:

1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.

2. Construct the valves to be serviceable from the top.

3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.

4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.

5. Replaceable seats and plugs.
6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
 - a. Manufacturer's name, model number, and serial number.
 - b. Body and trim size.
 - c. Arrow indicating direction of flow.

E. Two-Way Globe Valves NPS 2 and Smaller:

1. Globe Style: Single port.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Range: 20 to 250 deg F.
9. Ambient Operating Temperature: 5 to 130 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Equal percentage flow characteristic.
13. Globe Style: Mix flow pattern.
14. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
15. End Connections: Threaded.
16. Bonnet: Screwed.
17. Packing: PTFE V-ring.
18. Plug: Top guided.
19. Plug, Seat, and Stem: Brass or stainless steel.
20. Leakage: FCI 70-2, Class IV.
21. Rangeability: 25 to 1.
22. Linear flow characteristic.

F. Two-Way Globe Valves NPS 2-1/2 to NPS 6:

1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 20 to 250 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

2.12 CONTROL VALVE ACTUATORS

- A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.
- B. Position indicator and graduated scale on each actuator.

- C. Type: Motor operated, with or without gears, electric and electronic.
- D. Field Adjustment:
 - 1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
 - 2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
 - 1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
 - 2. Control Input Signal:
 - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains **in** last position.
 - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- and 4- to 20-mA signals.
- G. Terminal Unit Actuators:
 - 1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
 - 2. Control Input Signal:
 - a. Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
- H. Position Feedback:
 - 1. Where indicated, equip modulating actuators with a position feedback.
 - 2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- I. Fail-Safe:
 - 1. Where indicated, provide actuator to fail to an end position.
 - 2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
- J. Integral Overload Protection:
 - 1. Provide against overload throughout the entire operating range in both directions.
 - 2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

K. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

L. Temperature:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F

M. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

N. Stroke Time:

1. Operate valve from fully closed to fully open:
 - a. Globe and Butterfly valves within 60 seconds.
 - b. Ball valves within 90 seconds
2. Select operating speed to be compatible with equipment and system operation.

2.13 CURRENT SENSORS

A. Binary Sensors: minimum 1 - 135 continuous amperage rating with trip setpoint adjustable to plus or minus 1 percent of range.

1. Operating Parameters; 5 degrees F to 140 degrees F; Humidity 0 - 95 percent non- condensing.
2. Output Signal: Solid state, NO contact closure, 1.0A at 30 VAC/Vde
3. Supply Voltage: self-induced from load being monitored.

B. Analog Sensors: Minimum 0 - 200 continuous amperage rating with adjustable zero and span, frequency insensitive range between 10- 80 Hz to 1 percent of range, minimum response of 150 ms.

1. Accuracy: 0.5 percent of full scale
2. Output Signal 4-20 ma directly proportional to sensed amperage range.
3. Supply Voltage: 12-30 Vdc, 30 mA maximum supply circuit.

2.14 LEVEL TRANSMITTERS

A. RF Admittance-Type Liquid-Level Sensor and Transmitter:

1. Basis of Design Product: Siemens Sitrans LC300.

2. Description: Complete package with electronic unit, sensing element, connecting cable.
 - a. Continuous level transmitter shall produce an output signal that is proportional to level.
 - b. Measurement shall be free from effects of changes in temperature, density, or acoustic noise in vapor space above level.
 - c. Continuous measurement shall be independent of changes in material density and unaffected by presence of material clinging to sensing element.
 - d. No moving parts and no routine cleaning and recalibration necessary.
 - e. Electronic unit shall be integral to sensing element or mounted remotely up to 100 feet away from sensor.
 - f. Listed and labeled as defined in NFPA 70, by a qualified testing agency.

3. Sensor:
 - a. Material: Teflon-coated Type 316 stainless steel.
 - b. Length: To suit installation.
 - c. Connection: NPS 3/4 NPT or flanged.

4. Electronic unit housed in NEMA 250, Type 4X enclosure.
 - a. Calibrated Range: Varies with application. At least 20 percent beyond high- and low-level set point and alarm levels.
 - b. Accuracy: Within 1 percent of calibrated range.
 - c. Two wire, loop powered.
 - d. Supply Voltage: 11.5 to 50-V de.
 - e. Maximum Load: 625 ohms at 24-V de.
 - f. Output Signal: 4 to 20 mA de.
 - g. Response Time: 0.5 to 30 seconds, adjustable.
 - h. Temperature Range: Minus 40 to 165 deg F.
 - 1) Zero and Span Adjustments: Noninteracting.
 - i. Visual Indication: Continuous digital display of level and associated units of measure. Provide separate display device if not integral to instrument.
 - j. Field-changeable failsafe condition and phasing in event measurement requires changes to optimize level reading.
 - k. Free from effects of radio frequency interference.
 - l. Free from harmful effects of static electricity on sensing element with discharges of up to 10 A without damage.
 - m. Adjustable time delay (signal dampening).

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated
Fastening Hardware:
 - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- C. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 TEMPERATURE INSTRUMENT INSTALLATIONS

- A. Mounting Location:
 - 1. Roughing In:
 - a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
 - b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
 - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
 - 2) Do not begin installation without submittal approval of mounting location.
 - c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Architect on request.

2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
 3. Install liquid temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- B. Special Mounting Requirements:
1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
 2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.
- C. Mounting Height:
1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
 2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
- D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static- pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- E. Outdoor Air Temperature Sensor Installation:
1. Mount sensor in a discrete location facing north.
 2. Protect installed sensor from solar radiation and other influences that could impact performance.
 3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.
- F. Single-Point Duct Temperature Sensor Installation:
1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
 2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
 3. Rigidly support sensor to duct and seal penetration airtight.
 4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

G. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air- handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

H. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

I. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell and connection head.
2. For pipe NPS 4 and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4:
 - a. Install reducers to increase pipe size to NPS 4 at point of thermowell installation.
 - b. For pipe sizes NPS 2-1/2 and NPS 3, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
 - c. Minimum insertion depth shall be 2-1/2 inches.
4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor.

3.4 PRESSURE INSTRUMENT INSTALLATION

A. Mounting Location:

1. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
2. Install liquid pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
3. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

C. Duct Pressure Sensors:

1. Duct static pressure sensors for systems without static pressure setpoint reset shall be located so that setpoint is less than 1/3 fan design static pressure
2. Location of sensors shall be submitted and approved before installation.
3. Install mounting hardware and gaskets to make sensor installation airtight.
4. Install sensor in accordance with manufacturer's instructions.
5. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

D. Outdoor Pressure Sensors:

1. Install sensor in least-noticeable location and as far away from exterior walls as possible.
2. Submit sensor location for approval before installation.
3. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
4. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
5. Install sensor signal pipe with dirt leg and drain valve below roof penetration.
6. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.

E. Air-Pressure Differential Switches:

1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
2. A single sensor may be used to share a common signal to multiple pressure instruments.
3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
4. Do not mount switches on rotating equipment.
5. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
6. Install switches in an easily accessible location serviceable from floor.

F. Liquid-Pressure Differential Switches:

1. Where process connections are located in mechanical equipment room, install switch in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate switch near system control panel.
3. Where multiple switches serving same system are installed in same room, install switches by system to provide service personnel a single and convenient location for inspection and service.
4. Connect process tubing from point of system connection and extend to switch.
5. Install isolation valves in process tubing as close to system connection as practical.
6. Install dirt leg and drain valve at each switch connection.
7. Do not mount switches on rotating equipment.
8. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
9. Install switches in an easily accessible location serviceable from floor.

G. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.
3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.
4. Install isolation valves in process tubing as close to system connection as practical.
5. Install dirt leg and drain valve at each transmitter connection.
6. Do not mount transmitters on equipment.
7. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.

3.5 FLOW INSTRUMENTS INSTALLATION

A. Airflow Sensors:

1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Liquid Sensors:

1. Install sensors in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Alert manufacturer where installation cannot accommodate recommended clearance, and solicit recommendations for field modifications to installation, such as flow straighteners, to improve condition.
3. Install pipe reducers for in-line sensors smaller than line size. Position reducers at distance from sensor to avoid interference and impact on accuracy.
4. Install in-line sensors with flanges or unions to provide drop-in and -out installation.

C. Liquid Flow Meters:

1. Install meters in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Install pipe reducers for in-line meters smaller than line size. Install reducers at distance from meter to avoid interference and impact on accuracy.
3. Install in-line meters with flanges or unions to provide drop-in and -out installation.
4. Insertion Meters:
 - a. Install meter in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
 - b. In applications where top-dead-center location is not possible due to field constraints, install meter at location along top half of pipe if acceptable by manufacturer for mounting orientation.

D. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.
2. Install liquid flow transmitters, not integral to sensors, in vicinity of sensor. Where multiple flow transmitters serving same system are located in same room, co-locate transmitters by system to provide service personnel a single and convenient location for inspection and service.

E. Liquid Switches:

1. Install system process connection full size of switch connection, but not less than NPS 1. Install stainless-steel bushing if required to mate switch to system connection.
2. Install switch in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
3. In applications where top-dead-center location is not possible due to field constraints, install switch at location along top half of pipe if switch is acceptable by manufacturer for mounting orientation.

3.6 CONTROL DAMPERS

A. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

B. Service Access:

1. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 23 33 05 "Air Duct Accessories."

C. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

D. Attach actuator(s) to damper drive shaft.

- E. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.7 CONTROL VALVES

- A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

- B. Install flanges or unions to allow drop-in and -out valve installation.

- C. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

- D. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

- E. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

- F. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.9 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

3.10 CHECK-OUT PROCEDURES

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Verify location and length.
- E. Verify that wiring is correct and secure.

3.11 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.12 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Perform according to manufacturer's written instruction.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Prepare test and inspection reports.

3.13 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.14 TRAINING

- A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.
- B. Provide a complete set of instructional videos covering each product specified and installed and showing the following:
 1. Software programming.
 2. Calibration and test procedures.
 3. Operation and maintenance requirements and procedures.
 4. Troubleshooting procedures.
- C. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- D. Record videos in digital format.
- E. The owner shall have right to make additional copies of video for internal use without paying royalties.

3.15 BAS FIELD DEVICE LABELING REQUIREMENTS

- A. Of the 28 BAS devices listed in 250225, 1.2 Summary, no label is required for Control Dampers, or Control Valves. In addition, labeling is not required for devices that come as an integral part of another device or "skid" if that device does not report to BAS and is not controlled directly through BAS (e.g. a control valve that comes as an integral part of a CRAC does not have to be individually labeled).

B. BAS devices listed below will only require a P-touch label, white background with black letters:

1. Air-Temperature sensor (T)
2. Air-Temperature switch (T)
3. Carbon Dioxide Sensors and Transmitters (CO2)
4. Space Temperature sensors (T)
5. Space Occupancy Sensor (O)
6. Current Sensor
7. For sensors or switches which multiple functions, like CO2 detection, Occupancy and Temperature control, use the abbreviations above on the label to show functionality. (e.g. CUP.60-AHU-201.TU-105.T, CO2, H, O, for a device that has those four functions)
8. Labels should indicate the information given in i. above, as well as the point name for that device.
9. P-touch labels should be ½" tall with Bold black letters in a minimum of 24pt. font. See attached example.
10. P-touch labels should be attached directly to the device. Add label to Occupancy sensors on the side of the device, not the bottom. Otherwise, add the label at the bottom, on the face of the device as seen in the attachment.

C. BAS device listed below will require a black polycarbonate label:

1. Liquid-Temperature Sensor
2. Liquid-Temperature Transmitter
3. Liquid-Temperature Switches
4. Air-Pressure Sensors
5. Air-Pressure Switches
6. Air-Pressure Transmitters
7. Air-Pressure Indicating Transmitters
8. Liquid-Pressure Transmitters
9. Liquid-Pressure Differential Transmitters
10. Airflow Sensors
11. Liquid-Flow Meters
12. Thermal Energy Meters
13. Damper actuators
14. Liquid- Flow Switches
15. Thermal Mass Flow Meters
16. Control Valve Actuators
17. Level Transmitters

D. Polycarbonate Label requirement

1. The letters on the label shall be white and be a minimum of ¼" tall.
2. Label shall be comprised of four lines of type:
 - a. The equipment type (e.g. "Flow Meter", "Temp Sensor", etc.)
 - b. Specific Asset Identifier (e.g. "22-CCAE.AHU-3-14.V-3-3-37")
 - c. Point Name for that specific device
 - d. Maximum Expected Design Performance, if applicable. This should be given in GPM, CFM or other applicable units as they apply to an individual device. (e.g. A flow meter might say "3000 gpm" for this requirement.)
3. For devices which are submerged, attached the label near the submerged unit as close to the device as is practical. Use SS screws or rivets as needed to affix label on a wall, Cooling Tower, AHU, etc.

4. For all other devices attach the label to the device itself with a brass chain, or within 12" of the device if direct attachment is not possible.

E. A submittal will be required for each of the nomenclature configurations and label type, one each.

End of Section 250205

SECTION 28 08 00 –COMMISSIONING OF BUILDING AUTOMATION SYSTEM (BAS)

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning the Integrated Automation systems, sub-systems and equipment which are also interfaced with equipment not provided in this Division. The contractor is responsible for coordinating and facilitating interfaces and functionality of systems, point to point, calibration checks and testing. This Section supplements the general requirements specified in Section 01 91 05 General Commissioning Requirements.
- B. The commissioning activities have been developed to support delivery of project performance in accordance with the Contract Documents developed with the approval of the Owner.

1.2 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel, is required in cooperation with the Owner and the Commissioning Agent.

1.3 SUBMITTALS

- A. The contract process requires review of selected Submittals. The controls contractor will provide a complete list of submittals that will be reviewed by the design engineer. This list will be reviewed and approved by the Owner's Representative prior to forwarding to the Contractor.

PART 2 – EXECUTION

2.1 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing. The contractor will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the project engineer and the SLCDA agent for review. The SLCDA agent may spot-check a sample of completed checklists. If it is determined that the information provided on the checklist is not accurate, the report and the marked-up checklist will be returned to the Contractor for correction and re-submission. If the SLCDA agent determines that a significant number of completed checklists for similar equipment are not accurate, the SLCDA agent will select a broader sample of checklists for review. If the SLCDA agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission.
- B. Pre-Functional Checklist requirements
 1. Four weeks prior to startup, the installing contractor shall schedule startup and checkout with the Owner and Commissioning Agent. The performance of the Pre-functional Checklists, startup and checkout shall be directed and executed by the installing contractor as required by the SLCDA.
 2. The SLCDA Agent will observe the startup procedures for selected pieces of primary equipment.
 3. The installing contractor shall execute startup and provide the owner with a signed and dated copy of the completed start-up, Pre-functional Checklists, and initial tests.

4. Only individuals that have direct knowledge and witnessed that a line-item task on the Pre-functional Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

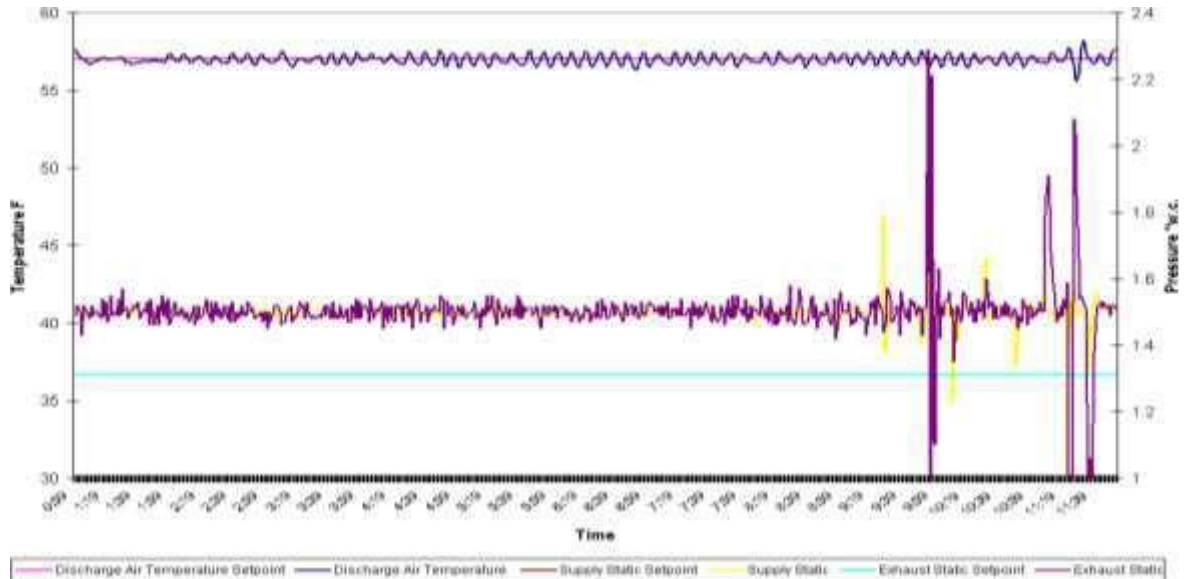
2.2 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 25 shall be scheduled and documented in accordance with SLCDA Requirements. The SLCDA Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

2.3 BUILDING AUTOMATION SYSTEM REQUIREMENTS

- A. The Controls Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements will be dictated by the SLCDA and included with the Functional Performance Test Procedures and/or determined while execution of testing. Trending shall occur before, during and after functional testing. The Controls Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the functional tests. These graphical reports shall be submitted to the SLCDA for review and analysis before, during dynamic operation, and after functional testing. The Controls Contractor is required to provide, but not limited to, the following trend requirements and trend submissions:
 1. Pre-testing, Testing, Post-testing - Trend reports of trend logs and graphical trend plots are required as defined by the SLCDA. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the SLCDA. At any time during the Commissioning Process the SLCDA may dictate changes to aspects of trending as deemed necessary for proper system analysis. No changes in trending requirements will be a basis for additional service change orders by the CMAR. Any pre-test trend analysis comments generated by the Commissioning Team will be addressed and resolved by the Controls Contractor prior to the execution of Functional Performance Testing.
 2. Dynamic plotting - The Controls Contractor shall also provide dynamic plotting during functional testing at frequent intervals for points determined by the SLCDA. The graphical plots will be formatted and plotted at durations dictated by the SLCDA.
- B. The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all dictated by the SLCDA. If this cannot be sufficiently accomplished directly in the Building Automation System then it is the responsibility of the Controls Contractor to plot these trend logs in Microsoft Excel at the direction of the SLCDA. The following table and graph is a reference sample similar to what will be expected for this project.

SAMPLE FOR REFERENCE	
Trend Log #1: Temperature & Pressure	
Data Collection Frequency	1 Minute
Trend Log Duration	Continuous
Trend Log Start Date/Time	Minimum 2 days before test
Trend Log Stop Date/Time	Minimum 2 days after test
Point #1	Discharge Air Temperature
Point #2	Discharge Air Temperature
Point #3	Supply Static Pressure
Point #4	Supply Static Pressure Setpoint
Point #5	Return Static Pressure
Point #6	Return Static Pressure Setpoint



C. Sensor and Actuator Calibration

1. All factory calibrated temperature, relative humidity, CO2 and pressure sensors calibration shall be checked against the automation system and calibrated as needed by the Controls Contractor.
2. All field calibrated temperature, relative humidity, CO2 and pressure sensors calibration shall be checked against the automation system and calibrated as needed by the Controls Contractor.
3. All actuators for dampers, valves, or other system components shall be checked against the automation system and calibrated as needed by the Controls Contractor. This shall include open, closed, and mid-point conditions at minimum.
4. All procedures used shall be fully documented, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

D. Loop Tuning Documentation

1. Loop tuning documentation and constants for each loop of the building systems shall be submitted by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop.
2. The loop tuning documentation used shall be fully documented, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

E. Sensor and Actuator Calibration Maintenance Requirements

1. A sensor and actuator calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors/actuators, separated by system, sub- system, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation.
2. The sensor calibration documentation used shall be fully documented, clearly referencing sensor type, frequency, and procedures to be followed specific to the location in the operations and maintenance manuals.

2.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Owner's Representative. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing. The Contractor shall sign the test reports to verify tests were performed.
- B. Test Methods: Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CMAR and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
 2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 4. Altering Set-points: Rather than overwriting sensor values, and when simulating conditions is difficult, altering set-points to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
 5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during pre-functional testing.
- C. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The CMAR shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the CMAR shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.
- D. Sampling: Sampling is not allowed in completing Pre-functional Checklists. Sampling is allowed for Functional Test procedures execution. The Commissioning Agent in cooperation with the OAR will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the CMAR to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

- E. Coordination and Scheduling: The CMAR shall provide sufficient notice to the Commissioning Agent and the Owner regarding the completion schedule for the Pre- functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Functional Performance Tests with the CMAR and Owner. The Commissioning Agent will direct, witness and document the Functional Performance Testing of equipment and systems. The CMAR shall execute the tests.
- F. Testing Pre-Requisites: Functional Performance testing will be conducted only after Pre- functional Checklists and startup has been satisfactorily completed. The control system shall be sufficiently tested. The air balancing and water balancing shall be completed before Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Graphical trending will be set-up and provided to the commissioning agent. Functional Performance Testing will proceed from components to sub-systems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

2.5 DEFERRED TESTING

- A. Deferred Seasonal Testing: Deferred Seasonal Functional Performance Tests are those that must be deferred until weather conditions are closer to the system's design parameters. The Commissioning Agent will review the system's parameters and recommend which Functional Performance Tests should be deferred until weather conditions more closely match the system's parameters. The CMAR shall review and comment on the proposed schedule for Deferred Seasonal Testing. The Owner will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Functional Performances Tests shall be directed, witnessed, and documented by the Commissioning Agent. Deferred Seasonal Functional Performance Tests shall be executed by the CMAR in accordance with these specifications.

2.6 SYSTEMS DOCUMENTATION

- A. Turn over the following documentation to the Commissioning Agent for preparation of a Systems Manual:
 - B. As-built control sequences of operation for all equipment/systems to be commissioned.
 - 1. Recommended schedule/frequency for recalibrating control sensors and actuators.

End of Section 2508000

BLANK PAGE

SECTION 25 1000 - AUTOMATIC TEMPERATURE CONTROLS

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

- A. The General Conditions, Supplementary General Conditions, alternates and addenda, applicable drawings and the technical specifications, shall all apply to all work under this division.

1.2 SCOPE OF WORK

- A. The scope of work shall include all labor, material, and equipment necessary to expand the existing automatic temperature control system for the facility. The Contractor under this heading shall furnish and install a complete direct digital control system as specified.
- B. Demolition of all existing pneumatic controls systems, pneumatic tubing and all related equipment and devices.
- C. This contractor shall remove the existing ATC compressor and filter dryer located in the boiler room and store the equipment on a pallet for owner pick up.
- D. Interface with existing DDC system and communication.
- E. Contractor shall provide at time of bid a statement of compliance including, but not limited to:
 - 1. Detailed points list.
 - 2. Any deviations from base specification with listed costs.
- F. Install a new complete, fully programmable, customized Direct Digital Control (DDC) system for control of the systems. This DDC control system shall be configured to operate over the district wide network.
- G. Provide the following:
 - 1. Demolition of all existing pneumatic systems and components.
 - 2. Local DDC Control Panels
 - 3. ATC Interface Panels
 - 4. Local Area Network Wiring & Setup
 - 5. Interface with Existing Systems
 - 6. Room Temperature Control
 - 7. VAV control
 - 8. VAV re-heat control
 - 9. New heating control valves
 - 10. New 3-Way Boiler Control Valve
 - 11. Control of Existing Heating Water Pumps
 - 12. Building Fire Alarm Interlocks
 - 13. New zone thermostats

14. Alarming as specified here in.
15. Connectivity and Interface with all VFD's
16. ACAD graphics for all systems per SLCDA standards
17. Integration of NOAA TI project VAV controls & graphics. (2) Boxes.

1.3 SYSTEM DESCRIPTION:

A. BASE BID SYSTEM

1. A web-based, password protected DDC automatic temperature controls shall be furnished and installed as a part of this contract as an extension of the existing system to give the owner a completely operable system.
2. Acceptable manufacturer and installer:

a. **Siemens System 600 as supplied and installed by Siemens Controls, as an extension of the existing building system.**

- B. A detailed points list shall be provided by base bid contractor.
- C. DDC system shall be configured and connected to the NWS Building Ethernet/Network. System shall be accessible from any remote site through an Ethernet or internet connection. All functions, programs and control system parameters shall be accessible and fully functional through the district network. The ATC contractor shall supply and install all required hardware and software to permit full access to the DDC system at the new school as well as every same manufacture system. All controllers shall be LON or open Native BACnet and freely programmable. Controllers with canned programming are not permitted.
- D. The entire building automation system shall tie into the existing NWS Lan Network. The ATC contractor shall include all software and hardware to permit network and complete intranet access to the DDC system. This includes graphic pages, per SLCSD standards, monitoring, alarming, trending, programming, database modifications, setpoint changes, DDC programming. All aspects and elements of the DDC control system shall be available across the entire district network. The use of PC anywhere, or similar remote software, or lick portal packages is not acceptable.
- E. The system shall be as indicated on the drawings and specified herein. Building HVAC systems and unitary heating devices shall be entirely controlled by the DDC system.
- F. The latest technology DDC/Energy Management systems will be furnished and installed. As a standard, these systems will include graphics and data files for the facility.

- G. The DDC/Energy Management system will have a ACAD graphic and/or text page for each major mechanical piece of equipment or system (I.E.: boilers, air handlers, fans, etc.). added to the existing system. From these pages, there will be “live” readouts of temperatures, pressures, RH levels, on/off status, valve and damper positions, outside air temperature, etc. It shall be possible from this screen to perform setpoint changes, equipment on/off overrides, implement “test” status and values, without additional screen or program manipulation. Functions such as equipment schedules and reset schedules shall be accessed from editing screens. All functions shall be protected with different levels and passwords.
- H. Update existing floor plan(s) to show modifications of all systems.
- I. All system and unitary controls shall be of the direct digital type (DDC). Self-tuning PID (Proportional, Integral, Derivative) control algorithms shall be applied where applicable on all applications. The control system shall be a networked, distributed intelligence system, with the control loops for each system being capable of stand-alone operation.
- J. The system shall include all control devices, valves and damper parts as called for hereinafter.
- K. All heating valves shall be normally open. No exceptions.
- L. **The ATC contractor is required to supply and install a 3/4" EMT conduit system for the DDC control system in all areas. This includes all wall areas, hard ceiling areas, exposed ceiling areas and mechanical rooms.**
- M. Wireless devices or systems **WILL NOT** be accepted.

1.4 WORK TO BE PERFORMED BY OTHERS

- A. Division 25 shall also provide 120 VAC, 20 Ampere power sources to each group of ATC panels as shown. The ATC contractor shall be responsible for all step-down transformers and 24 VAC wiring to ATC equipment.
- B. The sheet metal contractor shall install all dampers supplied by the ATC contractor. Each damper shall be installed so that it will operate freely and without binding. To ensure that the damper both opens and closes completely with less than 7#/sq. ft. torque applied at the operating shaft, each damper shall be checked after its installation, but before the damper actuators are attached. Dampers not properly installed or meeting this torque requirement shall be replaced and/or reinstalled without additional cost to the ATC contractor or the Jordan's School District.
- C. The mechanical contractor shall install all valves, immersion wells and pressure taps supplied to him by the ATC contractor.

1.5 INSTALLATION BY AUTOMATIC TEMPERATURE CONTROL (ATC) CONTRACTOR

- A. The successful control contractor shall furnish and install all necessary electrical control wiring and conduit for the complete temperature control system, heating and ventilating equipment motor starting circuit controls and all electrical control interlocks for same, and for control wiring for miscellaneous HVAC equipment furnished by the Owner.

- B. The ATC contractor shall be a licensed Electrical Contractor in the State of Utah with full time Master, Journeyman and apprentice electricians. If the ATC subcontracts the installation, it shall be to a licensed Electrical Contractor in the State of Utah. Full-time Master, Journeyman and apprentice electricians shall be utilized for the installation.
- C. The ATC contractor shall furnish & install all necessary electrical control wiring and conduit of all temperature controls, heating and ventilating equipment motor starting circuit controls, all electrical control interlocks for same and for miscellaneous packaged equipment as defined within this specification. Full-time Master, Journeyman and apprentice electricians shall be utilized for the installation.
- D. All line and low voltage electrical and control wiring shall be installed **in conduit, 3/4" minimum EMT as per 251000/1.3. Q.** The ATC system will be installed in 100% 3/4" EMT conduit & in accordance with the National Electrical Code and applicable local codes and in accordance with Division 26 of this specification. 3/4" nominal trade conduit shall be installed. When connecting to controllers, valves etc. that have no provisions for EMT connections, EMT may terminate in a junction box located within 36" of the controller or control valve. When making a transition between EMT and plenum cable, protect cable from abrasion by installing an insulating connector or equivalent on the exposed end of the EMT. Full time employees holding Master, Journeyman and apprentice electrician licenses in the State of Utah shall be utilized for the installation.
- E. Installation of plenum wire in return air plenums will not be accepted.
- F. All ATC rough-in boxes shall be identified with the letters "ATC" written across the inside of the box with permanent marker. In addition, each ATC cover plate shall be painted white with the letters "ATC" stenciled in black.

1.6 QUALITY ASSURANCE

- A. Provide an unconditional TWO-YEAR parts and service warranty. This warranty shall commence at the time of substantial completion of the various portions of the system.
- B. All parts and material and their installation methods shall be in accordance with the manufacturer's recommendations and specifications. All parts and material shall be new.
- C. The Contractor or firm executing the work of this section shall have at least 10 years' experience in completing work of similar scope and nature to that specified.
- D. Provide an unconditional **TWO-YEAR** parts and service warranty. This warranty shall commence at the time of demonstration of system completion of all portions of the ATC system.
- E. Emergency response by contractor shall be available 24 hours/day 7 days/week 365 days/yr. Response time shall not be greater than 12 hours from time of call.

1.7 SUBMITTAL AND TECHNICAL INFORMATION

- A. Submit shop drawings and manufacturer's data for the following items to the mechanical engineer:
1. Wiring and installation diagrams.
 2. ATC device specification sheets
 3. Complete and detailed point list
 4. Control flow diagrams, complete with all control schematics and sequences of operation.
 5. Documentation of all software and hardware. These manuals shall be complete with installation procedures as well as startup and programming instructions. They should also contain any testing or maintenance procedures required to operate the system on a continuing basis.

1.8 PROJECT COMPLETION REQUIREMENTS

- A. Upon completion of the project, the ATC contractor shall spend a minimum of **4 hours** with the SLCDA maintenance personnel to adequately instruct them on the operation and maintenance of the system. These training sessions shall be scheduled at times convenient to the owner and shall be conducted at the project. One on one, live, local hands-on training will be provided.
- B. The ATC contractor shall provide as part of his contract the on-site services of a technician familiar with the system to assist the air & water balance contractor in completing his portion of the project. The technician shall be available for a minimum of an additional **4 hours** for this assistance.
- C. The ATC contractor shall provide as part of his contract the on-site services of a programmer familiar with the system for an additional **2 hours** which the Engineer and/or the owner may use as they see fit to fine-tune or add features to the system.
- D. 6 months after the completion date of the project, the ATC contractor will provide **2 hours** of onsite training with the owner. This training is part of this scope of work and costs shall be inclusive. The hours can be allotted in separate training sessions as determined by the owner. One on one, live, local hands-on training will be provided.
- E. Provide a complete digital copy of the project operating and maintenance instruction manuals for use during the training sessions. Each manual shall contain all system components and DDC system programming.
- F. Operation & Maintenance Manuals: Provide a digital copy as specified above. These manuals shall provide descriptions of maintenance procedures for all system components, including sensors and controlled devices. They shall cover inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components. They shall include complete as-built ATC installation drawings with sequences of operation for all mechanical systems controlled by the ATC contractor. They shall each include all as-built system programming.

PART 2 – EQUIPMENT

2.1 CONTROLLERS

- A. Open BACNet controls with freely programmable controllers, including VAV controllers, shall be utilized as indicated and specified elsewhere in this specification. Proprietary control system communication protocols will not be accepted.
- B. All main level controller inputs shall have at least 12-bit A/D converters for input accuracy. Less resolution is unacceptable for main level controllers or any controllers using an air monitoring station or monitoring building pressure. All main level controller outputs shall have board mounted hand-off-auto switches for local output override capability.
- C. The contractor shall utilize and employ only the following controllers for any central plant systems and air handling units. A single controller shall be designated with all programming and I/O for each system. This will allow standalone equipment operation in the event of communications failure. Connection of multiple small controllers or combined operation with other programmable controllers on air handlers and central plant equipment is not permitted. All controllers shall be freely programmable; controllers with canned programming are not acceptable.
- D. The only Variable Air Volume box controllers allowed for VAV applications shall be freely programmable. No substitutions, no canned application programming will be accepted.
- E. All controllers and devices shall be identified.

2.2 DDC INPUT DEVICES

- A. All DDC input devices shall provide industry standard signals and shall be compatible with the DDC controllers used.
- B. All temperature input devices shall have a rated accuracy of 1% or better.
- C. All pressure input devices shall have a rated accuracy of 2% or better. Pressure transmitters shall be selected to match the application and shall not be damaged by pressures at five times the maximum measurable pressure.
- D. Miscellaneous input devices shall have accuracies as individually specified. All miscellaneous devices shall be specifically identified (with specifications) with submittals.

2.3 DDC OUTPUTS

- A. Modulating outputs shall be in accordance with industry standards and shall be compatible with the driven DDC devices.
- B. Outputs shall be 0-10 VAC/VOC or 0.5 sec - 5.0 sec. 4-20 MA, or a pneumatic signal 0-20 PSI.
- C. DDC digital outputs shall be either relay contact closures or Triacs rated for the application.

2.4 MANUFACTURERS

- A. Provide a new Direct Digital Control (DDC) system for the facility mechanical equipment. The new system shall be installed, programmed and commissioned by the ATC contractor.

2.5 AUTOMATIC VALVES

- A. ATC valve bodies 2" and smaller shall be screwed with union; larger valve bodies shall be flanged. Screwed valves shall be rated at 125 psi or greater and shall have brass bodies. Flanged valves shall be rated at 125 psi or greater and have cast iron or steel bodies. All automatic valves shall be for DDC control application.
- B. All ATC heating valves, including all 3-way valves shall fail Normally Open (N.O.)
- C. All heating valves shall fail Normally Open (N.O.) VAV Re-Heat valves will not be required to fail open.
- D. All valves shall be disc/plug and seat or ball valve construction.
- E. **Heating water valves for VAV re-heat coils shall be floating type, 3-wire valves.**
- F. Shut-off pressure ratings of each valve shall be as required by the application.
- G. Valves shall be Belimo or Honeywell, M640001, M7400 series. (No substitutions)

2.6 MOTORIZED ATC DAMPERS

- A. Motorized control dampers that are not supplied with the air handling units shall be furnished by the Automatic Temperature Control Contractor. Dampers shall be factory-built, low leakage units such as Ruskin CD-50 or approved equal. Blades shall be 6" maximum width, 6063-T5 extruded aluminum width, 1/2" axles, and Oilite or Cyclopedia bearings. No round shafts will be accepted.
- B. All blade-to-blade linkages shall be external and accessible. No linkage within the damper frame channel will be accepted.
- C. Frames shall be 5" x 1", 6063-T5 extruded aluminum hat channel design, 0.125" minimum thickness with corner braces to assure squareness.
- D. Dampers shall be low leakage type with compressible end seals and neoprene or extruded vinyl blade and jamb seals. Leakage shall not exceed 6.2 cfm/sq. ft. at 4" W.G. Dampers shall require less than 7#-in/sq. ft. torque at the operating shaft for proper operation.
- E. Outdoor & return air dampers shall be parallel blade with blade direction oriented to assist mixing of air streams with spring return to fail closed. Relief air and other volume control dampers shall be opposed blade.

2.7 DAMPER AND VALVE ACTUATORS

- A. Damper and valve actuators shall be of the gear-train type. All moving parts shall be permanently lubricated and not require addition or replacement of oil. Actuators shall meet the NEMA 2 rating and shall have an ambient temperature operating rating of -40°F to 140°F, without the addition of extra equipment.
- B. Damper and valve actuators shall accept the appropriate Ma, VDC or digital output signals provided by the DDC controllers.
- C. Damper actuators shall be mounted outside the air stream whenever possible and be of sufficient size to operate the connected damper. Mount damper actuator on firm baseplate.
- D. Damper actuators linked to outdoor air and relief air dampers shall close their attached dampers upon power failure or fan shutdown by means of a mechanical spring return.

2.8 Actuator manufacturers shall be Belimo or Honeywell. No substitutions.

2.9 ROOM THERMOSTATS

- A. Wall-mounted space temperature thermostat. No visible readout or adjustment at thermostat. Set point range shall be adjustable by owner via building control system.
- B. A 4 deg. F. +/- (adjustable) occupant adjustable slide device or similar shall be provided at each thermostat.
- C. Flat plate, stainless steel plate sensors will not be accepted. Thermostats shall match existing building thermostats and be approved by owner.
- D. Thermostats shall be located on interior stud walls wherever possible.
- E. Standardized locations and mounting heights shall be predetermined with owner prior to rough-in.
- F. New thermostats shall match existing thermostats installed.

2.10 USER INTERFACE

- A. The facility management and control system shall interface with the existing system. If the control system provided for this project will not seamlessly connect to the existing centralized system, the ATC contractor shall provide as specified to provide all programming, monitoring, alarming and configuration functions within this specification. Networking, lines, and software shall be furnished and installed by Division 25. Communication shall be completed by Division 25. This includes complete control system access.
- B. The most current versions of all necessary controlling & monitoring software & graphic displays shall be installed on the NWS centralized systems. Copies of all software disks, operation manuals, along with installation instruction shall be provided to the owner.

- C. The controlling software database shall be constructed by the ATC contractor to SLCDA requirements. The contractor shall consult with SLCSO representative to verify these requirements as a part of this contract. Contractor shall provide a fully operational DDC control system that may be monitored, controlled & modified from the District Centralized Host computer. All control schedules, algorithms, and control logic shall be in place within each DDC controller and stored as back-up copies on both Host computers' hard disks which may be downloaded to individual DDC controllers as necessary. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. A hard copy paper printout of points for each device shall be provided. Digital copies shall be provided in O&M manual.
- D. The building revisions shall be represented by complete graphical ACAD floor plans, with accurate locations of each major piece of HVAC equipment. A zoom feature shall allow the operator to select any of the main fan systems and see a graphical representation of the system with dynamic representation of all appropriate DDC input & output devices. Each major piece of HVAC equipment shall be graphically represented at each Host computer with all appropriate DDC points dynamically represented.

2.11 LOCAL DDC CONTROL PANELS

- A. Local DDC control panels shall be located near mechanical systems as necessary to provide both digital and analog input and output points as specified and/or required to achieve specified system performance.
- B. Each local DDC control panel shall provide all control functions for the mechanical equipment specified to be controlled from that panel.
- C. Every input and output point shall be well labeled, and every digital output shall have a LED indication of the position of the output relay.
- D. ATC contractor shall provide documentation of the software application program for each digital controller.
- E. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. Complete ATC drawings including terminal connections shall be available at each local panel.
- F. System acceptance shall not be completed until this documentation is provided and located in each ATC interface panel.
- G. Systems providing modulating outputs via pulse width modulation techniques shall provide within each ATC interface panel all the components required to implement the functions equivalent to an analog output.

2.12 LABELING

- A. All ATC supplied panels and devices shall be permanently labeled with engraved plastic laminate labels indicating device name, system identifier and function within the system.

- B. All conduit and wiring shall be labeled per SLCDA standards.

PART 3 – SEQUENCE OF OPERATION

3.1 HOT WATER HEATING SYSTEM CONTROL

- A. The building heating water heating system consists of (1) existing hot water heating boiler and (2) existing building heating water pumps.
- B. Boilers and associated pumps are enabled when OAT is less than 60 Deg F. (adjustable). HW variable frequency building pumps shall be monitored and controlled by the DDC. HW supply and return temperature shall be monitored by a Stainless-Steel temperature sensor mounted in a Stainless-Steel thermal well.
- C. The new boiler 3-water control valve shall modulate as required to maintain minimum flow required for the existing boiler and to maintain required heating water temperature to the building systems.
- D. There are 2 building heating water pumps. Pumps operate during the OCCUPIED and WARM-UP modes and are each rated at 100% of the building load.
- E. When the panel mounted toggle HAND-OFF-AUTO (H-O-A) switches are in the AUTO position, these pumps will be controlled by the building energy management system. During the OCCUPIED or WARM-UP modes, if the outside temperature is below 72 degrees F.(adjustable), pump will start. Pumps shall lead/lag based on schedule from the DDC system.
- F. When the panel mounted toggle HAND-OFF-AUTO (H-O-A) switch is in the AUTO position, the boiler is enabled by the building management system. The boiler will be enabled whenever one or more of the heating pumps are running. Once enabled, the boiler shall operate from its own operating and safety controls.
- G. When the existing air handling units are off, the DDC system shall command the hot water valves closed.
- H. If the room temperature falls below 50 Deg F. (adjustable), the building DDC shall generate an alarm.
- I. Static water pressure transmitters with pressure sensing taps located in both the heating water supply & return lines at locations approved by the Mechanical Engineer and acting through a DDC controller shall modulate the speed of the hot water pump(s) to maintain desired hot water system differential pressure. (Initial differential pressure setting shall be 10 psig) The first heating water pump shall start & run continuously when the outdoor air temperature is 75° F or lower (adjustable). The second pump shall start and run in parallel with the first pump when the outdoor air temperature is below 35° F. (adjustable).
- J. If a hot water pump is not running when commanded to do so by the DDC system, the other hot water pump shall automatically start & an alarm shall be sent to the DDC system.

- K. When water flow through a boiler is detected by a paddle-type water flow switch located in the return water line to the boiler, the boiler control system shall be enabled.
- L. Interlock the boiler controls to allow operation only when water flow exists through the boiler as determined by a flow switch installed in the boiler's heating water piping.
- M. Provide interlocks with each boiler alarm system to alarm the DDC system if boiler shuts down due to flame failure, etc. or if boiler does not fire when commanded to do so.
- N. Provide analog temperature sensors in immersion wells in the hot water supply piping of each boiler as well as the main supply and return water lines leaving the boiler room.
- O. A local DDC controller with analog temperature sensors located in both the supply water and the outdoor air shall modulate hot water reset to maintain building supply water temperature (reset from outdoor temperature) as follows (adjustable):

Outdoor Air Temperature	Supply Water Temperature
70°F	90°F
0°F	140°F

- P. This sequence shall incorporate proportional plus integral (PI) control algorithms to minimize offset from setpoint.
- Q. Provide supply and return temperature sensors in the heating hot water piping at each boiler, analog current sensors for all heating pumps.
- R. ATC contractor shall control boiler automatic isolation valves as required for sequencing of boilers per manufacture requirements.

3.2 EMERGENCY SHUTDOWN SWITCHES (Boiler B-1)

- A. A remote mushroom type, single acting, manually reset, shutdown switch shall be located just inside the boiler room door and marked for easy identification. A pilot light shall illuminate whenever the push button is pressed. If there is more than one door to the boiler room, there should be a switch located at each door.
- B. The emergency shutdown switches, when activated, must disconnect all power to the boiler burner controls. A visual alarm indicator of a different color than the building fire alarm indicators shall be activated when the boilers are shutdown.

3.3 BOILER ROOM VENTILATION CONTROL

- A. A room temperature sensor, acting through a DDC controller shall cycle the existing ventilation fan and associated damper and existing relief air motorized damper to maintain desired boiler room temperature.
- B. Provide fan status to the BMS.

3.4 FAN POWERERED VAV RE-HEAT BOXES

- A. The VAV fan systems consist of as a part of an existing fan system.
- B. VAV boxes shall be balanced and commissioned.
- C. New VAV re-heat boxes shall be controlled as specified, and as per SLCDA standards.
- D. Room space temperature sensing shall be from wall-mounted temperature sensing elements with no adjustment or visible temperature indication. A duct style temperature sensor shall be installed at each VAV box air discharge.
- E. A VAV box mounted DDC controller shall be provided for control and operation of each VAV box and reheat coil. Sensor shall modulate the box primary air damper between minimum ventilation position and maximum designed airflow and position the reheat coil valve in sequence to maintain the desired space temperature. Heating and cooling set points shall be individually adjustable from the man-machine interface device.
- F. Each VAV box shall be configured for central plant heat mode which shall reverse the operation of the VAV damper to open for heating instead of cooling whenever the air handler is in the warm-up mode.
- G. Each VAV box shall be configured and programmed for CFM set point modulation based on system variable such as CO2. The ATC contractor shall demonstrate the program and the freely programmable VAV DDC controller.
- H. Each VAV box DDC controller shall have a 24-volt power connection with all 24-volt control wiring by the ATC contractor. 24-volt transformers shall be located in the DDC controller of the air handler serving the VAV box for ease of maintenance.

3.5 VAV BOXES

- A. The VAV fan systems consist of as a part of an existing fan system.
- B. VAV boxes shall be balanced and commissioned.
- C. New VAV re-heat boxes shall be controlled as specified, and as per SLCDA standards.
- D. Room space temperature sensing shall be from wall-mounted temperature sensing elements with programmable adjustment with no visible temperature indication. A duct style temperature sensor shall be installed at each VAV box air discharge.
- E. A VAV box mounted DDC controller shall be provided for control and operation of each VAV box and reheat coil. Sensor shall modulate the box primary air damper between minimum ventilation position and maximum designed airflow and position the damper in sequence to maintain the desired space temperature. Heating and cooling set points shall be individually adjustable from the man-machine interface device.

- F. Each VAV box shall be configured for central plant heat mode which shall reverse the operation of the VAV damper to open for heating instead of cooling whenever the air handler is in the warm-up mode.
- G. Each VAV box shall be configured and programmed for CFM set point modulation based on system variable such as CO₂. The ATC contractor shall demonstrate the program and the freely programmable VAV DDC controller.

3.6 LOW VOLTAGE TRANSFORMERS AND POWER REQUIREMENTS

- A. Each VAV box DDC controller shall have a 24-volt power connection with all 24-volt control wiring by the ATC contractor. 24-volt transformers shall be located in the DDC controller of the air handler serving the VAV box for ease of maintenance.
- B. Provide and install (2) 120-volt 20-amps circuits for the (2) new PSC-500A LVC low voltage transformers located in the main boiler room and as indicated on the drawings for interface with the new digital VAV boxes.

3.7 HOT WATER CABINET UNIT HEATER CONTROL (Existing CUH)

- A. During OCCUPIED mode space temperature sensors, acting through DDC controllers, shall modulate their respective cabinet unit heater valves to maintain desired space temperature. Cabinet unit heater fans shall run whenever the heating valve is not completely closed and heating hot water is available. During UNOCCUPIED mode, heater operation is similar, except at a lower space temperature.

3.8 HOT WATER UNIT HEATER CONTROL (Existing UH)

- A. A wall-mounted line voltage thermostat shall cycle the new heating valve and fan to maintain space temperature setpoint. A strap-on thermostat on the hot water line leaving the coil shall prevent fan operation if heat is not available.
- B. Electric unit heaters & electric wall heaters shall be controlled with a room thermostat reading to the BMS.

3.9 HOST COMPUTER & BUILDING GRAPHIC DISPLAY

- A. Graphics pages shall be created to remain consistent with the existing graphics on the districts host computer. Floor plans, air handler summaries, and alarm pages, equipment pages, summary pages, etc. shall all be included. In addition to this section, the ATC contractor shall refer to section 2.13 and other sections within this specification for user interface, alarming, programming and configuration requirements from the graphical user interface (Host Computer).
- B. Graphics pages shall be completed in the latest version of ACAD, and per SLCDA standards.

End of section 251000

BLANK PAGE