



**CAPITOL COMPLEX
TALLAHASSEE, FLORIDA**

**100% PERMIT DOCUMENTS
SPECIFICATIONS BOOKLET**

10/31/25



**KNOTT BUILDING RENOVATIONS
FLORIDA SENATE
CAPITAL COMPLEX**

10/31/25

100% PERMIT DOCUMENTS TECHNICAL SPECIFICATIONS

DIVISION 1 – GENERAL REQUIREMENTS

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DIVISION 4 – MASONRY – NOT USED

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DIVISION 6 – WOOD AND PLASTICS

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SECTION 10830 – MIRROR UNITS

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DIVISION 12 – FURNISHINGS – NOT USED

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END ARCHITECTURAL SPECIFICATIONS:

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PLUMBING, FIRE PROTECTION AND ELECTRICAL DRAWINGS.

SEE ATTACHED INDEX FOR DIVISION 23 MECHANICAL AND DIVISION 25 INTEGRATED
AUTOMATION SPECIFICATIONS

**FLORIDA SENATE KNOTT BUILDING
[PEG #225-110]**

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SECTION 01010 - SUMMARY OF THE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

1.2 PROJECT/WORK IDENTIFICATION

- A. General: Project name is as shown on the Contract Documents prepared by Dodstone Architects, 3011-1 Powell Road Tallahassee, Florida 32308, (850) 656-7326.

Project location: Knott Building, Tallahassee, Florida

Owner: The Florida Senate, State of Florida Department of Management Services

- B. Summary of References: Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda and modifications to the contract documents issued subsequent to the initial printing of this project manual and including but not necessarily limited to printed material referenced by any of these. It is recognized that work of the contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions and other forces outside the contract documents.

Building Codes and Standards:

Florida Building Code, Building	8th Edition 2023
Florida Building Code, Residential	8th Edition 2023
Florida Building Code, Existing Building	8th Edition 2023
Florida Building Code, Accessibility Code	8th Edition 2023
Florida Building Code, Energy Conserv.	8th Edition 2023
Florida Building Code, Mechanical	8th Edition 2023
Florida Building Code, Fuel Gas	8th Edition 2023
Florida Building Code, Plumbing	8th Edition 2023
Florida Fire Prevention Code	2023 Edition
National Electrical Code	2020 Edition
NFPA 101 – Life Safety Code	2020 Edition

- C. **Abbreviated Written Summary:** Briefly and without force and effect upon the contract documents, the work of the Contract can be summarized as follows: The Project consist of the selective demolition and remodeling and renovation to the existing Knott Building as indicated on the drawings. The Work includes the construction, demolition, remodeling and renovations as indicated on the drawings and herein described including but not limited to architectural, structural, mechanical and electrical work required for the project to be ready for occupancy.

1.3 CONTRACTOR USE OF PREMISES

- A. General: During the construction period, the Contractor shall have limited use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited to the designated access route and areas of construction which will be discussed during the pre-construction meeting. **Remodeling and renovation work shall be completed so as not to interfere with the owner's operation. Adjacent and other areas of the Building will be occupied during the course of construction. Prior to commencement of work, the contractor shall schedule a coordination meeting to review building security, parking locations, fire protection, access routes, use of elevators, etc.**
- B. Use of the Site: Limit use of the premises to work in areas indicated herein. Staging areas, access route, etc. will be clarified in the pre-construction meeting. The actual area of work will be vacated for construction. Confine operations to areas within contract limits agreed upon during the coordination meeting prior the commencement of the work. Do not disturb portions of the site beyond the areas in which the Work is indicated. Restore site when work is complete.
- C. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Parking will be arranged during the coordination meeting. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site. **Keep building manager informed concerning deliveries and when work is scheduled to occur.**
- D. Dust barriers: Erect dust barriers to confine and limit the areas to be renovated within the building. Wood or metal studs may be used to form the barrier to attach 6 mil polyethylene. Provide doors as required for access to the area.

1.4 OWNER OCCUPANCY

- A. Allow for Owner occupancy and use by the public of those portions of the building where work is not scheduled. The contractor shall have the use of the area indicated to be renovated.
- B. The Owner will occupy the site, adjacent existing buildings and parking structures and existing building during the normally work day. Cooperate with the Owner during construction operations to minimize conflicts and facilitate owner usage. Perform the Work so as not to interfere with the Owner's operations. **Noisy operations that may disturb occupants shall be performed during hours when building users are not present.**
- C. All buildings on the adjacent sites will remain fully occupied. Contractor shall erect and maintain all reasonable safeguards for the safety and health of the occupants. This shall include but is not limited to posting danger signs, and other warnings against hazards, as well as promulgating safety regulations. The contractor shall provide safety precautions and barricades for pedestrians at all access and egress

locations.

- D. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. The Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner occupancy.
 - 2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions of the building.
 - 3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions of the building.
- E. All proposed interruptions to operations and equipment shall be reviewed with and approved by the owner prior to starting such work. Unless otherwise approved in writing only weekend or evening work requiring interruption of utilities shall be approved.

1.5 ALTERATIONS AND COORDINATION

- A. General: The work of this Contract includes coordination of the entire work of the project, including preparation of general coordination drawings, diagrams and schedules, and control of site utilization, from beginning of construction activity through project closeout and warranty periods.

1.6 MISCELLANEOUS PROVISIONS

- A. Layout of the Work: Dimensions and elevations indicated on the drawings shall be verified by the contractor. Discrepancies between drawings, specifications and existing conditions shall be referred to the Architect immediately for adjustment before effected work is performed. Failure to make such notification shall place responsibility upon the Contractor to carry out the work in a satisfactory and workmanlike manner at no additional cost to the Owner. The contractor shall coordinate the installation of equipment with the location of utilities to the equipment. The Contractor shall layout items of work in plan, elevation and on ceilings to avoid later conflict.
- B. Deliveries: The contractor shall coordinate and make arrangements for deliveries of materials and equipment to be installed in the renovated areas. Verify ahead of deliveries routes, opening sizes, etc. needed for delivery of items within the space.
- C. Fire Watch: When the fire alarm system and/or automatic fire sprinkler system is not operational, make arrangements acceptable to Capitol Police and the Tallahassee Fire Department.
- D. Mechanical/Electrical Requirements of General Work:

1. General: Except as otherwise indicated, comply with applicable requirements of the codes listed.

E. Performance Requirements for Completed Work:

1. General: The Contract Documents indicate the intended occupancy and utilization of the building and its individual systems and facilities. Compliance with governing regulations is intended and required for the work and for the Owner's occupancy and utilization.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01010

SECTION 01011 - PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Information (RFIs).
 - 5. Cleaning and protection
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings." Project meetings shall be held monthly.
- D. Construction Schedule: Requirements for the Contractor's Construction CPM Schedule are included in the Supplementary Conditions of the contract.

1.3 COORDINATION

- 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for

required maintenance, service, and repair of all components, including mechanical and electrical.

- 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 the Owner's designated representative and building occupant and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule utilizing the Critical Path Method, as outlined in the Associated General Contractors of America publication.
 - 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. Pre-installation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

1.4 SUBMITTALS

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including cellular and office telephone numbers. Provide names, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
 - 2. Provide the Architect and Owner's designated representative an electronic copy of the original list as well as all updates to the list.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

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

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner, Occupant, County and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, County, Building Occupant and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to the Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site. Conduct the meeting to review responsibilities and personnel assignments.
 - 1. Attendees: Authorized representatives of Building Owner and Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.

- v. Progress cleaning.
 - w. Working hours.
- 3. Minutes: Record and distribute meeting minutes.
- C. Progress Meetings: Conduct progress meetings at intervals designated by Owner. Coordinate dates of meetings with preparation of payment requests.
 - 1. Attendees: In addition to representatives of the Owner's designated representatives, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.

20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - 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.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs: .
 1. Identify each page of attachments with the RFI number and sequential page number.

- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 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 Division 1 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01012 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 STANDARDS

- A. Reference to standards, codes specifications, recommendations and regulations: refer to the latest edition of printing in effect at the date of issue shown in the Documents, unless other date is implied by the suffix number of the standard.
- B. Applicable portions of the standards listed that are not in conflict with the Contract Documents shall be constructed as Specifications for this work.
- C. Specified variations from the standards listed shall be constructed as amendments and the unaltered portions of the Standards shall remain in full effect.
- D. In cases of discrepancies or variations between the listed Standards, the more stringent requirements shall govern.

1.2 DELIVERY AND STORAGE

- A. Schedule deliveries and unloading to prevent interference with other site operations and construction work. Arrange deliveries to avoid larger accumulations than can be suitably stored at site.
- B. Pack and handle material to prevent damage during loading, delivering and storing.
- C. Deliver packaged materials to site in manufacturer's original, unopened, labeled containers. Do not open containers until approximate time for use.
- D. Store materials at locations that will not interfere with progress of work. Arrange locations of storage areas in approximate order of intended use.
- E. Store materials in a manner that will prevent damage to materials or structure, and that will prevent injury to persons.

1.3 STORING AREAS

- A. The Owner will make available limited storage areas on the building site. At the start of the operation, make arrangements with the Owner's representative for the assignment of the areas. During construction maintain the areas in a neat condition.

1.4 MANUFACTURER'S DIRECTIONS

- A. Apply, install, connect and erect manufactured items or materials according to the recommendations of the manufacturer when such recommendations are not in conflict with the Contract Documents.
- B. Furnish to the Architect, copies of the manufacturer's recommendations. Secure approval of recommendations before proceeding with work.
- C. Keep at site not less than one copy, in good condition, of manufacturer's recommendations or directions pertaining to work at the site. Inform involved personnel of requirements and availability of manufacturer's recommendations.

END OF SECTION 01012

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of 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 submittals required for performance of the Work, including;
 - 1. Contractor's construction schedule.
 - 2. Submittal schedule.
 - 3. Shop Drawings.
 - 4. Product Data.
 - 5. Samples.
- B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - 1. Special prequalification requirements.
 - 2. Applications for payment.
 - 3. Performance and payment bonds.
 - 4. Insurance certificates.
 - 5. List of Subcontractors.
- C. Inspection and test reports are included in Section "Quality Control Services."

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - 3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
- B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Project name, and building reference.
 2. Date.
 3. Name and address of Architect.
 4. Name and address of Contractor.
 5. Name and address of subcontractor.
 6. Name and address of supplier.
 7. Name of manufacturer.
 8. Number and title of appropriate Specification Section.
 9. Drawing number and detail references, as appropriate.
- C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
1. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar- chart type Contractor's construction schedule. Submit within 30 days of the date established for "Commencement of the Work".
1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".
 2. Within each time bar indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
 5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
 6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

- B. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.
- C. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.
- D. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating "precalculated" and "actual" costs. On the line show dollar-volume of Work performed as of the dates used for preparation of payment requests.
- E. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
 - 1. When revisions are made, distribute 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 construction activities.
- F. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.5 SUBMITTAL SCHEDULE

- A. After development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for establishment of the Contractor's construction schedule.

1.6 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, and performance curves.
 - 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with recognized trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 - 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

3. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.
4. Submittals:
 - a. Submit an electronic pdf.
The Architect will review and mark with action taken and corrections or modifications required and will return by email electronic marked up pdfs for your use.
 - b. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
6. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
7. Do not permit use of unmarked copies of Product Data in connection with construction.

1.7 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of materials, color range sets, and swatches showing color, texture and pattern.
 1. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Include the following:
 - a. Generic description of the Sample.
 - b. Sample source.
 - c. Product name or name of manufacturer.
 - d. Compliance with recognized standards.
 - e. Availability and delivery time.
 2. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 3. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
- B. Submittals: Submit three (3) sets; one will be returned marked with the action taken.
 1. Maintain sets of Samples, as returned, at the Project site, for quality comparisons throughout the course of construction.
 2. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 3. Sample sets may be used to obtain final acceptance of the construction associated with each set.
- C. Field Samples specified in individual Sections are special types of Samples. Field

Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.

1. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.8 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility

- B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

SECTION 01710 - FINAL CLEANING

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 final cleaning at Substantial Completion.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Contract Closeout" specifies general contract closeout requirements.
 - 2. Special cleaning requirements for specific construction elements are included in appropriate Sections of Divisions 2 through 16.
- C. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.
 - 1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final-cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.

1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 3. Remove petrochemical spills, stains, and other foreign deposits.
 4. Remove tools, construction equipment, machinery, and surplus material from the site.
 5. Remove barricades to provide safe access to the building.
 6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 8. Broom clean concrete floors in unoccupied spaces.
 9. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 11. Remove labels that are not permanent labels.
 12. 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.
 - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 13. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 14. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 16. Clean ducts, blowers, and coils if units were operated without filters during construction.
 17. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 19. Leave the Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.

- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
 - 1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

END OF SECTION 01710

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including drawings and all Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 2 through 16 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 in 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. In the Application for Payment that coincides with, or first follows, the date that Substantial Completion is claimed, show 100 percent completion for portion of the Work claimed as Substantially Complete. Include supporting documentation for completion and a statement showing an accounting of changes to the Contract Sum.
 - 3. Advise Owner of pending insurance changeover requirements.
 - 4. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 5. 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.

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. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. 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. Re-inspection: Request re-inspection 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 date of Final Completion, complete the following:
1. Submit a final Application for Payment.
 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. Submit pest-control final inspection report and warranty.
 5. 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit 3 copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order based upon room number, and ending with exterior items.
 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.

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. 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, 3-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.
- C. 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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide 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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Remove snow and ice to provide safe access to building.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Clean transparent materials, including mirrors and 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 mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. 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 similar labels, including mechanical and electrical nameplates.
 - k. Wipe surfaces of electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - l. Replace parts subject to unusual operating conditions.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - 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. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 01781 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including drawings and all Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 1 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Submit one set of marked-up Record Prints and a CADD file (AutoCAD version 2000 or later) incorporating all of the changes.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of black-line white prints 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 prepare the 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 understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 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, Supplemental Instructions, and/or Architectural Directives. Attach copy of related documents to Drawings and separate copy of related documents in 3-ring notebook(s) divided by index tabs.
 - 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 or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 - 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.

7. Record drawings should be available at monthly coordination meetings for review by the Architect, Owner, and/or Owner's representative.
- B. 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. 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 and Record Drawings where applicable.

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 and Record Drawings where applicable.
 4. Include all Product Data submittals, Shop Drawings, samples and other submittals. Provide in labeled box. Provide Submittal Log(s) in tabular form listing all referenced items.

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.

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 01781

SECTION 01782 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This 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. Maintenance manuals for the care and maintenance of products, materials, and finishes.
- B. Related Sections include the following:
 - 1. Division 1 Section "Submittals" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 2 through 16 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 SUBMITTALS

- A. Final Submittal: Submit one of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

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 MANUALS, GENERAL

- 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: Enclose title page in transparent plastic sleeve. 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, address, and telephone number of Contractor and Subcontractor.
 6. Name and address of Architect.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf 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.. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. 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 diskettes 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. Water leak.
 4. Power failure.
 5. Water outage.
 6. System, subsystem, or equipment failure.
- 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.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Wiring diagrams.
 6. Control diagrams.
 7. Piped system diagrams.
 8. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
 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 MANUAL

- 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.
- 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 MANUAL

- 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.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 1. Standard printed 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 videotape, 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.
- 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 1 Section "Project Record Documents."
- F. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 02070 - SELECTIVE DEMOLITION

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. The extent of selective demolition work is indicated on the drawings.
- B. Types of Selective Demolition Work: Demolition requires the selective removal and subsequent offsite disposal and coordination of the following:
 - 1. Removal of miscellaneous construction to interface with new construction.
 - 2. Salvage of existing items to be reused or recycled
 - 3. Demolition and removal of selected portions of building or structure.
 - 4. Demolition and removal of existing floor coverings, partitions, etc. as scheduled.
 - 5. Demolition and removal of existing ceiling system where indicated.
 - 6. Demolition and removal of existing piping, HVAC system, and electrical as scheduled.
 - 7. Demolition and removal/salvage of existing door units where indicated.
 - 8. Demolition and removal of other materials and items indicated on the drawings.

1.3 DEFINITIONS

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

1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- A. Pre-demolition Photographs or Videotapes: While not required, the Contractor may wish to take photographs and/or videotapes of the site in order to document the existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations.

1.5 PROJECT CONDITIONS

- A. Occupancy: Owner will be continuously occupying areas of the campus immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work area.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Architect and Owner.
- D. Utility Service: Maintain existing utilities serving the building and surrounding buildings.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
 - 2. Notify the Owner's designated representative in advance of any required breaks in utility services. Outages must be scheduled and approved in advance with Owner's designated project manager.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
 - 1. Review building with the Facilities Manager to identify any areas with active warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 - 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall ensure continued operation of downline devices.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

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

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- E. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

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

END OF SECTION 02070

SECTION 06100 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 — GENERAL

1.1 SECTION INCLUDES

- A. Dimensional Wood Lumber (BLOCKING ONLY)
- B. Plywood sheathing (BLOCKING ONLY)

1.2 SUMMARY

- A. Extent of rough carpentry for wood framing, wood nailers and blocking, and wood sheathing is indicated on the Drawings, including schedules, notes and details.
- B. Where conflicts arise between this specification and those noted on the structural drawings, the more stringent requirement will govern.
- C. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.3 DESCRIPTION OF WORK

- A. Definition: Rough Carpentry includes structural components of dimensional lumber, composite lumber, and structural panels constructed at the project site as part of the load bearing system.
- B. The extent of rough carpentry is shown on drawings, including schedules, notes and details to show size and location of members, typical connections and treatments required.
- C. Coordination: It is the responsibility of every subcontractor to cooperate with the Contractor and other subcontractors to prepare coordinated drawings in areas of congestion and to apprise themselves of the requirements of other trades that affect their work.
- D. Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of nailers, blocking, and similar supports to allow attachment of other work.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Handling and Storage: Handle and store lumber with care, and in accordance with manufacturer's instructions and APA recommendations to avoid damage from moisture and other causes.
- B. Delivery: Time delivery of lumber products to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow.
 - 1. Building Owner will not sign for or handle any project related materials.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's current technical literature for each component.

PART 2 — PRODUCTS

2.1 LUMBER AND PANELS PRODUCTS, GENERAL

- A. Lumber Standards: PS 20 "American Softwood Lumber Standard" and applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Grade Stamps: Factory-mark each piece of lumber with grades stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- C. Sizes: Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20 for moisture content specified for each use.
 - 1. Provide dressed lumber, S4S, seasoned to 19 percent maximum moisture content at time of dressing and shipment.
- D. Dimension Lumber: For light framing (2" to 4" wide) provide Construction Grade lumber of any species unless noted otherwise on the structural drawings.
- E. Plywood Construction Panels: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with American Plywood Association (APA)" Performance Standard and Policies for Structural-Use Panels," Form No. E445.
 - 1. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.
 - 2. Minimum Requirements for plywood used for the interior wood floor: Pressure treated, tongue-and-groove, exposure 1. Thickness to match existing subfloor. Support all edges of the plywood with pressure treated blocking.
 - 3. Minimum Requirements for plywood used for roof sheathing:
 - a. Match existing depth when patching an existing roof, using CDX or better materials. See structural drawings for additional requirements.
 - b. At new roofs, use thicknesses as noted on drawings, CDX or better materials. See structural drawings for additional requirements.
 - 4. Minimum Requirements for plywood used for interior wall sheathing:
 - a. Match existing depth, using materials suitable for use under tile and/or to match existing where painted.

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.

Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

- B. Blocking: Provide blocking in walls for all wall-mounted equipment, grab bars, coat hooks, baby changing station, roll-down doors, lavatories, mirrors, etc.

2.3 WOOD TREATMENT BY PRESSURE PROCESS

- A. Preservation Treatment: Where lumber or plywood is indicated as “PT” or “Treated,” or is specified herein to be treated, comply with applicable requirements of American Wood Preservers’ Association (AWPA) Standards C2 (Lumber) and C9 (Plywood) and of AWPA Standards listed below. Mark each treated item with the AWPA Quality Mark Requirements. Lumber not in contact with ground and not exposed to the weather may be treated according to AWPA C31 with inorganic boron (SBX).
 - 1. Use treatment containing no arsenic or chromium, except as follows: Use CCA-treated wood for work within 60 feet of water (shore) and ACQ-treated wood for work greater than 60 feet from water (shore). (CCA: chromated copper arsenate; ACQ: ammoniacal copper quat.)
 - 2. AWPA standards shall be used for determining pressure treatment of wood used in the project. Pressure treatment retention for wood shall be as follows:
 - a. Above-ground: 0.25 pcf.
 - b. Ground contact: 0.40 pcf.
 - c. Piling in ground: 0.80 pcf.
 - d. Marine piling: 2.5 pcf.
 - 3. If Wolmanized (Copper Azole – Type B, CA-B) wood treatment is used, the pressure treatment retention for wood shall be as follows:
 - a. Above-ground: 0.10 pcf.
 - b. Ground contact: 0.21 pcf.
 - c. Piling: Not to be used.
- B. Pressure-treat all designated dimension lumber materials with water-borne preservatives to comply with AWPA LP-2. After treatment, kiln-dry lumber to a maximum moisture content, respectively, of 19 percent.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. All fasteners to preservative-treated materials shall be stainless steel (Grade 316).
- E. All exposed wood to be pressure treated.

PART 3 — EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.
- B. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

3.2 NAILERS AND BLOCKING

- A. Provide wherever shown and where required for attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
 - 1. Provide blocking as required for all restroom accessories to support loading indicated by the manufacturer.
 - 2. Blocking for ADA grab bars must be provided to withstand design pressures as required by code.

3.3 WOOD FRAMING, GENERAL

- A. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association (N.F.P.A.).
- B. Anchor and nail as shown, and to comply with "Recommended Nailing Schedule" of "Manual for House Framing" and "National Design Specifications for Wood Construction" published by N.F.P.A.
- C. Stud Framing, General: Provide stud framing of size and spacing indicated. Arrange studs so wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using 2" thick members with widths equaling that of studs; except single top plate may be used for non-loading-bearing partitions. Nail or anchor plates to supporting construction.

3.4 INSTALLATION OF CONSTRUCTION PANELS

- A. General: Comply with applicable recommendations contained in Form No. E 30F, "APA Design/Construction Guide - Residential & Commercial," for types of construction panels and applications indicated.
- B. Fastening Methods: Fasten sheathing panels by nailing to framing.

END OF SECTION 06100

SECTION 06200 – FINISH CARPENTRY

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood Base trim.
2. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed with other construction before woodwork installation.
3. Shop finishing of wood trim.

B. Related Sections

1. Section 06 "Rough Carpentry"
2. Section 09 "Painting"

1.2 SUBMITTALS

- ##### **A. Product data for each type of product.**

1.3 FIELD CONDITIONS

- ##### **A. Weather limitations for Exterior Work: Proceed with installation of exterior trim only when existing and forecasted weather conditions permit work to be performed.**
- ##### **B. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until the building is enclosed and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.**

PART 2 — PRODUCTS

2.1 MATERIALS, GENERAL

- ##### **A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.**

2.2 INTERIOR AND EXTERIOR TRIM

A. Base trim:

1. Grade: Clear stain grade
2. Wood Species: to match existing.
3. Profile: As indicated on drawings.
4. Location: As indicated on drawings.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer.
 - 1. Use waterproof resorcinol glue for exterior applications.

PART 3 — EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior wood trim to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. General:
 - 1. Follow manufacturer's best practices.
 - 2. Edge treatment: Caulk, paint or prime all field cut edges.
- B. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Preservative-Treated wood: Where cut or drilled in field, treat end cuts and drilled holes according to AWWPA M4.
- E. Anchor wood trim to anchors or blocking built in or directly attached to substrate. Secure with fastening, countersunk and filled flush with woodwork.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces to greatest extent possible. Do not use pieces less than 36 inches long except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
- G. Install standing and running trim with no more variation from a straight line than 1/8 inch in 98 inches.
- H. Where undulations in concrete floor result in gaps greater than 1/8" between finished floor and underside of wood base, install 3/4" quarter round of same material as wood base.
 - 1. Where quarter round is required in one area, install on all perimeter walls in that room.
 - 2. Except at corners, stagger joints between quarter round members from joints in the wood base by at least 16".

END OF SECTION 06200

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood cabinets.
 - 2. Synthetic stone countertops
- B. Related Sections include the following:
 - 1. Division 6 Section "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
 - 2. Division 9 Section "Gypsum Board Assemblies" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including panel products, cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and grommets installed in architectural woodwork.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

5. Apply WI-certified compliance label to first page of Shop Drawings.

C. Samples for Verification:

1. Lumber with or for transparent finish, not less than 4" long, for each species and cut, finished on 1 side and 1 edge.
2. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm) for each species and cut. Include at least one face-veneer seam and finish as specified.
3. Chemetal veneer on substrate, 4" long. Include at least one seam.
4. Synthetic stone, 4 inches (150 mm) square.
5. Exposed cabinet hardware and accessories, one unit for each type[and finish].

D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

E. Qualification Data: For fabricator.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Fabricator of products or Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

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

- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Lighting Coordination: Distribute copies of approved light fixture schedule specified in Division 16 Section "Lighting" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with fixture requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: As indicated on the drawings.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
 - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Polilam

- b. Formica Corporation.
- c. Nevamar Company, LLC; Decorative Products Div.
- d. Wilsonart International; Div. of Premark International, Inc.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
- C. Door Pulls: As indicated on the drawings.
- D. Catches: Magnetic catches, BHMA A156.9, B03141
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - 2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 - 3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 - 4. Trash Bin Slides: Grade 1HD-100; for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Grommets for Cable Passage through Countertops: As indicated on the drawings.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- F. Install glass to comply with applicable requirements in Division 8 Section "Glazing" and in GANA's "Glazing Manual".

2.5 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: Premium
- B. AWI Type of Cabinet Construction: Reveal overlay.
- C. Reveal Dimension: 1/2 inch (13 mm).

- D. Wood Species and Cut for Exposed Surfaces: As indicated on the drawings.
1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
 2. Matching of Veneer Leaves: Book match.
 3. Vertical Matching of Veneer Leaves: End match.
 4. Veneer Matching within Panel Face: Balanced match.
 5. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- E. Semiexposed Surfaces: As indicated on the drawings.

2.6 SYNTHETIC STONE COUNTERTOPS

- A. Product: Wilsonart and Corian Quartz or architect approved equal
1. Gloss: 47 minimum on polished surfaces as measured with a glossmeter.
 2. Resistance to abrasion (measured as the loss of volume after abrasion): 125 mm³ per UNI 10532.
 3. Water absorption (expressed as percent of water absorbed based on dry weight): Less than or equal to 0.02% per ASTM C-97.
 4. Density (Weight of sample divided by the volume of water displaced by the sample): 2.4 g/cm³.
 5. Modulus of Rupture: 6800 psi per ASTM C-674.
 6. Moisture Expansion: 0.10% maximum per ASTM C-370
- B. Material Thickness: 1-1/4"
- C. Colors & Pattern: As indicated on drawings
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
1. Fabricate tops with shop eased and polished edges.
 2. Fabricate tops with backsplashes where indicated in the drawings.
- E. Install integral sink bowls in countertops in shop.
- F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes as recommended by manufacturer.
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- I. Refer to Division 9 Sections for final finishing of installed architectural woodwork.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 06402

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Blanket-type building insulation within walls.
- B. Related Sections include the following:
 - 1. Division 9 Section Gypsum Board Assemblies for installation in metal-framed assemblies of insulation specified by referencing this Section.
 - 2. Division 15 Section "Mechanical Insulation."

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.
- B. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by r-values they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at meant temperatures indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Research/Evaluation Reports: For foam-plastic insulation.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.
- C. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 GLASS-FIBER BLANKET INSULATION

- A. Acceptable Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Guardian Fiberglass, Inc.
 - 3. Johns Manville.
 - 4. Knauf Fiber Glass.

5. Owens Corning.
- B. Faced Fiberglass Blanket/Batt Insulation: Thermal insulation produced by combining fibers of type described below with thermosetting resins to comply with ASTM C 665:
1. Mineral Fiber Type: Fibers manufactured from glass or slag.
 2. Facing: Faced on one side with mesh reinforced Kraft paper.
 3. Combustion Characteristics: Unfaced blanket/batt passes ASTM E84 test.
 4. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectfully.
 5. Thermal resistance: 5-1/2 inches thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of

insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
- D. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.5 PROTECTION

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

END OF SECTION 07210

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Extent of each form and type of joint sealer is indicated on drawings and schedules.
- B. This Section includes joint sealers for the following locations:
 - 1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Silicone sealants:
 - 1) Expansion joints of precast concrete panels.
 - 2) Expansion joints of brick masonry.
 - 3) Sheetmetal flashing to concrete or masonry.
 - 4) Sheetmetal flashing at metal roof and wall panels.
 - 5) Joints between different materials listed above.
 - 6) Perimeter joints between aluminum frame of windows and masonry, precast concrete or metal wall panels.
 - 7) Other joints as indicated.
 - b. Urethane sealants:
 - 1) Joints between concrete, stucco, and masonry panels specifically indicated to be sealed with urethane sealant, or coated with elastomeric waterproof coating.
 - 2) Perimeter joints between materials listed above and metal flashings associated with bituminous roofing system.
 - 2. Exterior joints in horizontal traffic surfaces as indicated below:
 - a. Control, expansion, and isolation joints in cast-in-place concrete slabs for floors and paving.
 - b. Other joints as indicated.
 - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Perimeter joints of exterior openings where indicated.
 - b. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - d. Perimeter joints of toilet fixtures.
 - e. Other joints as indicated.
 - 4. Fire Stopping sealant
- C. Sealing joints related to flashing and sheet metal for roofing is specified in

Division-7 Section: "Flashing and Sheet Metal."

- D. Sealants for glazing purposes are specified in Division-8 Section "Glass and Glazing."

1.3 SYSTEM PERFORMANCES:

- A. Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.4 SUBMITTALS:

- A. Product Data from manufacturers for each joint sealer product required, including instructions for joint preparation and joint sealer application.
- B. Samples for verification purposes of each type and color of joint sealer required. Install joint sealer samples in 1/2 inch wide joints formed between two 6 inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealers.
- C. Certificates from manufacturers of joint sealers attesting that their products comply with specification requirements and are suitable for the use indicated.
- D. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project name, addresses, names of Architects and Owners, plus other information specified.

1.5 QUALITY ASSURANCE:

- A. Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.
 - 1. Testing will not be required when joint sealer manufacturer is able to submit joint preparation data required above which is acceptable to Architect and is based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:
 - 1. Conduct field tests for each application indicated below:
 - 2. Test Method: Test joint sealers by hand pull method described below:
 - 3. Install joint sealants in 5-foot joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed Work. Allow sealants to cure fully before testing.
 - 4. Make knife cuts as follows: A horizontal cut from one side of joint to the other followed by 2 vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2 inch cuts. Place a mark 1 inch from top of 2 inch piece.
 - 5. Use fingers to grasp 2 inch piece of sealant just above 1 inch mark; pull

firmly down at a 90 degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

6. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
7. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants which fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS:

- A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:
 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40 deg F (4.4 deg C).
 2. When joint substrates are wet due to rain, frost, condensation, or other causes.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by joint sealer manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 SPECIAL PROJECT SEALANT WARRANTIES

Special Project Warranties: Provide written warranties by the Contractor and his authorized installer, agreeing to replace/repair defective materials and workmanship. Provide written warranty by the manufacturers of the sealant material agreeing to replace defective or failed materials within the specified warranty period. Repairs and replacements required because of events beyond the Contractor's/Installer's/Manufacturer's control (and which exceed performance requirements) shall be completed by Contractor/Installer and paid for by the

Owner.

1. Manufacturer's sealant warranty period is 20 years for silicone sealants. The manufacturer's sealant warranty period is 10 years for urethane sealants.

2. The Contractor and Installer's warranty period is two years after date of substantial project completion with no dollar limit and no penal sum.

1.9 SEQUENCING AND SCHEDULING

A. Installation of joint sealer with other products (water repellent and coating) as recommended by manufacturer of sealant, and other products. Submit manufacturer's recommendation of sequence.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL:

A. Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealers indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS:

A. Elastomeric Sealant Standard: Provide manufacturer's standard neutral curing, elastomeric sealant of base polymer indicated which complies with requirements of Federal Specifications TT-S-00230C, Type II, Class A, and with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses.

B. Single Part Neutral Curing Silicone Sealants for concrete, aluminum and glass joints, and other joints specifically indicated; use NT; Type S, Grade NS, Class 25, and uses NT, M, A, and O.

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

a. Dow Corning 790 Silicone Sealant.

C. Minimum Performance Criteria:
Colors - Min. 10 standard colors
L-S-8802 Tack-Free Time, 50% RH, hours - 1

Curing Time RH @ 25 deg.C. (77 deg.F), days - 7-14
MIL-S-8802 Full Adhesion, days - 14-21
Flow, Sag or Slump, in 3-inch wide joint - None
Working Time, minutes - 10-20

As Cured, after 7 days at 25 deg.C (77 deg.F) and 50% RH
ASTM D 2240 Durometer Hardness, Shore A, points - 5
ASTM D 412 Ultimate Tensile Strength, max. elongation, psi100
ASTM D 412 Elongation, percent maximum - 1600
MIL-S-8802 Peel Strength, lbs/in. - 25
ASTM C 1135 Tensile Adhesion
With 25% extension - 15
With 50% extension - 20
TT-S-001543 Staining, after 14 days of 50% compression, at
158 deg.F. on concrete, granite, limestone and brick - None
Ozone Resistance - Good
Weathering, after 6000 hours in Atlas Weatherometer
Min. change in hardness
Joint Movement Capabilities, percent,
Extension – (+100)
Compression – (-50)
Fire Endurance, hours - 2

2.3 MISCELLANEOUS JOINT SEALANTS:

- A. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
- B. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Acoustical Sealants for Concealed Joints:
 - a. "BA-98"; Pecora Corp.
 - b. "Tremco Acoustical Sealant"; Tremco Inc.

2.4 FIRE-RESISTANT JOINT SEALERS:

- A. General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling

openings around cables, conduit, pipes and similar penetrations through walls and floors.

- C. One-Part Fire-Stopping Sealant: One part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Foamed-In-Place Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - b. "Pensil 851"; General Electric Co.
 - 2. One-Part Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
 - c. "RTV 7403"; General Electric Co.
 - d. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.5 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam of material indicated below; nonabsorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Either open-cell polyurethane foam or closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer, for cold-applied sealants only.

2.6 MISCELLANEOUS MATERIALS:

- A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

- C. Accessory Materials for Fire-Stopping Sealants: Provide forming, joint fillers, packing and other accessory materials required for installation of fire-stopping sealants as applicable to installation conditions indicated.

2.7 JOINT FILLERS FOR CONCRETE PAVING:

- A. General: Provide joint fillers of thickness and widths indicated.
- B. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D 1751:
 - 1. Asphalt saturated fiberboard.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
 - 1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellents; water; surface dirt; and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile; and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALERS:

- A. General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.
- D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.
- E. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- F. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.
 - 2. Provide flush joint configuration per Figure 6B in ASTM C 962, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.
- H. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around mechanical and electrical

services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.4 CLEANING:

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

3.5 PROTECTION:

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

END OF SECTION 07900

SECTION 08111 – STEEL DOORS AND FRAMES

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Standard and custom hollow metal doors and frames.

- B. Related Sections:

- 1. Division 01 Section "General Conditions".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Door Hardware".
 - 4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

- 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
 - 6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 9. 10. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.

10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect doors and frames upon delivery for damage. Minor damage is to be repaired, provided they are equal in all respects to new work and acceptable to the architect.
- D. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
1. Curries Company (CU) - Polystyrene Core - 707 Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - SU SR Series.
 - b. Curries Company (CU) - M Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - SU Series.
 - b. Curries Company (CU) - M Series.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

- a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:
 - Two anchors per jamb up to 60 inches high.
 - Three anchors per jamb from 60 to 90 inches high.
 - Four anchors per jamb from 90 to 120 inches high.
 - Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - Three anchors per jamb up to 60 inches high.
 - Four anchors per jamb from 60 to 90 inches high.
 - Five anchors per jamb from 90 to 96 inches high.
 - Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.6 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 — EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. General Contractor to see that any scratches or disfigurements caused in shipping or handling are properly cleaned and touched up with a rust inhibiting primer.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Prior to installation, all frames must be checked for rack, twist and out of square conditions.
 - 2. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - a. When temperature conditions necessitate an additive to be used in the plaster or mortar to prevent freezing, the contractor installing the frames will coat the inside of the frames, in the field, with a corrosion inhibiting bituminous material.
 - 5. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
- d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.6 SCHEDULES

- A. After installation, copies of the door schedules will be turned over to the owner when the building is accepted.

END OF SECTION 08111

SECTION 08211 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid-core doors with wood-veneer faces. **ALL NEW DOORS SHALL MATCH EXISTING DOORS IN ALL ASPECTS.**
 - 2. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Sections include the following:
 - 1. Division 8 for Finish Hardware.

1.3 SUBMITTALS

- A. Product Data: For each type of door. Include the followings:
 - 1. Details of core and edge construction
 - 2. Trim for openings and louvers.
 - 3. Factory finish specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate doors to be factory finished and finish requirements.
 - 4. Indicate fire ratings for fire doors.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually such that they are protected from damage, soiling, and deterioration, during transit, storage, and handling.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.
- D. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flush Wood Doors:
 - a. Algoma Hardwoods Inc.
 - b. Ampco Products, Inc.
 - c. Buell Door Company.
 - d. Chappell Door Co.
 - e. Eagle Plywood & Door Manufacturing, Inc.
 - f. Eggers Industries; Architectural Door Division.
 - g. GRAHAM Manufacturing Corp.
 - h. Haley Brothers, Inc.
 - i. Ideal Wood Products, Inc.
 - j. IPIK Door Company.
 - k. Lambton Doors.
 - l. Marlite.
 - m. Mohawk Flush Doors, Inc.
 - n. Oshkosh Architectural Door Co.
 - o. Poncraft Door Co.
 - p. Southwood Door Co.
 - q. Vancouver Door Company, Inc.
 - r. VT Industries Inc.
 - s. Weyerhaeuser Company.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Species and Cut: Match existing doors (Confirm with Owner).
 - 3. Match between Veneer Leaves: Pleasing match.
 - 4. Construction: SLC-5 (Glued block core, 5-ply).
- B. Fire-Rated Doors:
 - 1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.

2.3 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.

- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

2.4 SHOP PRIMING

- A. Doors for Transparent Finish: Shop seal faces and edge of doors, including cutouts, with stain (if required), other required pretreatments, and first coat of finish as specified in Division 9 Section "Painting".

2.5 FACTORY FINISHING

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Transparent Finish:
 - 1. Grade: Premium
 - 2. Finish: AWI System TR-4 conversion varnish
 - 3. Staining: To match existing.
 - 4. Effect: Semifilled finish.
 - 5. Sheen: Satin

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."

- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
 - a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- E. Field-Finished Doors: Refer to the following for finishing requirements:
 - 1. Division 9 Section "Painting"

3.3 ADJUSTING

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

END OF SECTION 08211

SECTION 08710– DOOR HARDWARE

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
 - 4. **NOTE: ALL HARDWARE SHALL MATCH EXISTING. WHERE HARDWARE IS BEING REPLACED ON EXISTING DOORS TO REMAIN, HARDWARE SHALL BE REPLACED IN A ONE FOR ONE REPLACEMENT. IN NEW DOOR LOCATIONS WITH NEW OR RELOCATED DOORS, HARDWARE SHALL BE PROVIDED TO MATCH SIMILAR DOOR FUNCTIONS IN AREA.**
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
 - 4. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section “Hollow Metal Doors and Frames”.
 - 2. Division 08 Section “Flush Wood Doors”.
 - 3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
 - 4. Division 08 Section “Automatic Door Operators”.
 - 5. Division 28 Section “Access Control Hardware Devices”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.

5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Installation of Smoke Door Assemblies.
 7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 8. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 3. ANSI/UL 294 - Access Control System Units.
 4. UL 305 - Panic Hardware.
 5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.

- h. Warranty information for each product.
- 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation

manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in

materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 — PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
 5. Manufacturers:

- a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 - 1. Where specified, provide modular continuous geared hinges that ship in two or three pieces and form a single continuous hinge upon installation.
 - 2. Manufacturers:
 - a. Pemko (PE).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 - 1. Manufacturers:
 - a. Pemko (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 - 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
 - 2. Manufacturers:
 - a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Manufacturers:
 - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 6. Manufacturers:
 - a. Rockwood (RO).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.

4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. New System: Key locks to a new key system as directed by the Owner.
- D. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.7 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide locksets with functions and features as follows:
 - a. Heavy duty 12-gauge wrought steel case.

- b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1" projection deadbolt.
 - c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
 - f. Status indicators inside, outside, or on both sides of doors as specified; available with wording for "locked/unlocked", "vacant/occupied" or custom wording options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.
 - g. Ten-year limited warranty for mechanical functions.
2. Electromechanical locksets shall have the following functions and features:
- a. Universal Molex plug-in connectors that have standardized color-coded wiring and are available in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.
 - d. Optional high security monitoring with internal end-of-line monitoring alongside deadbolt privacy and integrated door position monitoring.
 - e. Two-year limited warranty on electrified functions.
3. Manufacturers:
- a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.

2.8 DEADLOCKS AND LATCHES

- A. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.

1. Manufacturers:
- a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.
 - b. Adams Rite Manufacturing (AD) - 4900 Series.

2.9 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.10 ELECTROMAGNETIC LOCKING DEVICES

- A. Surface Electromagnetic Locks (Commercial Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 3 with minimum holding force strength of 600 pounds. Locks to autosense either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Locks are to have an integrated door position switch and lock bond sensor. Locks are to have optional integrated motion sensor and/or security camera as indicated in the hardware sets. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.
 - 1. Manufacturers:
 - a. Securitron (SU) - M380E Series.

2.11 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. Exit devices shall have a five-year warranty.
 - 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide exit devices with functions and features as follows:
 - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - c. Five-year limited warranty for mechanical features.
 2. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.

- b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
3. Manufacturers:
- a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.12 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
- 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 - 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
- a. Corbin Russwin Hardware (RU) - DC6000 Series.

- b. Norton Rixson (NO) - 8500 Series.
- c. Sargent Manufacturing (SA) - 1431 Series.

2.13 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - a. Norton Rixson (RF).

- b. Rockwood (RO).
- c. Sargent Manufacturing (SA).

2.15 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Manufacturers:
 - a. Securitron (SU) - DPS Series.
- B. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 - 1. Power supplies shall meet all functions and features as specified herein.

- a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
- b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
- c. Enhanced surge immunity for input/output protection
- d. Separate, dedicated battery charging circuit to keep locks cooler.
- e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
- f. Instant auto-switch to battery on AC loss.
- g. Expandable up to 16 outputs in the standard enclosure
- h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
- i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
- j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

- a. Securitron (SU) - AQL Series.

2.17 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 — EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handling and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Manufacturer's Abbreviations:

1. MK – McKinney
2. PE – Pemko
3. SU - Securitron
4. RO - Rockwood
5. RU - Corbin Russwin
6. AD - Adams Rite
7. RF - Rixson
8. NO - Norton
9. OT - Other
10. SA – SARGENT

NOTE: ALL HARDWARE SHALL MATCH EXISTING. WHERE HARDWARE IS BEING REPLACED ON EXISTING DOORS TO REMAIN, HARDWARE SHALL BE REPLACED IN A ONE FOR ONE REPLACEMENT. IN NEW DOOR LOCATIONS WITH NEW OR RELOCATED DOORS, HARDWARE SHALL BE PROVIDED TO MATCH SIMILAR DOOR FUNCTION IN AREA.

END OF SECTION 08710

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Non-load-bearing steel framing.
 - 2. Interior gypsum wallboard.
 - 3. Tile backing panels
 - 4. Moisture resistant interior gypsum wallboard.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood framing and furring.
 - 2. Division 7 Section Building Insulation for insulation installed in gypsum board assemblies.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from:
 - a. UL's "Fire Resistance Directory".
 - b. Florida Building Code latest edition.
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
 1. Single source Responsibility: Obtain gypsum board products, joint treatment products, and textured coatings from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one the following:
 1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Consolidated Systems, Inc.
 - c. Dale Industries, Inc. - Dale/Incor.
 - d. Dietrich Industries, Inc.
 - e. MarinoWare; Division of Ware Ind.
 - f. National Gypsum Company.
 - g. Scafco Corporation.
 - h. Unimast, Inc.
 - i. Western Metal Lath & Steel Framing Systems.
 2. Gypsum Board and Related Products:

- a. American Gypsum Co.
- b. G-P Gypsum Corp.
- c. National Gypsum Company.
- d. United States Gypsum Co. (basis of design).

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
- C. Hangers: As follows:
 - 1. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch- wide flange, with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
 - 1. Depth: 2-1/2 inches.
- E. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
 - 1. Steel Studs: ASTM C 645.
 - a. Minimum Base Metal Thickness: As indicated on drawings.
 - b. Depth: As indicated on drawings
 - 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch.
 - 3. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
- F. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation; Drywall Furring 640 or 660 System.
 - c. USG Interiors, Inc.; Drywall Suspension System.

2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
1. Minimum Base Metal Thickness:
 - a. 0.0312-inch at fire door frames.
 - b. 0.0312-inch at heavy-weight doors.
 - c. 0.0179-inch at all other locations unless noted otherwise on the drawings.
 2. Depth: As indicated on the drawings.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges (unless indicated otherwise on the drawings).
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0179 inch unless otherwise indicated on drawings.
 2. Depth: As indicated on the drawings.
- E. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
- F. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
1. Depth: As indicated on the drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch diameter wire.
- G. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- H. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- 2.4 INTERIOR GYPSUM WALLBOARD
- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
1. Regular Type:

- a. Thickness: As indicated on the drawings.
 - b. Long Edges: Square, tapered, or beveled taper.
- 2. Type X:
 - a. Thickness: As indicated on the drawings.
 - b. Long Edges: Square, tapered, or beveled taper, unless indicated otherwise on the drawings.
 - c. Location: As indicated on the drawings.
- C. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness. Apply multiple layers to approximate depth of adjacent gypsum board used.
 - 1. Thickness: 1/4 inch.
 - 2. Long Edges: Tapered.
 - 3. Location: As indicated on the drawings.
- D. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
 - 3. Location: Ceiling Surfaces & underside of soffits over 42" deep.
- E. Moisture Resistant Gypsum Board: ASTM D 3273, having improved mold resistance (min score of 10 required).
 - 1. Thickness: 5/8" (Can use 1/2" at tight radii)
 - 2. Long Edges: Tapered
 - 3. Location: Restroom (throughout as part of base bid. Above tile wainscot and on ceilings and bulkheads as part of Add Alternate 2) and Kitchen.
 - 4. Products: DensArmor Plus Paperless Interior Panel by G-P Gypsum or architect approved equal.

2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M.
 - 1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, "Dens-Shield Tile Backer" manufactured by G-P Gypsum Corp.
 - 2. Product: Subject to compliance with requirements, provide "Dens-Shield Tile Backer" manufactured by G-P Gypsum Corp.
 - 3. Core: 5/8" thick unless otherwise noted on the drawings. 1/2" acceptable at tight radii.
 - 4. Location: Used behind wall tiles in restrooms as part of Add Alternate 2.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges and as noted on drawings.
 - c. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges and as noted on drawings.
 - d. Expansion (Control) Joint: Use where indicated on drawings and wherever new stud walls cross an existing expansion joint.
 - e. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges and as noted on drawings.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated on drawings and where walls cross expansion joints.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by [one of] the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
 - d. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Moisture Resistant Gypsum Board: Fiberglass tape as recommended by manufacturer.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: 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 drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels & Moisture Resistant Gypsum Board:
1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
 2. Glass-Mat, Water-Resistant Backing Panel: As recommended by manufacturer.

2.8 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 2. Acoustical Sealant for Concealed Joints:
 - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
 - b. Pecora Corp.; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
- E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

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

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings 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 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 - 4. Secure rod, flat or angled hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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 deck tabs.
 - 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. For exterior soffits, install cross bracing and framing to resist wind uplift.
- D. Install suspended steel framing components in sizes and spacings indicated on drawings, but not less than that required by the referenced steel framing and installation standards.
- E. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
 - 1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
 - 2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - a. Terminate partition framing at suspended ceilings where indicated.
- D. Install steel studs and furring at spacings indicated on drawings.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Curved Partitions:
 - 1. Cut top and bottom track (runners) through leg and web at 2-inch intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches at ends of arcs.
 - 2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - 3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch- high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
 - 4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- G. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two studs at each jamb, unless otherwise indicated.

- H. 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.
- I. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 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.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum 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.
- E. 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.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition 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 open concrete coffer, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffer, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 12 inches o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 PANEL APPLICATION METHODS

- A. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to the 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 board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Multilayer Application 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 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

- C. Multilayer Application 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.
 - 1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- E. Multilayer Fastening Methods: See drawings.
- F. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- G. Curved Partitions:
 - 1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
 - 2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
 - 3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches o.c.
 - 4. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.
 - 5. Allow wetted gypsum panels to dry before applying joint treatment.
- H. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Fasten with corrosion-resistant screws.
- I. Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated and at

- locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings. If not indicated, install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- 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 those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
- E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

- a. Installation of 80 percent of lighting fixtures, powered for operation.
- b. Installation, insulation, and leak and pressure testing of water piping systems.
- c. Installation of air-duct systems.
- d. Installation of air devices.
- e. Installation of mechanical system control-air tubing.
- f. Installation of ceiling support framing.

END OF SECTION 09260

SECTION 09300 – TILE WORK

PART 1 — GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Ceramic mosaic tile
 - 2. Floor Tiles
 - 3. Wall Tiles
- B. Related Sections Include
 - 1. Division 03 Section “Cast-in-Place Concrete” for monolithic slab finishes specified for tile substrates.
 - 2. Division 07 Section “Joint Sealers”
 - 3. Division 09 Section “Gypsum Board Assemblies” for tile backer units.

1.2 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Nominal tile size as defined in ANSI A137.1

1.3 PERFORMANCE REQUIREMENTS

- A. Floor Tiles: Static coefficient of friction not less than 0.6 for level surfaces and 0.8 for ramps, per ASTM C 1028.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile of the same type and color from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

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

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-sized units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated, but not less than 5 tiles each.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for each tile type is based on the product named on the Finish Schedule.
- B. Architect approved equal. All substitutions must be approved during the bidding process.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article

C. Colors, Textures, and Patterns:

1. Provide products and colors as listed on the Finish Schedule.
2. Where same tile is used on the floor and wall, align the grout joints.
3. See interior elevations for additional information regarding pattern and tile placement.

D. Tile trim:

1. Basis-of-design product: ¼" Rondec by Schluter, brushed stainless steel or architect approved equal.
2. Include all related connector profiles (interior corners, exterior corners, sink corners).
3. Install trim at the following locations:
 - a. Top edge of tile where exposed to view
 - b. Transition between tiles at outside corners
 - c. Where indicated on the drawings.
4. Trim can be omitted at the following locations (unless otherwise indicated on the drawings):
 - a. Transition between tiles at inside corners
 - b. Transition between tiles in the same plain.

E. Where indicated, protect exposed surfaces of tile against adherence of mortar and grout by factory pre-coating them with a hot-applied continuous film of petroleum paraffin wax. Do not coat unexposed tile surfaces.

2.3 INSTALLATION MATERIALS

A. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.

1. Thin-Set Mortar Type: Dry-set portland cement.
2. Grout Type: Water-cleanable epoxy, unless otherwise indicated.
3. Grout Color: As indicated on the finish schedule.

B. Setting-Bed Accessories: ANSI A108.1A.

C. Cementitious Backer Units: Complying with ANSI A118.9, of thickness indicated.

1. Waterproofing Membranes for Thin-Set Installations: ANSI A118.10, polymer sheet product.

2.4 STONE THRESHOLDS

- A. Granite thresholds complying with ASTM C 615 fabricated to be not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.

PART 3 — EXECUTION

3.1 INSTALLATION

- A. Comply with tile installation standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.
- B. Comply with TCA's "Handbook for Ceramic Tile Installation."
- C. Floor Tile Installation Method[s]:
 - 1. Exterior Patios and Walkways Over Concrete: TCA F101 (cement mortar bed bonded to concrete slab)
 - 2. Over Concrete Subfloors: TCA F111 (cement mortar bed with cleavage membrane, over concrete subfloor)
- D. Wall Tile Installation Method[s]:
 - 1. Exterior Walls Over Concrete or Masonry: TCA W201 (cement mortar bed, on metal lath).
 - 2. Over Concrete and Masonry: TCA W202 (latex-portland cement mortar over concrete or masonry)] W223, except use water-cleanable epoxy adhesive instead of organic adhesive (epoxy adhesive over solid backing).
 - 3. Over Metal Studs: TCA W241 (cement mortar bed over metal studs)] B414 and TCA W241 (shower receptor with cement mortar bed over metal studs on walls).
 - 4. Over Gypsum Board: TCA W242, except use water-cleanable epoxy adhesive instead of organic adhesive (epoxy adhesive over gypsum board on metal studs
 - 5. Over Cementitious Backer Units: TCA B415 and TCA W244 (shower receptor with thin-set mortar bonded to cementitious backer units).
- E. Lay in pattern indicated on the drawings. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.
- F. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

END OF SECTION 09300

SECTION 09511 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

- A. Extent of each type of acoustical ceiling is shown and scheduled on drawings.
- B. Types of acoustical ceilings specified in this section include the following:
 - 1. Acoustical panel ceilings, exposed suspension.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
- B. Samples for Verification Purposes: Submit the following:
 - 1. 6" square samples of each acoustical panel type, pattern and color.
 - 2. Set of 12" long samples of exposed runners and moldings for each color and system type required.
- C. Certificates: Submit certificates from manufacturers of acoustical ceiling units and suspension systems attesting that their products comply with specification requirements.

1.4 QUALITY ASSURANCE:

- A. Fire Performance Characteristics: Provide acoustical ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate marking of applicable testing and inspecting agency.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
- B. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS:

- A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIALS:

- A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quantity of full size units equal to 2.0% of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0% of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING UNITS, GENERAL:

- A. Standard for Acoustical Ceiling Units: Provide manufacturer's standard units of configuration indicated which are prepared for mounting method designated and which comply with FS SS-S-118 requirements, including those indicated by reference to type, form, pattern, grade (NRC or NIC' as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).
- B. Sound Attenuation Performance: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1-II "Ceiling Sound Transmission Test by Two-Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).

- C. Colors, Textures, and Patterns: Provide products to match appearance characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for acoustical ceiling units and exposed metal suspension system members of quality designated.

2.2 ACOUSTICAL PANELS:

- A. Mineral Fiber Composition Panels - Water Formed, with Acoustical Transparent Membrane and Acrylic Latex painted finish: Provide Type IV, Form 2 Pattern E per ASTM E 1264 and complying with the following requirements:
 - 1. Pattern: Manufacturer's standard design combining exceptional light reflectance and superior sound absorption: other panel characteristics as follows:
 - a. Standard of Design: **Armstrong World Industries – “Ultima” beveled/tegular No. 1911 with Humiguard in 15/16” Prelude ML Exposed Tee System**
 - b. Color/Light Reflectance: White/LR 0.90 (per ASTM 1477).
 - c. Grade: NRC .70
 - d. STC Range: 33-39.
 - e. Size: 24" x 24" x 3/4" - unless otherwise indicated.

2.3 METAL SUSPENSION SYSTEMS, GENERAL:

- A. Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C 635 requirements for service.
- B. Finishes and Colors: Provide manufacturer's environmental performance factory-applied finish for type of system indicated. For exposed suspension members and accessories with painted finish, provide color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's full range of standard colors.
- C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung.
- D. Hanger Wire: Galvanized carbon steel wire, ASTM A 641, soft temper, prestretched, Class 1 coating, sized so that stress at 3-times hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.
- E. Edge Moldings and Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated.
 - 1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

- F. Hold-Down Clips for Non-Fire-Rated Ceilings: For interior ceilings composed of lay-in panels weighing less than 1 lb. per sq. ft., provide hold-down clips spaced 2'-0" o.c. on all cross tees.

2.4 EXPOSED METAL DIRECT-HUNG SUSPENSION SYSTEMS:

- A. Non-Fire-Resistance-Rated Double Web Steel Suspension System: Manufacturer's standard system roll-formed from prefinished cold-rolled, hot dipped galvanized steel sheet with 15/16" wide aluminum cap exposed faces on structural members; other characteristics as follows:
1. Basis of Design: **Prelude ML Exposed T Grid 15/16" Acoustical Suspension System**
 2. Structural Classification: Intermediate-Duty System.
 3. Finish: white.
 4. Manufacturers of Non-Fire-Resistance-Rated Double Web Steel Suspension Systems:
 - a. USG
 - b. Armstrong
 - c. Chicago Metallic Corporation.
 - d. Eastern Products Div., Armstrong World Industries, Inc.
 - e. National Rolling Mills, Inc.

2.5 MISCELLANEOUS MATERIALS:

- A. Acoustical Sealant: Resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for interior sealing of concealed construction joints.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. BA-98; Pecora Corp.
 - b. Tremco Acoustical Sealant; Tremco.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
- B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans wherever possible.

3.2 INSTALLATION:

- A. General: Install materials in accordance with manufacturer's printed instructions,

and to comply with governing regulations, fire-resistance rating requirements as indicated, and CISCA standards applicable to work.

- B. Arrange acoustical units and orient directionally-patterned units (if any) in manner shown by reflected ceiling plans.
 - 1. Install tile with pattern running in alternating directions to form "checkerboard" layout.
- C. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0".
 - 1. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.
 - 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, countersplaying or other equally effective means.
- D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
 - 1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
 - 2. Screw-attach moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.
- E. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
 - 1. Install hold-down clips in areas indicated, and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.3 CLEANING:

- A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09651 – RESILIENT FLOORING

PART 1 — GENERAL

1.1 THIS SECTION INCLUDES

- A. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.2 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

1.3 RELATED SECTIONS

- A. Other Division 9 sections for floor finishes related to this section but not the work of this section.
- B. Division 3 Concrete; not the work of this section.
- C. Division 6 Wood and Plastics; not the work of this section.
- D. Division 7 Thermal and Moisture Protection; not the work of this section.

1.4 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS

- A. Select an installer who is competent in the installation of Mannington solid vinyl flooring with acrylic adhesive or two part polyurethane.
- B. If required, provide resilient flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- C. If required, provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
 - 1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
 - 2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

1.5 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

1.6 ENVIRONMENTAL CONDITIONS

- A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.

- B. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
- C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of [100°F (38°C)] [85°F (29°C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.
- D. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

1.7 WARRANTY

- A. Special Warranty for Resilient Tile; Manufacturer agrees to repair or replace defective material within specified warranty period.
 - 1. Warranty does not include installer's workmanship.
 - 2. Resilient tile must be installed and maintained according to manufacturer's recommendations.
 - 3. Warranty Period:***
 - a. Manufacturing Defects Warranty: 10 years.
 - b. Limited Commercial Wear Warranty: 15 years.
 - c. Underbed Warranty: 10 years.

PART 2 — PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
- B. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington Commercial; Amtico Signature Collection - Wood or architect approved equal.
 - 1. Style: Wood - 40 Mil
 - 2. Color: Reclaimed Oak - AROW7870.

B. Specifications

1. Construction: Heavy Commercial Luxury Vinyl Tile
2. Class per ASTM F1700: Class III, Type B
3. Wearlayer Thickness: 40 mil (1mm)
4. Overall Thickness: 2.5 mm (0.098 in)
5. Nominal Dimensions: Match existing LVT in kitchens 312 and 512
6. Actual Size per ASTM F536:
7. Edge Profile: Match existing LVT in kitchens 312 and 512
8. Installation Tyle: Dry Back
9. Installation: Direct Glue

2.3 INSTALLATION MATERIALS

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

PART 3 — EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates are below 90 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room geometry.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

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

END OF SECTION 09651

SECTION 09680 – CARPET

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Carpet and installation.

1.3 MEASUREMENTS

- A. Dimensions in the drawings are to be considered as approximates. Contractor shall be required to carefully check in the field all dimensions and other conditions affecting his work. The Contractor will be held solely responsible for proper installation of the carpet in all areas designated. Contractor shall be responsible for providing all carpeting required under his contract.

1.4 SUBMITTALS

- A. Shop Drawings: Within fourteen (14) Calendar days after the Contractor has received Architect's Notice to proceed seaming diagram must be submitted to the architect for approval prior to the ordering of material.
 - 1. The layout shall make the most effective use of widths and lengths available and shall minimize waste and seams. Indicate direction of pattern. Direction of carpet must be approved.
 - 2. Indicate seam location, edge strip types and locations and method of joining seams where possible and practical. Locate seams in areas of least amount of traffic. Seams shall not be placed perpendicular to door openings. If any exceptions are taken, note these exceptions on the seaming diagrams. Seams occurring parallel to doors shall be centered directly under the door.
 - 3. Show relationship to related work such as thresholds, reducers, expansion joints, bases, etc. Refer to related Contract Documents for construction of areas to receive carpet and verify that conditions shown and specified remain unchanged at time of shop drawing preparation. If changes have been ordered, show revised conditions.
- B. Product Data: For the following, including installation recommendations for each type of substrate:
 - 1. Carpet: For each type indicated. Include Carpet Manufacturer's printed literature, specifications and installation instructions for carpeting material, seaming system, adhesive and installation accessories required, and other data required to prove compliance with the Contract Documents including written data on physical characteristics, durability, resistance to fading and flame resistance characteristics. Carpet manufacturers recommend installation procedures, when

approved by the Architect, shall become the basis for accepting or rejecting actual installation procedures and used on the work.

- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet: 12-inch- (300-mm-) square Sample.
- D. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet underlayment.
 - 3. Provide from carpet manufacturer a written commitment and enrollment for certified maintenance training for maintenance personnel.
- E. Warranties: Written warranty, executed by manufacturer providing a non-prorated limited warranty against excessive surface wear and static, delamination, edge ravel, zippering, and backing resiliency loss at no material or labor cost to the Owner. The manufacturer shall supply unrestricted, full replacement, non-prorated warranties guaranteeing wear no more than 15% yarn loss by weight for a minimum of 15 years of carpet under normal use, no edge ravel in normal use for a minimum of 15 years of normal carpet use, no zippering for a minimum of 15 years of normal carpet use and no delamination of primary and secondary backings for a minimum of 15 years of normal carpet use.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Fire Performance Characteristics: Provide carpet that meets or exceeds code requirements.
- D. Appearance Retention Rating (ARR): Test Method: Carpet and Rug Institute (CRI) test TM101 graded in accordance with ASTM-5225 (hexapod). Rating 4.0 or higher.
- E. Colorfastness to Light Test Method: AATCC-16, option E. Rating: 4 minimum. 4.5 for heavy light exposure locations (within ten feet of east, west, or south facing windows/glass doors), after 40 AATCC fading units using AATCC gray scale for color change.
- F. Soiling Resistance Test Method: AATC 189 Rating: An average of 3 fluorine analyses of a single composite sample to be a minimum of 500 ppm fluorine by

weight when new and 400 ppm fluorine by weight after 2 AATCC 171 (HWE) cleanings.

- G. Stain Resistance: Test Method: Red Dye 40 Test. Rating 8 or better.
- H. Durability Characteristics: Tuft Bind/Edge Ravel: Test Method: ASTM D-1335. Rating 10 lbs. of force or higher, wet. Delamination Strength of Secondary Backing: Test Method ASTM-D3936. Rating 2.5 lbs. of force per inch width.
- I. Dimensional Stability of Modular Carpet: Test Method: Physical measurement. Rating: within 1/32" of specification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver carpet in original mill protective wrapping clearly marked with manufacturer's labels indicating size, dye lot, quality and registration numbers.
- B. Use all means necessary to protect carpeting materials before, during and after installation and to protect the existing premises.
- C. Carpet shall be stored at Contractor's expense in a warehouse capable of storing carpet in a manner that will not damage the carpet or shorten its useful life.
- D. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Architect at no cost to the End User.
- E. Deliver to site only the amount of carpet that will be installed each day.

1.7 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet or carpet cushion until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet or carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet: Written warranty, executed by manufacturer, agreeing to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period at no material or labor cost to the Owner.
 - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
 - 3. Warranty Period: Fifteen years from date of Substantial Completion.

PART 2 — PRODUCTS

2.1 CARPET

A. Basis of Design:

1. Carpet for all areas shall be direct glue-down.
 - a. Carpet manufacturer: The carpet shall be purchased off the State Contract using the allowances and actual cost of the carpet. The carpet shall be Mannington, w/ Integra HP backing, broadloom. The type and color of carpet are listed below. Provide for complete installation of carpet.
2. Carpet C1:
 - a. Carpet: Mannington, Portela Collection, Santorini, 3416
3. Carpet Wall Base: At Main Corridors
 - a. Carpet Base: Mannington, Portela Collection, Santorini, 3416
4. Rubber Wall Base: Johnsonite, Millwork, Reveal 6", 63 Burnt Umber
5. Wood Wall Base: Stained, location and profile noted on plans.

B. All carpet selections listed are subject to change but can be used for budgetary purposes.

C. Trowelable Underlayments and Patching Compounds: As recommended by the carpet manufacturer.

D. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated and to comply with flammability requirements for installed carpet as recommended by the carpet manufacturer.

E. Seaming: Seal carpet edges in accordance with manufacturer's written instructions, if required.

PART 3 — EXECUTION

3.1 EXAMINATION

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

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

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

2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

- A. Comply with CRI 104 and carpet and carpet cushion manufacturers' written installation instructions for the following:
 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
 1. Level adjoining border edges.
- C. Do not bridge building expansion joints with carpet.
- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations. See drawings for installation pattern.
- H. Comply with carpet cushion manufacturer's written recommendations. Install carpet cushion seams at 90-degree angle with carpet seams.

3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
 - 4. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- B. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion and adhesive manufacturers.

END OF SECTION 09680

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. If a patched area is called to be painted, paint entire surface, corner to corner.
- D. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Pre-finished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Plastic Laminate cabinets, countertops, and cubbies.
 - c. Toilet enclosures.
 - d. Finished mechanical and electrical equipment.
 - e. Light fixtures.
 - f. Built-in furniture and or shelving unless noted otherwise on drawings.
 - g. Louvers.
 - h. Storefront.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

- a. Furred areas.
 - b. Ceiling plenums.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Duct shafts.
- 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
- 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
- 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - 3. Semi-gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

- B. Samples for Initial Selection: For each type of finish-coat material indicated.
- C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

1. Deliver to owner any paint left over from project. Consolidate identical colors into single container. Securely fasten all lids. Label each container on top and sides w/ color & finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 1. Sherwin-Williams Co. (Sherwin-Williams). * Basis of Design
 2. The Glidden Company (Glidden)
 3. Benjamin Moore & Co. (Benjamin Moore).
 4. Coronado Paint Company (Coronado).
 5. ICI Dulux Paint Centers (ICI Dulux Paints).
 6. M. A. Bruder & Sons, Inc. (M. A. B. Paint).
 7. PPG Industries, Inc. (Pittsburgh Paints).

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

- a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
- 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- 4. Plywood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Remove any splinters and or blow-outs caused by nails, screws, or by any other means. Fill in holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - c. If transparent finish is required, backprime with spar varnish.
- 5. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

6. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.

- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove non-complying paint from Project site, pay for testing, and repaint surfaces previously coated with the non-complying paint. If necessary, Contractor may be required to remove non-complying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

- A. All coats listed are minimum requirements. Additional coats may be required to achieve full coverage and concealment as determined by the architect
- B. Gypsum Drywall – new construction
 - 1. Primer: Masterprep Latex Primer B28WV2200 1.5 mils DFT
 - 2. Finish: 2 coats Pro Mar 200 Latex Egg shell B20w2251 1.6 mils DFT
- C. Concrete Masonry Units – exterior
 - 1. Block Guard and Grafitti Control by Prosoco.
 - a. Apply on masonry mock-up first. If wets out, apply to building. Notify architect immediately if any bonding or other issues arise. Do not continue application until all issues are resolved to architect's satisfaction.
- D. Ferrous Metal - exterior
 - 1. Primer: Kem Kromik Universal Primer B50Z Series 3.5 mils DFT
 - 2. Finish: 2 coats Industrial Enamel B54 Series 3 mils DFT
- E. Ferrous Metal - interior
 - 1. Primer: Kem Kromik Universal Primer B50Z Series 3.5 mils DFT
 - 2. Finish: 2 coats Pro Mar 200 Alkyd Semi-Gloss B34 Series 1.7 mils DFT
- F. Galvanized Metal – exterior
 - 1. Primer: DTM Primer/Finish B661W1 3.5 mils DFT
 - 2. Finish: 2 coats DTM Acrylic Semi-Gloss B66-200 3 mils DFT

- G. Galvanized Metal – interior
 - 1. Primer: DTM Primer/Finish B661W1 3.5 mils DFT
 - 2. Finish: 2 coats DTM Acrylic Semi-Gloss B66-200 3 mils DFT
- H. Painted Woodwork – interior
 - 1. Primer: Preprite Wall and Wood Primer B49W2 1.6 mils DFT
 - 2. Finish: 2 coats Pro Mar 200 Alkyd Semi-Gloss B34W2251 1.7 mils DFT
- I. Wood lumber & plywood - exterior:
 - 1. Primer: A100 Oil Primer Y24W20 1.4 mils DFT
 - 2. Finish: 2 coats A100 Exterior Latex Semi-Gloss A8 Series 1.3 mils DFT
- J. Exterior Column Covers (part of Add Alternate 1).
 - 1. Primer: Preprite Bonding Primer B51W50 1.4 DFT
 - 2. Finish: 2 coats A100 Exterior Latex Semi-Gloss A8 Series 1.3 mils DFT
- K. Caulking
 - 1. Pro Select C950A
- L. Concrete Sealer
 - 1. Sealkrete applied as recommended.

END OF SECTION 09900

SECTION 10155 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and Samples.

PART 2 - PRODUCTS

2.1 TOILET COMPARTMENTS AND SCREENS

- A. Products:

- 1. SCRANTON PRODUCTS

2.2 MATERIALS

- A. Panel, Pilaster, and Door Material:

- 1. Solid-Plastic, Polymer Resin: High-density polyethylene with homogenous color, not less than 1 inch (25 mm) thick, with seamless construction and eased edges.
 - 2. Color: GREY.
 - 3. Texture: Orange Peel

- B. Pilaster Shoes and Sleeves (Caps): Stainless steel or solid plastic, polymer resin, not less than 3 inches (75 mm) high.

- C. Brackets: Continuous.

- 1. Material: Solid plastic.

2.3 FABRICATION

- A. Toilet Compartments: Overhead braced and floor anchored.

- B. Urinal Screens: Wall hung.

- C. Metal Units: Internally reinforce metal panels for hardware, accessories, and grab bars.

- D. Solid-Plastic, Polymer-Resin Units: Provide aluminum heat-sink strips at exposed bottom edges of panels and doors.

- E. Doors: Unless otherwise indicated, 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a

minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.

- F. Door Hardware: Clear anodic aluminum or cast-zinc alloy (zamac). Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 1. Hinges: Self-closing type, adjustable to hold door open at any angle up to 90 degrees.
 - 2. Latches and Keepers: Recessed unit designed for emergency access and with combination rubber-faced door strike and keeper.
 - 3. Coat Hook: Combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Rubber-tipped bumpers at out-swinging doors or entrance screen doors.
 - 5. Door Pull: Provide at out-swinging doors. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units rigid, straight, level, and plumb, with not more than 1/2 inch (13 mm) between pilasters and panels and not more than 1 inch (25 mm) between panels and walls. Provide brackets, pilaster shoes, bracing, and other components required for a complete installation. Use theft-resistant exposed fasteners finished to match hardware. Use sleeve nuts for through-bolt applications.
 - 1. Stirrup Brackets: Align brackets at pilasters with brackets at walls. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - 2. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

END OF SECTION 10155

SECTION 10801 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet tissue dispensers
 - 2. Waste receptacles
 - 3. Sanitary napkin disposal receptacles
 - 4. Grab bars
 - 5. Mirrors
 - 6. Coat hook
 - 7. Soap Dispenser
 - 8. Toilet Seat Cover
 - 9. Paper Towel Dispenser

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.5 COORDINATION

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

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, minimum gauge as listed on drawings on restroom accessory.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Bobrick Corporation.
- B. Toilet Tissue (Roll) Dispenser, Type T1.
1. Basis-of-Design Product: B2840 Bobrick (surface mounted). See plan for locations of each.
 2. Description: Toilet paper dispenser with utility shelf.
 3. Capacity: Designed for two 4-1/2" – 5" diameter by 5" wide tissue rolls.
 4. Material and Finish:
 - a. Flange: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. 1-piece construction.
 - b. Cabinet: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. Keyed tumbler lock.
 - c. Spindles: Molded polyethylene.
- C. Paper Towel Dispenser, Type P1
1. Basis-of-Design Product: B262 Bobrick.
 2. Mounting: Surface Mounted.
 3. Minimum Towel Capacity: 525 multi-fold or 400 C-fold papertowels.
 4. Material and Finish:
 - a. Cabinet: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. All welded construction with welded construction with seamless corners and burr-free edges.
 - b. Flange: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. 1-piece seamless construction, 1" wide w/ 1/4" return.
 - c. Door: Type 304 (18-8), 18 gauge stainless steel. Warp resistant with full length piano hinge.
 5. Lockset: Tumbler type lock, keyed like other Bradley units used on this project.
- D. Sanitary Napkin Disposal Receptacle, Types N1
1. Basis-of-Design Product: B270 Bobrick (surface mounted). See plan for locations of each.
 2. Minimum Capacity: 1.0 gallon.
 3. Material and Finish:
 - a. Cabinet: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. All welded construction.
 - b. Flange: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. 1-piece seamless construction, 1" wide w/ 1/4" return.
 - c. Push Flap Door: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. Stainless steel piano hinge on self-closing flap door.
 4. Lockset: Tumbler type for waste-receptacle.
- E. Liquid-Soap Dispenser, Type S1.
1. Basis-of-Design Product: B41120 Bobrick
 2. Description: Designed for dispensing soap in liquid or lotion form.
 3. Mounting: Surface mounted on wall.

4. Capacity: 40 oz. liquid soap.
5. Materials:
 - a. Plunger and Spout: Type 316, stainless steel.
 - b. Escutcheon: Heavy chrome plated brass.
 - c. Shank: Molded ABS plastic.
 - d. Valve Cylinder: Molded clear ABS plastic.
 - e. Valve Components: Celcon, Buna-N rubber or stainless steel.
 - f. Plastic Globe: Translucent Polyethylene.

F. Grab Bar, Types G36 & G42

1. Basis-of-Design Product: B6806 Bobrick.
2. Mounting: Flanges with concealed fasteners.
3. Materials:
 - a. Flanges: Type 304 (18-8), 11 gauge stainless steel, 3-1/8" diameter.
 - b. Escutcheons: Type 304 (18-8), 22 gauge stainless steel. 1-piece drawn construction. Satin finish where exposed to view. Snap over flanges to conceal mounting screws.
 - c. Tubing: Type 304 (18-8), 18 gauge stainless steel, seamless construction. Safety-grip finish. 1-1/2" outside diameter.
4. Configuration and Length: As indicated on Drawings.

G. Mirror Unit, Type M1.

1. Basis-of-Design Product: B290 Bobrick 18Wx36H.
2. Materials:
 - a. Frame: 1-piece, roll-formed stainless steel w/ bright annealed finish. Channel 3/4" x 3/4"x7/16" with 90 degree mitered corner. Double-strength continuous integral stiffener on all sides for added strength.
 - b. Back: 20 gauge galvanized steel.
 - c. Mirror: 1/4" float glass triple silver plated w/ electro-copper plated layer and thermosetting infrared cured paint backing w/ Poly-Glaze protective finish. Shock-absorbing, neoprene tubing along edges.
 - d. Mounting brackets: 18 gauge cold rolled steel.
 - e. Hangers: Produce rigid, tamper- and theft-resistant installation.
3. Size: As indicated on Drawings.

H. Mirror Unit, Type M2.

1. Basis-of-Design Product: 22Wx36H mirror with 2" etched band each side.
2. Materials:
 - a. Frame: No frame.
 - b. Back: 20 gauge galvanized steel.
 - c. Mirror: 1/4" float glass triple silver plated w/ electro-copper plated layer and thermosetting infrared cured paint backing w/ Poly-Glaze protective finish. Etched edges.

- d. Mounting brackets: 18 gauge cold rolled steel.
 - e. Hangers: Produce rigid, tamper- and theft-resistant installation.
- I. Clothes Hook, Type H1.
 - 1. Basis-of-Design Product: B2116 Bobrick
 - 2. Mounting: Wall-mounted w/ mounting screws.
 - 3. Materials: Forged or cast brass, nickel plated with polished chrome finish.
- J. Toilet Seat Cover Dispenser, C1.
 - 1. Basis-of-Design Product: B4221 Bobrick.
 - 2. Mounting: Surface Mounted.
 - 3. Minimum Capacity: 250 half-fold or single toilet seat covers.
 - 4. Material and Finish:
 - a. Cabinet: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. All welded construction with welded construction with seamless corners and burr-free edges.
 - b. Flange: Type 304 (18-8), 22 gauge stainless steel, satin finish where exposed. 1-piece seamless construction, 1" wide w/ 1/4" return.
 - c. Door: Type 304 (18-8), 18 gauge stainless steel. Warp resistant with full length piano hinge.
 - 5. Lockset: Tumbler type lock, keyed like other Bradley units used on this project.
- K. Waste Receptacle, R1.
 - 1. Basis-of-Design Product: B2400 Bobrick.
 - 2. Mounting: Floor standing large capacity.
 - 3. Minimum Capacity: 33 gallon with removeable funnel top.

2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of 5 keys to Owner's representative. All restroom accessories to be keyed alike.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

- B. Grab Bars: Install to withstand a downward load of at least 250lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

SECTION 10830 - MIRROR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of mirror units is indicated on drawings.
- B. Types of mirror units required include the following:
 - 1. Stainless steel framed mirrors.
 - 2. 22" x 36" surface mounted mirror with 2" etched band each side.
 - 3. Salvage existing mirrors in two unisex restrooms to be renovated.
- C. Toilet accessories are specified elsewhere in Division 10.

1.3 QUALITY ASSURANCE:

- A. General: Provide framed mirror units produced by single manufacturer for entire project.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data, detail drawings, and installation instructions for mirror units.
- B. Schedule: Submit schedule indicating mirror types, quantities, sizes and installation locations for each mirror to be provided for project.

1.5 SPECIFIED PRODUCT WARRANTY:

- A. Provide manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors which develop visible defects within warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide mirror units of one of the following:
 - 1. American Dispenser Co., Inc.

2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corp.
 4. Hallmack-NuTone/Div. Scovill.
 5. McKinney/Kidde, Inc.
 6. Parker - Scovill.
- B. Basis of Design: Bobrick Washroom Equipment, Inc. Refer to drawings for sizes and locations.

2.2 MATERIALS:

- A. Mirror Glass: 1/4" thick, Type I, Class 1, Quality q2, conforming to FS DD-G-451, with silvering, copper coating, and protective organic coating complying with FS DD-M-411.
- B. Stainless Steel Framing: AISI Type 302/304, with polished No. 4 finish.
- C. Galvanized Steel Sheet: ASTM A 527, G60.
- D. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

2.3 FABRICATION:

- A. Edge Protection: Fabricate frames for glass mirrors to accommodate wood, felt, plastic, or other glass edge protection material.
- B. Backing: Provide mirror backing and support system which will permit rigid, tamperproof glass installation and prevent accumulation of moisture, as follows:
- C. Galvanized steel backing sheet, not less than 22 gage and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.
- D. Hangers: Provide system of mounting mirror units which will permit rigid, tamperproof and theftproof installation, as follows:
 1. One-piece galvanized steel wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.
- E. Stainless Steel Framed Mirrors:
 1. Heavy-Duty Type: Fabricate frame with angle shapes of not less than 18 gage (0.050"), with square corners mitered, welded, and ground smooth. Provide in No. 4 satin polished finish.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Secure mirrors to walls in a concealed tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.
- B. Refer to drawings for installation details at vanities with backsplashes.

3.2 ADJUST AND CLEAN:

- A. Clean exposed surfaces of mirror units in compliance with manufacturer's recommendations.

END OF SECTION 10830

MECHANICAL SPECIFICATIONS

SECTION 23 05 10 – MECHANICAL REQUIREMENTS

PART 1 – GENERAL

This section applies to all Division 23 specifications and trades.

Cooperate with all other trades and install work as fast as the progress of the job will permit.

Use only mechanics skilled in the work they are to perform and have a competent representative on the job when any work is being done.

No work shall be done unless the Superintendent of the Contractor is on the job site. Work shall be properly protected, all rubbish removed promptly, and exposed work shall be carefully cleaned prior to final acceptance.

In decisions arising from discrepancies, interpretation of Drawings, and Specifications, substitutes, and other pertinent matters, the decision of the Owner's representative shall be final unless the Contractor seeks relief per the General Conditions.

1.1 QUALITY ASSURANCE

- A. Applicable welding certifications, procedures, and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping, and The American Welding Society, Welding Handbook.
- B. Soldering and Brazing procedures for refrigerant piping shall conform to ASME/ANSI B31.5 Refrigeration Piping.
- C. Installation of refrigeration systems shall conform to ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration.

1.2 WARRANTY

- A. Contractor shall provide a one-year parts and labor warranty on all equipment provided on this project. Warranty shall start on the date of substantial completion. Contractor shall purchase manufacturer's warranty for all refrigeration equipment. Refer to individual Sections for additional warranty requirements.

1.3 RELATED DOCUMENTS

- A. Work herein shall conform to all applicable laws, ordinances, codes, regulations, and local utility companies' rules. The general conditions and all requirements of the contract documents shall apply to all work of this section. Work shall be in accordance with the latest requirements and addendums as of the date of this specification unless otherwise noted:

NFPA 13 – 2019 Standard for the Installation of Sprinkler Systems.

NFPA 14 – 2019 Standard for the Installation of Standpipe and Hose Systems, except 4-4.3 shall be omitted.

NFPA 25 – 2020 Standard for Inspection, Testing and Maintenance of Water-Bases Fire Protection System.

NFPA 70 – 2020 National Electrical Code

NFPA 90A – 2021 Standard for the Installation of Air Conditioning and Ventilating Systems.

NFPA 90B – 2021 Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

NFPA 92 – 2018 Standard for Smoke Control Systems

NFPA 101 – 2021 Life Safety Code (Florida Edition)

NFPA 105 – 2019 Recommended practice for the Installation of Air Conditioning and Ventilating Systems

NFPA 170 – 2012 Fire Safety Symbols

NFPA 241 – 2019 Standard for Safeguarding Building Construction and Demolition Operations.

NFPA 251 -2006 Standard Methods of Fire Testing of Building Construction and Materials Tests of Door Assemblies
NFPA 252 – 2012 Standard Methods of Fire Test of Door Assemblies
NFPA 257 - 2012, Standard for Fire Tests of Window & Glass Block Assemblies
ANSI-A 17.1 - Elevator Code
2023 Florida Fire Prevention Code, 8th Edition
Local Government Growth Management
Local Permit Authority Requirements
2023 Florida Building Code, 8th Edition
State of Florida, Department of Environmental Protection Rules
State of Florida, State Fire Marshal, Rules and Regulations (Rule 69A-3.012, FAC)
SMACNA, HVAC Duct Construction Standards
Americans with Disabilities Act
Florida Accessibility Code for Building Construction
Department of Management Services Guidelines & Standards

1.4 DEFINITIONS

- A. Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
- B. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, start-up and similar requirements.
- C. Provide: Furnish and install, complete and ready for intended use.
- D. Installer: Entity (firm or person) engaged to install work by Contractor, subcontractor, or sub-subcontractor. Installers are required to be skilled experts in work they are engaged to install.
- E. Specification Text Format: Any underscoring facilitates scan reading, no other meaning. Imperative language is directed at Contractor, unless otherwise noted.

1.5 SPECIFICATIONS AND DRAWINGS

- A. Plans show locations of equipment and are intended to depict the general intent of the work in scope, layout, and quality of workmanship. They are not intended to show in minute detail every or all accessories intended for the purpose of executing the work, but it is understood that such details are a part of this work.
- B. Where Drawings and Specifications conflict, it shall be the responsibility of this Contractor to bring such conflict to the attention of the Architect/Engineer for clarification. If the contractor fails to bring the conflict to the Engineer's attention, the most stringent (most costly) requirements apply. All changes from the Drawings necessary to make the work conform with the building as constructed and to fit the work of other trades or to conform to the rules of authorities having jurisdiction, shall be made by the Contractor at his own expense.
- C. Keep a record of the locations of concealed work and of any field changes in Contract Drawings and Specifications for each trade and, upon completion of the job, supply "As-Built" Drawings and Specifications showing, in pencil on sepia reproductions, any deviations from the original Drawings indicating in the Specifications each manufacturer's name underlined or inserted whose product was used on the job. These Drawings shall indicate dimensions of buried utility lines from building walls. One set of sepia reproductions of the original tracings will be furnished upon request for this purpose. Provide record documents in accordance with the General Conditions.
- D. Where equipment is used other than manufacturers specified, the Contractor shall request approval to substitute materials and/or products in accordance with the General Conditions.

- E. The Contractor shall lay out all the work as required by the drawings and be held responsible for damage, if any is incurred, due to incorrect layout of work. The Contractor shall establish all building lines, benchmarks, and levels from which all trades can work, and take necessary measures to keep the marks in visible evidence throughout all stages of the work.
- F. The Contractor shall comply with all rules and regulations of the Florida Industrial Commission, the State and Federal Departments of Commerce and Labor, EPA regulations, and the OSHA Laws, as they may apply to the work. The Contractor shall also comply with all Owner policies while on-site.
- G. By submitting a bid for equipment other than the "Design Basis Equipment" (i.e., that which is shown on the Contract Drawings), the Contractor:
 - 1. Represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified and complies with all the requirements set forth in the General Conditions;
 - 2. Certifies that the cost data presented is complete and includes all related costs under this Contract but excludes costs under separate contracts, and excludes the Engineer's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent;
 - 3. Will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects; and,
 - 4. Certifies that the proposed equipment meets the requirements of the Contract Documents.

1.6 PERMITS, FEES, AND INSPECTIONS

- A. The Contractor shall give all necessary notices, obtain all permits, and pay all government fees, and other costs, and file all permit applications required by all governmental departments having jurisdiction.
- B. Obtain all required certificates of inspection for work and deliver them to the Owner before requesting acceptance and final payment for the work.
- C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, and drawings required to comply with all applicable laws, ordinances, rules and regulations.
- D. The Contractor shall inform the Owner of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.

1.7 GENERAL

- A. Materials or products specified herein and/or indicated on drawings by trade name, manufacturer's name and/or catalog number shall be provided as specified. Substitutions will not be permitted except as described herein and in the General Conditions.
- B. All materials shall be new and of quality as specified, and when required, be clearly labeled and/or stamped as manufactured in the United States.
- C. A list of all materials and equipment which the Contractor proposes to furnish shall be submitted for approval within ten (10) days after the contract has been awarded. Data shall be complete in all respects.

1.8 RENOVATION WORK

- A. Areas under renovation which are adjacent to occupied areas shall be sealed off and maintained under a negative pressure during construction. If existing exhaust fans are used, then the ducts shall be cleaned after construction is complete but before final test and balance.

1.9 SHOP AND ERECTION DRAWINGS

- A. Submit shop drawings for all components in the proposed system for review by Owner's representative before ordering or installing any equipment or material. Equipment or material ordered or installed before Owner's representative review may not be accepted and will have to be removed from the project.
- B. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs, including descriptive literature which shall clearly indicate the construction, material, physical dimensions, wiring diagrams and complete operating data clearly marked for each item. Data of general nature will not be accepted.
- C. Submit shop drawings in accordance with the General Conditions.

1.10 COORDINATION DRAWINGS

- A. Prepare coordination drawings when alternate manufacturers are proposed of space containing air handling units, pumps, chillers, water heaters or similar large mechanical equipment detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Drawings shall be prepared at a scale of 1/4" - 1'0" or larger. Indicate locations of access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.
- B. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:

Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance; Equipment connections and support details; Exterior wall and foundation penetrations; Fire-rated wall and floor penetrations; concrete pads and bases.
- C. Floor plans, elevations, and details shall indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.11 MECHANICAL EQUIPMENT CLEARANCES

- A. Maintain three (3) feet clearance in front of mechanical equipment requiring maintenance. Pay close attention to access doors of new and existing equipment.

1.12 ROOF MOUNTED EQUIPMENT

- A. All equipment installed on the roof shall be attached to the structure in a manner approved by the manufacturer and shall be capable of withstanding winds in excess of 130 mph.

1.13 ROUGH-IN

- A. For all piping and equipment field verify final locations for rough-ins with actual field measurements and with the requirements of the actual equipment to be connected.

1.14 UNDERGROUND PIPING

- A. Provide the Engineer with a seven (7) day notice prior to covering up any underground pipe to allow sufficient time for inspection.

1.15 EXPERIENCE

- A. The Contractor performing this work shall be a Florida licensed, reputable firm, regularly performing the type of work incorporated in this project and who also maintains, as part of the firm, a service department with qualified personnel who regularly perform this type of work. The Contractor shall, upon request, show evidence of at least two jobs of similar scope and size either completed or under contract within the preceding two years.

1.16 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

- A. All electrical components shall be U.L. listed. All wiring components and devices shall conform to the National Electrical Code.

1.17 WIRING FOR MECHANICAL EQUIPMENT

- A. All power wiring for mechanical equipment shall be provided by Division 26.
- B. All control wiring for mechanical equipment shall be provided by Division 23. Control wiring shall be defined as all wiring not in the direct path of supplying power to the mechanical equipment.

1.18 MOTORS

- A. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion proof when located in hazardous atmospheres.
- B. Unless indicated otherwise, motors shall be NEMA Design B with a service factor of 1.15 with total temperature rise of 50 degrees C. (resistance measured) in 40 degrees C. ambient when powered from the system voltage feeding the motor. TEFC motors shall have class F insulation and ODP motors shall have class B insulation. Motors located in areas exceeding 40 degrees C. ambient shall be factory rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Design N split phase induction motors with built-in thermal protectors. Unless otherwise noted, motors supplied on this project one (1) HP and larger shall have an efficiency which meets or exceeds the efficiency shown in Tables 1 and 2, below (per FBC Energy Conservation – C405.7), tested in accordance with IEEE Standard 112, Test Method B, and shall have a power factor not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated load conditions. Power factor corrective devices, installed to comply with this requirement, shall be switched with the utilization equipment.

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Table 1:
Minimum Nominal Full Load Efficiencies for 4 Pole (1800 RPM) Electric Motors at 60Hz

Motor Horsepower	Open Motors	Enclosed Motors
	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)
1	85.5	85.5
1.5	86.5	86.5
2	86.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.0	91.7
10	91.7	91.7
15	93.0	92.4
20	93.0	93.0
25	93.6	93.6
30	94.1	93.6
40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	94.4
100	95.4	95.4
125	95.4	95.4
150	95.8	95.8
200	95.8	96.2
250	95.8	96.2
300	95.8	96.2
350	95.8	96.2
400	95.8	96.2
450	96.2	96.2
500	96.2	96.2

Table 2:
Minimum Nominal Full Load Efficiencies for 2 Pole (3600 RPM) Electric Motors at 60Hz

Motor Horsepower	Open Motors	Enclosed Motors
	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)
1	77.0	77.0
1.5	84.0	84.0
2	85.5	85.5
3	85.5	86.5
5	85.5	88.5
7.5	85.5	89.5
10	89.5	90.2
15	90.2	91.0
20	91.0	91.0
25	91.7	91.7
30	91.7	91.7
40	92.4	92.4
50	93.0	93.0
60	93.6	93.6
75	93.6	93.6
100	93.6	94.1
125	94.1	95.0
150	94.1	95.0
200	95.0	95.4
250	95.0	95.8
300	95.4	95.8
350	95.4	95.8
400	95.8	95.8
450	96.2	95.8
500	96.2	95.8

- C. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Shaft Grounding Ring: Microfiber type.
 - 6. Provide grounded discharge path for VFD induced voltage in the shaft to prevent arcing in the motor bearings.

1.19 REMOVAL OF RUBBISH

- A. Contractor shall keep premises free from accumulations of waste material or rubbish caused by his employees or work. At completion of work, he shall remove all his tools, scaffolding, surplus materials, and rubbish from building and site. He shall leave premises and his work in a clean orderly condition acceptable to the Owner's representative.

1.20 QUIET OPERATION AND VIBRATION

- A. All equipment provided under this section shall operate under all conditions of load free of abnormal sound and vibration. Sound and vibration conditions considered abnormal shall be corrected in an approved manner at no additional cost to the Owner.

1.21 EXAMINATION OF EXISTING CONDITIONS

- A. Visit and carefully examine those portions of the site and/or present buildings affected by this work to become familiar with existing conditions and difficulties that will affect the execution of the work before submitting proposals.
- B. Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment, or materials required because of difficulties encountered, which could have been foreseen had such examination been made, will not be recognized.

1.22 CLEANING AND ADJUSTMENTS

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Clean and flush hydronic piping systems; remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- C. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- D. Upon completion of work, Contractor shall clean and lubricate pumps, fans, motors, and other running equipment and apparatus which he has installed and make certain such apparatus and mechanisms are in proper working order and ready to test.
- E. Scratched or damaged painting shall be touched up as necessary to return the painting to "new" condition and appearance.
- F. All piping and equipment shall be thoroughly blown out under pressure and cleared of all foreign matter, wasting air, gas, or water through temporary connections as long as necessary to thoroughly clean system before system is placed in operation. Use every precaution to prevent pipe compound, scale, dirt, welding, and other objectionable matter from getting into the piping system and equipment.

- G. During blow out period, baskets from strainers shall be removed, traps and control valves, etc., shall be by-passed.
- H. All cleanings shall be done prior to any pressure testing, flow balancing or equipment adjustment procedures.

1.23 DEMOLITION

- A. Demolition shall be as shown on drawings or specified.
- B. Schedule all demolition work with Owner to cause minimum downtime of any building service or function. No extra cost to the contract will be allowed for overtime work unless specifically authorized in advance by representative or Owner in writing.
- C. During demolition and construction, protect from damage all existing equipment and services that are to remain. Repair or replace any damage to existing facilities at no extra cost to the contract.
- D. Remove with care and deliver to a location designated by representative of the Owner all items designated to remain the property of the Owner.
- E. Drawings are diagrammatic and show only major obstructions, coordinate with other trades for removal or relocation of pipes, conduits, hangers, etc., in path of work.
- F. No columns, beams, joists, building foundations, nor any other structural building component shall be cut, drilled, or disturbed in any way. Conflicts shall immediately be brought to the attention of the Owner's representative. Contractor shall not proceed until instructed in writing by the Owner's representative if conflicts between mechanical work and structural elements occur.
- G. Temporary Removal: Carefully remove, store, clean, reinstall, reconnect, and make operational equipment indicated to be reused. Prior to removal Contractor shall inspect existing equipment and note any deficiencies and repairs needed. Failure to note deficiencies will require the Contractor to repair the equipment for no additional cost.
- H. Demolish and remove inactive and obsolete piping, fittings, and specialties, equipment, ductwork, controls, fixtures, and insulation.
- I. Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations.
- J. Demolish and remove obsolete and abandoned exposed piping and ducts to a point flush with floors and walls. Remove materials above accessible ceilings and below raised floors. Drain and cap piping and ducts allowed to remain.

1.24 CONNECTIONS TO EXISTING WORK

- A. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing facilities.
- B. Submit to the Owner for approval, a schedule of necessary temporary shut-downs of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of the Owner.
- C. To ensure continuous operation, make necessary temporary connections between new and existing work.
- D. Connect new work to existing work in neat and approved manner. Restore disturbed existing work to original condition.
- E. After completion of project clean the exterior surface of equipment included in this section, remove all concrete residues and touch up paint or completely repaint all damaged surfaces.

1.25 STORAGE OF MATERIALS

- A. All materials stored on site shall be in a Contractor supplied trailer or enclosure and shall be properly protected from injury or deterioration. Materials shall not be stored in contact with ground or floor.
- B. Do not remove manufacturer's packing materials until ready to install. Materials showing signs of corrosion, improper handling or storage shall be replaced at no cost to the Owner.
- C. During construction protect all piping and equipment from damage and dirt. Cap the open ends of all piping and equipment.
- D. Provide continuous protection for all equipment already installed.

1.26 WATERPROOFING

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Owner before the work is done.
- B. Provide all necessary sleeves, caulking and flashing required to make openings watertight. Waterproof flashing materials shall be compatible with base materials.

1.27 TESTS

- A. Contractor shall make all tests required to establish the adequacy, quality, safety, completed status, and satisfactory operation of all systems to the satisfaction of the Owner's representative. Provide all instruments, labor, and services necessary to conduct tests.

1.28 INSTRUCTIONS

- A. Fully instruct Owner's personnel in the care and operation of mechanical systems and furnish a letter to the Owner's representative advising the particular person who has received such instruction.

1.29 AUTOMATION CONTROLS

- A. Refer to Division 25 Specifications. Include all indicated Mechanical work scope. Fully coordinate and cooperate with Integrated Automation Contractor so that all work scope is included, and work proceeds as expedited as possible.

1.30 COORDINATE WITH OTHER DISCIPLINES

- A. Also, include work scope as required for the Controls Contractor and Test & Balance Contractor and associated work scopes.
- B. Coordinate with and cooperate with Div 26 Contractor and other disciplines as required to fully complete work for fully operational systems.

END OF SECTION 23 05 10

SECTION 23 05 11 – ELECTRICAL REQUIREMENTS FOR MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections: Other separate electrical components and materials required for field installation and electrical connections are specified in Division 26. Refer to other sections of Division 23 specifications for related work or requirements.

1.2 SUMMARY

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment or are separate electrical components provided for mechanical equipment. These components include, but are not limited to motors, starters, disconnect switches and adjustable frequency drives furnished either as a separate or integral part of packaged mechanical equipment as specified.
- B. Specific electrical requirements (i.e., horsepower and electrical characteristics, etc.) for mechanical equipment are specified within the individual equipment specification sections.

1.3 REFERENCES

NEMA Standards MG 1: Motors and Generators.
NEMA Standards ICS 2: Industrial Controls Devices, Controllers, and Assemblies.
NEMA Standard 250: Enclosures for Electrical Equipment.
NEMA Standard KS 1: Enclosed Switches.
Comply with National Electrical Code (NFPA 70).

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each material described in this section as is applicable. These submittals and shop drawings shall be in no less detail than the product, material and installation descriptions provided herein and on the drawings. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.5 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.

1.6 MOTOR STARTERS

Motor Starter Characteristics:

- A. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations, plenums and exterior locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
- B. Type and size of starter shall be as recommend by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.
- C. Manual Switches Shall Have: Pilot lights and extra positions for multi-speed motors.
- D. Overload Protection: Melting alloy type thermal overload relays.
- E. Magnetic Starters:

1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, and similar devices as required for coordination with control requirements of Division 23 Controls sections.
4. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts.
5. Externally operated manual reset.
6. Under-voltage release or protection.

1.7 DISCONNECTS SWITCHES

- A. Fusible Switches: Fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "Open" position; arc quenchers; capacity and characteristics as indicated.
- B. Non-fusible Switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating is indicated. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

PART 2 – EXECUTION (Not Applicable)

PART 3 – EXECUTION

3.1 GENERAL

- A. Division 23 contractor shall provide all starters, contactors, and disconnects required to operate mechanical equipment provided by this Division 23 contractor unless specifically stated otherwise on the plans or in these specifications, including Division 26 plans and specifications.

3.2 WIRING FOR MECHANICAL EQUIPMENT

- A. All power wiring for mechanical equipment shall be provided by Division 26 as required, unless stated otherwise in Division 23.
- B. Wiring that is required as a part of Division 23 shall conform to the requirements for wiring methods and materials as stated in Division 26.
- C. Provided detailed composite wiring diagrams for all control systems and equipment which may be required by Division 23 & 25. Verify electrical characteristics of equipment before ordering and finalize with Division 26. Reference electrical drawings for electrical characteristics of equipment specified herein and on the plans.
- D. Division 23 & 25 shall be responsible for the correct functioning of all the control systems and equipment supplied by Division 25.

END OF SECTION 23 05 11

SECTION 23 05 12 – BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section specifies mechanical components and installation methods common to more than one section of Division 23 and shall apply to all Division 23 work as is applicable.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each material described in this section as is applicable. These submittals and shop drawings shall be in no less detail than the product, material and installation descriptions provided herein and on the drawings.

PART 2 – PRODUCTS

2.1 CEILING/WALL ACCESS DOORS

- A. Steel Access Doors & Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, precast, or cast-in-place concrete, ceramic tile, or wood paneling.
- C. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
- D. For gypsum wallboard or plaster: perforated flanges with 22 gage wallboard bead.
- E. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- F. Flush Panel Doors: 14-gage sheet steel, with concealed continuous piano hinge set to open 175 degrees; factory applied baked on powder coat finish to match adjacent ceiling finish color.
- G. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- H. Locking Devices: Flush, screwdriver-operated cam locks.

2.2 AVAILABLE MANUFACTURERS

- A. Larsen's Manufacturing Company L-DWC series or approved equal.

2.3 FIRE STOPS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Fire-Resistant Joint Sealers: Two-part foamed-in-place silicone sealant, intumescent putty, or one-part silicone elastomeric sealant, formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
- C. Sealants and accessories shall provide fire-resistance ratings to three (3) hours protection, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.4 ACCEPTABLE MANUFACTURERS:

3-M Corporation
Dow-Corning Corp.
General Electric Co.
Nelson Flame Seal
Fire Stop V

Submit manufacturer's technical data for each produce used and include installation instructions, and material safety data sheets.

PART 3 – EXECUTION

EXAMINATION

3.1 DELIVERY, STORAGE, & HANDLING

- A. Deliver fire stop materials and similar type items in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle all materials in compliance with the manufacturer's recommendations to prevent their deterioration and damage.

3.2 SEQUENCING & SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor-bolt inserts into pad.
- B. Coordinate the installation of pipe sleeves for foundation wall penetrations, etc.
- C. Coordinate mechanical equipment locations and supports with roof work.

3.3 CONTROLS COORDINATION

- A. The mechanical contractor shall install control valves/actuators, control dampers, damper actuators, immersion wells, pressure sensor taps, flow meters, etc. which are to be furnished by the controls contractor.

3.4 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location. Where equipment is insulated or otherwise concealed, nameplates shall be located so as to be visible with insulation installed.
- B. HVAC Unit Information Tag: Each HVAC unit shall be affixed with Department of Management Services (DMS) custom HVAC unit information tag. Coordinate with DMS project manager for required info to be permanently displayed on the exterior panel of the HVAC unit.

3.5 IDENTIFICATION

- A. Provide a complete identification system for all systems. All equipment, valves, controls and piping shall be identified and marked as specified below. All numbers and letters shall be manufacturer's standard block lettering. Provide a typed index of all abbreviations and numbering systems used in the identification system. Coordinate names, abbreviations and number with those used on the drawings.
- B. Coordination: Where identification is to be applied to surfaces which require insulation, painting, or other covering of finish, including valve tags in finished mechanical spaces, install identification prior to installation of acoustical ceiling and similar removable concealment.

3.6 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock, and control device in each piping system; exclude check valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
- C. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than one single machine room.

3.7 EQUIPMENT IDENTIFICATION

- A. Each unit furnished shall be identified by its system number and other appropriate designation as directed by the owner. Minimum requirements include engraved plastic laminate signs (1/8" thick) permanently attached to each piece of equipment. Equipment requiring identification shall include but not be limited to: pumps, chillers, cooling towers, DX equipment controls, and other equipment as may be directed by the Owner's representative. The contractor shall submit proposed equipment identification system with shop drawings.

3.8 PIPING IDENTIFICATION

- A. Provide plastic pipe markers for all new piping systems using plastic pipe markers specified below.

3.9 PLASTIC PIPE MARKERS

- A. General: Pipe Markers shall comply with ANSI/ASME A13.1 (latest edition) "Scheme for the Identification of Piping Systems" and be installed as required and indicated below using legends (pipe content) spelled out fully and few abbreviations and directional arrows to indicate flow. Arrows must have the same background color as the pipe marker legend or be incorporated into the pipe marker.
- B. Color: Pipe Markers shall conform to ANSI Z535.1 "Safety Color Code". For existing Plants & MER's, match existing color scheme as directed by owner.
- C. Small Pipes: For external diameters less than 6" (including insulation if any), provide semi-rigid plastic full band pipe markers, extending 360 degrees around pipe at each location. The marker shall include the legend (pipe content) and a direction flow arrow. The marker shall be supplied as a pre-tensioned device and be equipped with a 1/2" strip of adhesive on the inside to secure marker in place. The marker shall also be fastened to the pipe with two metal color coded bands (color selected by Owner).
- D. Large Pipes: For external diameters greater than 6" (including insulation, if any), provide a semi-rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend (pipe content) and a direction flow arrow. The Marker shall be supplied with no less than two metal color coded bands (color selected by Owner) to secure the marker in place.
- E. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 deg. F (52 deg. C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

3.10 PIPING IDENTIFICATION INSTALLATION

- A. General: Install pipe markers on each system provided and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated above. Install on pipe insulation segment where required for hot non-insulated pipes.
2. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - a. Near each valve and control device.
 - b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - c. Near locations where pipes pass through walls or floors/ceilings or enter non-accessible enclosures.
 - d. At access doors, manholes and similar access points which permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.11 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and 5/32" hole for fastener.
- B. Provide 1-1/2" diameter tags, except as otherwise indicated.
- C. Provide size and shape as specified or scheduled for each piping system.
- D. Fill tag engraving with black enamel.
- E. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.
- F. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hold to allow attachment.
- G. Fire Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
- H. Provide UL label on each fire-rated access door.

3.12 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

3.13 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

3.14 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers, or as required for proper identification and operation/maintenance of mechanical systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

3.15 DUCT SYSTEM IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake, outside air, and relief ducts with duct markers or stenciled signs and arrows, showing duct system service and direction of flow. Locate in each space where ducts are exposed and where ducts are located above accessible ceiling systems. Locate near points where duct enter the space and at maximum 50-foot intervals.
- B. Identify the location of all fire and fire/smoke dampers. Identification tags shall be affixed to the ceiling/wall and shall be visible from the occupied space.

3.16 EQUIPMENT SUPPORTS

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

3.17 CUTTING, PATCHING, AND LAYOUT

- A. Provide openings required for the installation of the work. Patch work as required. Finished work shall match the existing adjoining work.
- B. Verify all conditions affecting the work to be performed under this contract.
- C. Carefully verify measurements at the site, determine the exact location of chases and openings required. Provide sleeves, inserts, and hangers as required. Neither columns, beams, joists, building foundations nor any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of the Owner's representative.
- D. Any damage incurred by the Contractor shall be repaired by the Contractor in a manner approved by the Owner's representative at no cost to the Owner and with no extension of time limitation.

3.18 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
- C. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- D. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- E. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

- F. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- G. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.19 INSTALLATION OF ACCESS DOORS

- A. Provide metal framing as required for rough opening. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.20 SMOKE DETECTORS

- A. Install smoke detectors as indicated on drawings and comply with these specifications and the manufacturer's instructions. Install in an accessible area or provide access door if installed above a hard ceiling. Smoke detectors installed prior to the air handler shall be installed in the return air duct prior to mixing with outside air. Install level so sampling tube openings are directly exposed to air flow. Coordinate the following application considerations with the Division 26 contractor who will furnish smoke detectors.
- B. Application Considerations: Only one detector is required per location, regardless of volume of air, if:
 - 1. The sampling tube extends at least 3/4 of the total width of the duct and is located approximately at the center of the vertical dimension of the duct, and
 - 2. There is no air inlet to the duct upstream.
- C. If, however, there is an inlet within a distance of six duct widths upstream:
 - 1. Use one detector for each four feet of vertical height (lower sampling tube located two feet above the bottom of the duct and additional sampling tubes mounted four feet on center of vertical height).
 - 2. For ducts wider than 12 feet use two detectors for each position, mounted on opposite sides of the duct.
- D. The above recommended detector limits apply to both the return air and supply air locations as required.

3.21 PAINTING/PROTECTIVE COATINGS

- A. Prime and paint (2 coats) all ducts (except stainless steel) in Mechanical Equipment Rooms (or otherwise exposed to view), piping, insulation, unpainted equipment or steel, structural bases and supports provided in Division 23 and existing in the limits of construction. Paint shall be industrial grade enamel; match existing color scheme or as directed by the Owner.
- B. Uninsulated piping, bases, supports and other unfinished steel shall be thoroughly cleaned of all rust and dirt. Apply one coat of rust inhibiting primer and two finishing coats.
- C. Insulated piping and equipment shall receive one coat of primer and two finishing coats.
- D. Pipe hangers, saddles and accessories shall be painted to match the piping (or existing color scheme).

- E. Colors for piping systems shall conform to ANSI A13.1 and ASHRAE Fundamentals, Chapter 38. Color for equipment supports and bases shall be gray.

3.22 IDENTIFICATION ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices and glass frames of valve charts.

3.23 COMMISSIONING

- A. Coordinate all work with Owner's Commissioning Agent prior to Bid.
- B. Install Strainers with Start-Up Screens: Install permanent screens after flushing and start-up is complete.
- C. Fill the System: Check compression tanks to determine that they are not air bound and that the system is completely full of water. Sanitize domestic water systems. Perform initial chemical treatment of hydronic and systems.
- D. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- E. After operating system to remove solids, remove start-up screens and provide standard screen.
- F. Before operating the system perform these steps:
- G. Open valves to full-open position. Close coil bypass valves.
- H. Remove and clean strainers.
- I. Check pump for proper direction of correct improper wiring.
- J. Set automatic fill valves for required system pressure.
- K. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- L. Set temperature controls so all coils are calling for full flow.
- M. Check operation of automatic bypass valves.
- N. Install minimum 30% efficient ASHRAE filters for start-up and install all new pre and final filters prior to test and balance.
- O. Check and set operating temperatures of chillers to design requirements.
- P. Lubricate motors and bearings.
- Q. Close drain valve, hydrants, and hose bibbs.
- R. Charge refrigerant systems using the following procedure:
- S. Install core in filter dryer after leak test but before evacuation.
- T. Evacuate refrigerant system with vacuum pump; until temperature of 35°F. is indicated on vacuum dehydration indicator.
- U. During evacuation, apply heat to pockets, elbows, and low spots in piping.

- V. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
- W. Break vacuum with refrigerant gas; allow pressure to build up to 2 psi.
- X. Complete charging of system using new filter dryer core in charging line. Provide full operating charge.
- Y. Train Owner's Maintenance Personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.
- Z. Review data in Operating and Maintenance Manuals. Refer to Division 1 section "Project Closeout."
- AA. Schedule training with Owner through the Architect, with at least 7 days advance notice.

END OF SECTION 23 05 12

SECTION 23 05 19 – METERS & GAGES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes meters and gages used in mechanical systems.

1.2 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Maintenance data shall be included in the "Operating and Maintenance Manuals" specified in Division 1 Section "Project Closeout."

1.3 QUALITY ASSURANCE

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- B. Design Criteria: The Drawings and specifications indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mercury-in-Glass Thermometers:
 - Marshalltown Instruments, Inc.
 - H.O. Trerice Co.
 - Weiss Instruments, Inc.
 - Weksler Instruments Corp.
 - Marsh Instrument Company
 - 2. Pressure Gages:
 - Ametek, U.S. Gauge Div.
 - Marsh Instrument Co.
 - Marshalltown Instruments, Inc.
 - H.O. Trerice Co.
 - Weiss Instruments, Inc.
 - Weksler Instruments Corp.
 - 3. Test Plugs:
 - Flow Design, Inc.
 - MG Piping Products Co.
 - Peterson Equipment Co., Inc.
 - Sisco Co., Spedco, Inc.
 - H.O. Trerice Co.
 - Watts Regulator Co.

2.2 THERMOMETERS, GENERAL

- A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
- B. Scale Range: Temperature ranges for services listed as follows:
 - Domestic Hot Water: 30 to 240 deg F with 2-degree scale divisions.
 - Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions.
 - Hot Water: 30 to 240 deg F with 2-degree scale divisions.
 - Condenser Water: 0 to 160 deg F with 2-degree scale divisions.
 - Chilled Water: 0 to 100 deg F with 2-degree scale divisions.
 - Steam and Condensate: 50 to 400 deg F with 2-degree scale divisions.

2.3 MERCURY-IN-GLASS THERMOMETERS

- A. Case: Weather resistant, die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9" long.
- B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- C. Tube: Red reading, mercury filled, magnifying lens.
- D. Scale: Satin-faced, non-reflective aluminum, with permanently etched markings.
- E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.4 APPROVED MANUFACTURERS

Marshalltown Instruments
H.O. Trevice
Weiss Instruments
Weksler Instruments

2.5 THERMOMETER WELLS

- A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2" extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometer well shall be as provided with the thermometer from the manufacturer.

2.6 PRESSURE GAGES

- A. Type: Industrial Grade, ASME B40.1, Grade A, 316 S.S. bourdon- tube type, bottom connection.
- B. Case: Poly propylene safety case, solid front with blow out back, 4-1/2" diameter.
- C. Connector: 316 S.S., 1/4" NPS, provide brass snubber.
- D. Scale: White coated aluminum, with permanently etched markings, slotted adjustable micrometer pointer.
- E. Accuracy: 1/2 of 1 percent of range span.
- F. Range: Conform to the following:
- G. Vacuum: 30 inches Hg to 15 psi.
- H. All Fluids: 1.5 times operating pressure.

2.7 PRESSURE GAGE ACCESSORIES

- A. Snubber: 1/4" NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.
- B. Siphon: 1/4" NPS straight coil constructed of brass tubing with threads on each end.

2.8 APPROVED MANUFACTURERS

Ametek
U.S. Gauge Division
Marshalltown Instruments, Inc.
H.O. Trerice Co.
Weiss Instruments Co.
Weksler Instruments Corp.

2.9 PHOTOHELIC PRESSURE GAUGES

- A. Differential pressure indicating transmitter shall be diaphragm operated with sensing element motion restrained by a calibrated spring affixed with a strain gauge transducer. Electrical signal shall be internally conditioned to a two-wire standard 4-20 mA control loop output. Transmitter shall have local pointer dial indication of sensed pressure with white dial, black figures, and graduations and pointer zero adjustment. Transmitter shall be Dwyer Instruments, Inc., Catalog No. 605 or approved equal.

2.1 TEST PLUGS

- A. Test Plugs shall be nickel-plated brass body, with 1/2" NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8" O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.
- B. Core Material: Conform to the following for fluid and temperature range:
 - 1. Air, Water, Oil, and Gas, 20 to 200°F: Neoprene.
 - 2. Air and Water, minus 30 deg to 275°F: EPDM.
 - 3. Steam: Provide as recommended by manufacturer for specific application.
- C. Test Kit: Provide test kit consisting of one (1) pressure gage adapter with probe, two (2) bimetal dial thermometers, and carrying case.
- D. Ranges of pressure gage and thermometers shall be approximately two (2) times systems operating conditions.

2.11 APPROVED MANUFACTURERS:

MG Piping Products
Peterson Equipment
H.O. Trerice
Watts Regulator

PART 3 - EXECUTION

3.1 METER AND GAGE APPLICATIONS

- A. General: Where indicated, install meters and gages of types, sizes, and capacities.

3.2 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

3.3 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.
 - 1. Fill wells with oil or graphite and secure caps.

3.4 PRESSURE GAGE INSTALLATION

- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position.
- B. Pressure Gage Needle Valves: Install in piping tee with snubber. Install siphon instead of snubber for steam pressure gages.

3.5 TEST PLUG INSTALLATION

- A. Install test plugs in piping tees where indicated, located on pipe at most readable position, secure cap.

3.6 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.
- C. Make electrical connections to power supply and electrically operated meters and devices.

3.7 ADJUSTING & CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 23 05 19

SECTION 23 05 23 – VALVES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes general duty valves common to most mechanical piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Valves of same type shall be provided by the same manufacturer.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.4 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed below:

Armstrong
Crane
Grinnell
Hammond
Jenkins
Lunkenheimer
Milwaukee
Powell
Stockham
Jomar
Tour and Andersson

1.5 DELIVERY, STORAGE, & HANDLING

- A. Preparation For Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
 - 3. Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.
- B. Storage: Use the following precautions during storage:
 - 1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves whose size requires handling by crane or lift; rig valves to avoid damage to exposed valve parts. Do not use hand wheels and stems as lifting or rigging points.

PART 2 – PRODUCTS

2.1 VALVE FEATURES; GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems.
- B. Non-rising Stem Valves may be used where headroom prevents full extension of rising stems.
- C. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- D. Sizes: Same size as upstream pipe, unless otherwise indicated.
- E. Operators: Provide the following special operator features:
 1. Hand wheels, fastened to valve stem, for valves other than quarter turn.
 2. Lever handles, on quarter-turn valves 6" and smaller, except for plug valves. Provide memory stops on valves used for balancing. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
 3. Chain wheel operators, for valves 2-1/2" and larger, installed 72" or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
 4. Gear drive operators, valves 8" and larger.
- F. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- G. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- H. End Connections: As indicated in the valve specifications.
- I. Threads: Comply with ANSI B1.20.1.
- J. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
- K. Solder-Joint: Comply with ANSI B16.18.
 1. Caution: Where soldered end connections are used, use solder having a melting point below 840°F for gate, globe, and check valves; below 421°F for ball valves.

2.2 GATE VALVES

- A. Cast bronze 2 Inch and Smaller: MSS-SP-80
 - Class 125 and 150 - ASTM B-62 cast bronze body and union bonnet.
 - Class 250 - ASTM B-61 cast bronze body and union bonnet.

Threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, malleable iron handwheel. Do not use solder end valves for hot water heating or steam piping applications; use where system temperature and pressure is applicable.

B. Iron 2-1/2 Inch and Larger: MSS-SP-70

- Class 125 and 250 - ASTM A-126 Class B body and bolted bonnet.
- Class 150 - ASTM A-395 Ductile iron body.

Iron body bronze mount, with raised face flanged ends, "Teflon" impregnated packing or Aramid fibers with graphite, and two-piece backing gland assembly.

2.3 GLOBE VALVES

A. Case Bronze 2" and Smaller: MSS-SP-80

- Class 125 and 150 – ASTM B-62 cast bronze body and union bonnet.
- Class 250 – ASTM B-61 cast bronze body and union bonnet.

Threaded or solder ends, brace or replaceable composition disc, copper-silicon alloy stem, brass packing gland, Aramid fibers with graphite, and malleable iron handwheel.

B. Iron 2-1/2 Inch and Larger: MSS-SP-85

- Class 125 and 250 – ASTM A-126 Class B cast iron body and bolted bonnet.
- Class 150 – ASTM A-395 ductile iron body bolted bonnet.

Iron body bronze mount, raised face flanged ends, "Teflon" impregnated or Aramid fibers with graphite, and two-piece backing gland assembly.

2.4 CHECK VALVES

A. Swing Check Valves

1. Cast Bronze 2" and Smaller: MSS-SP-80

- Class 125 and 150 – ASTM B-62 cast bronze body and bonnet.
- Class 250 – ASTM B-61 cast bronze body and bonnet.

Threaded or solder ends, horizontal swing, bronze disc, and Y-pattern; provided valves capable of being reground while the valve remains in line.

2. Iron 2-1/2 Inch and Larger: MSS-SP-71

- Class 125 and 250 – ASTM A-126 Class B cast iron body and bolted bonnet.
- Class 150 – ASTM A-395 ductile iron body and bolted bonnet.

Raised face flanged ends and horizontal swing. Provided valves are capable of being reground while the valve remains in line.

3. Wafer Check Valves 2-1/2" and Larger:

Should be of non-slam design lapped and balanced twin flappers or lift type design as specified on the drawings, stainless steel trim and torsion spring. Provided valves designed to open and close at approximately one foot differential pressure.

2.5 BALL VALVES

A. 1 Inch and Smaller: WW-V-35B

1. Bronze body conforming to ASTM B-62:

- a. Rated for 150 saturated steam pressure, 400 psi WOG pressure; 2 or 3 piece construction; full port, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered oval stainless steel handle.

B. 1-1/4 Inch to 2 Inch: WW-V-35

1. Bronze body conforming to ASTM B-62:
 - a. Same as 1" and smaller bronze body.
- C. 2-1/2 Inch and Larger: MSS-SP-72
 1. Carbon steel body conforming to ASTM A216:
 - a. Same as 1-1/4" to 2" carbon steel body except end are flanged.
 - b. All ball valves provide IPS ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low pressure steam.
- D. Select valves with the following ends or types of pipe/tube connections:
 1. Copper Tube Size, 2" and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
 2. Steel Pipe Sizes, 2" and Smaller: Threaded or grooved end.
 3. Steel Pipe Sizes 2-1/2" and Larger: Flanged.

2.6 PLUG VALVES

- A. Plug Valves, 2" and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
- B. Plug Valves – 2" and Smaller:
 1. Lunkenheimer 454
- C. Plug Valves, 2-1/2" and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semisteel body, single gland, wrench operated, and flanged ends.
- D. Plug Valves – 2-1/2" and Larger:
- E. Powell: 2201

2.7 BUTTERFLY VALVES

- A. Provide butterfly valves with an end cap for dead end service. Drill and tap valves on dead end service or requiring additional body strength.
- B. 2-1/2" and Larger: MSS-SP-67
- C. ASTM A-536 Ductile iron body or A126 Class B iron.
 1. Provide valves with field replaceable EPDM sleeves nickel-plated ductile iron discs, stainless steel stem, and EPDM O-ring stem seals. Provide lug-type body. Provide lever operator with position indicator for sizes 2 through 6" and gear operators with position indicators for size 8 through 30". All valves in manholes and vaults shall have working pressure of 250#.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides, and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

- C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2" and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
 - 2. Steel Pipe Sizes, 2" and Smaller: threaded end.
 - 3. Steel Pipe Sizes 2-1/2" and Larger: flanged.

3.3 VALVE INSTALLATIONS

- A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Install valves where indicated by and in accordance with equipment manufacturer's recommendations.
- C. Install shut-off duty valves at each branch connection to supply mains, and elsewhere as indicated.
- D. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.
- E. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.
- F. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required to facilitate system balancing.
- G. Install check valves on each pump discharge and elsewhere as required to control flow direction.
- H. Install angle pattern globe valves on the supply side of each wall mounted terminal unit. If unit has an enclosure, install the valve within the enclosure.
- I. Locate valves for easy access and provide separate support where necessary.
- J. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- K. Tag Valves with a metal tag attached with a metal chain.
- L. Install valves in horizontal piping with stem at or above the center of the pipe.
- M. Install valves in a position to allow full stem movement.
- N. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.
2. Wafer Check Valves: Horizontal or vertical position, between flanges.

3.4 PRESSURE REDUCING VALVE INSTALLATIONS

- A. General: Install pressure reducing valves as required to regulate system pressure. Install in a location readily accessible for maintenance and inspection.
- B. Size reducing valves to supply the maximum steam requirements of the heating system or equipment indicated, at the indicated inlet and outlet pressures.
- C. Provide bypass around each reducing valve, with a globe valve equal in size to the area of the reducing valve seat ring.
- D. Install gate valves and unions around each reducing valve to facilitate removal and repair of reducing valves. Unions may be omitted for reducing valves with flanged connections.
- E. Install pressure gages on the low-pressure side of each reducing valve and ahead of the shutoff valve plus one downstream for the shutoff valve.
- F. Install strainers upstream for each reducing valve.
- G. Install safety valves downstream from each reducing valve set a 5 psig higher than the reduced pressure when the reduced pressure is under 35 psig; and at 10 psig higher than the reduced pressure, if the reduced pressure is above 35 psig or the first-stage of two-stage reducing.

3.5 RELIEF VALVE INSTALLATIONS

- A. Install relief valves in accordance with and where required by ASME B 31.1 - "Power Piping".
- B. Pipe discharge to atmosphere outside the building, without stop valves.
- C. Terminate vent pipe with screened vent cap.
- D. Install a drip pan elbow fitting adjacent to the safety valve.
- E. Pipe drip pan elbow drain connection to the nearest floor drain without valves.
- F. Comply with ASME Boiler and Pressure Vessel Code for the installation requirements.

3.6 SOLDER CONNECTIONS

- A. Cut tube square and to exact lengths. Ream interior of tubing.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.7 THREADED CONNECTIONS

- A. Note the 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.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.8 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. 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.

3.9 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.10 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.11 VALVE SCHEDULES

VALVE	SIZE	CLASSIFICATION
Domestic Water, 125 Class:		
Gate	None	Use Butterfly or Ball Valve
Globe	1/2" to 2" 3" to 4"	125# SWP Bronze Screwed 125# IBBM RF FLGD
Check	1/2 to 2" 3" & 4"	125# SWP Bronze Screwed 125# Iron Body Swing Check
Ball Valves	1/2" to 2" 2" & Up	125# SWP Bronze Screwed Use Butterfly
Butterfly	3" to 4"	125#/200# LUG Pattern
Chilled Water, 150 Class:		
Gate	1/2" to 2" 3" to 10"	150# Screwed Bronze Use Butterfly Valve
Globe	1/2" to 2" 3" to 10"	150# SWP Bronze Screwed 150# IBBM FLGD RF
Check	1/2" to 2" 3" to 10"	150# SWP Bronze Screwed 150# IBBM Swing Check
Ball Valves	1/2" to 2"	150# SWD Bronze Screwed
Butterfly Valves	3" to 30"	150#/250# Lug Pattern

Condenser Water, 125 Class:

Gate	None	Use Butterfly or Ball Valve
Globe	1/2" to 2"	125# SWP Bronze Screwed
	2 1/2" to 10"	125# Bronze Flanged
Check	1/2" to 2"	125# SWP Bronze Screwed
	2 1/2" to 10"	125# IBBM Wafer Check
Ball Valves	1/2" to 2"	125# SWP Bronze Screwed
	3" to 10"	None, Use Butterfly
Butterfly	3" to 12"	125#/200# Lug Pattern
	14" to 16"	250# Lug Pattern

Hot Water, 150 Class:

Gate	1/2" to 2"	150# Screwed Bronze
	3" to 10"	125# IBBM FLGD RF
Globe	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM FLDG RF
Check	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM Swing Check
Ball Valves	1/2" to 2"	150# SWD Bronze Screwed
Butterfly Valves	None	Use Gate or Ball Valves

3.12 VALVE SCHEDULE LEGEND

OS&Y	-	OUTSIDE SCREW & YOKE
RF	-	RAISED FACE
RS	-	RAISED STEM
SWD	-	SOLID WEDGE DISC
SWP	-	STEAM WORKING PRESSURE
IBBM	-	Iron Body, Bronze Mounted

END OF SECTION 23 05 23

SECTION 23 05 93 – TESTING, ADJUSTING, & BALANCING

PART 1 – GENERAL

This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results. Test and Balance Contractor must be AABC or NEBB certified.

The Contractor shall procure the services of an independent balancing and testing agency which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The agency will balance, adjust, and test all heating, ventilating, and air conditioning systems within the building. The Contractor shall provide test and balance to place the system in operation. The Contractor shall participate in the Test and Balance, make any changes necessary, and be responsible for any retesting that may be required to meet specification and drawing requirements. This initial test and balance shall be performed in accordance with this specification and a written report shall be provided. The project will not be accepted as substantially complete until this report has been made and reviewed with NO EXCEPTIONS TAKEN. The Test & Balance Contractor shall coordinate with the BAS Contractor as required to set all design parameters.

Test, adjust, and balance the following mechanical systems:

Fans;

VAV and CV Terminal Units;

Supply, return, outside and exhaust air systems, all pressure/flow ranges; including variable volume systems. Test and balance all air devices and traverse duct at each air handler, and exhaust fan (record static and CFM).

Test & Balance Contractor shall identify outside air and return air damper positions for design OA flow rate for varying SA flow rates and advise Control Contractor.

Hydronic systems (record flow and pressure drop across major equipment including CRAC units);

- Cooling coils
 - Measure and Adjust Flow (and Entering/Leaving Water Temperatures)
 - Measure and record entering and leaving dry bulb and wet bulb temperatures.
- Heating coils/Heat exchangers
 - Measure and Adjust Flow (and Entering/Leaving Water Temperatures)
 - Measure and record entering and leaving temperatures
- Terminal Boxes & Controls
 - Measure and Adjust (Design Maximum & Minimum) Air Flow
 - Measure and Adjust Water Flows (As Applicable)
 - Measure and record entering and leaving temperatures

HVAC Control Systems

Verify temperature control system operation in both heating and cooling modes.

Sound and Vibration

In retrofit projects, record preliminary flow and pressure data to confirm proper operation of existing equipment prior to any demolition work and to confirm new operating conditions can be achieved. Submit preliminary report to Engineer.

The installing mechanical contractor shall make any necessary sheave/pulley and belt changes or motor speed adjustments to obtain final air flows.

The test and balance contractor shall provide preliminary testing as necessary to assist the mechanical contractor.

Test systems for proper sound and vibration levels. Record sound and vibration levels in final report.

1.1 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data:
- C. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- D. Forms shall be those standard forms prepared by the AABC or NEBB.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
- F. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be handwritten, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
- G. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 6 complete sets of final reports and one electronic set.
- H. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - General Information and Summary
 - Air Systems
 - Hydronic Systems
 - HVAC Control Systems
 - Sound & Vibration
- I. Report Contents: Provide the following minimum information, forms, and data:
- J. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
- K. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- L. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.2 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineer (either on the installer's staff or and independent consultant), registered in the State in which the services are to be performed, and having at least 3-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications: The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB as a Test and Balance Engineer.
- C. Codes and Standards:

NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

AABC: "National Standards For Total System Balance."

ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

- D. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing. The T&B contractor shall conduct a thorough pre-balance site review and submit a written report for the HVAC design engineer's approval regarding the suitability of site conditions for commencing T&B procedures.
- E. Other Trade Contractors will be required to provide the following information and capabilities as required by the T&B Contractor for completion of work:
 - 1. Equipment (Approved) Submittals;
 - 2. Equipment Start-up Reports;
 - 3. EMCS Control Point Lists;
 - 4. Access to the EMCS Network;
 - 5. Project Drawings (for reference and mark-up purposes).
- F. T&B Contractor shall submit the following items to the HVAC design engineer, CM, Commissioning Agent and Owner:
 - 1. A Detailed overview of all T&B procedures;
 - 2. A Detailed description of each testing procedure;
 - 3. Regular field reports regarding progress, observed deficiencies, etc; and,
 - 4. Reports as indicated herein.

1.3 PROJECT CONDITIONS

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

1.4 SEQUENCING & SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, ~~steam~~, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 – PRODUCTS - Not Used

PART 3 – EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

- A. Before operating the system, perform these steps:
- B. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- C. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
- D. Compare design to installed equipment and field installations.
- E. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
- F. Check filters for cleanliness.
- G. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- H. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- I. Determine best locations in main and branch ductwork for most accurate duct traverses.
- J. Place outlet dampers in the full open position.
- K. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting of deficiencies.
- L. Lubricate all motors and bearings
- M. Check fan rotation

3.2 PRELIMINARY PROCEDURES FOR HYDRONIC SYSTEM BALANCING

- A. Before operating the system perform these steps:
- B. Open valves to full open position. Close coil bypass valves.
- C. Remove and clean all strainers.
- D. Examine hydronic systems and determine if water has been treated and cleaned.
- E. Check pump rotation.
- F. Clean and set automatic fill valves for required system pressure.
- G. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- H. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- I. Set temperature controls so all coils are calling for full flow.
- J. Check operation of automatic bypass valves.
- K. Check and set operating temperatures of chillers and boilers to design requirements.

- L. Lubricate all motors and bearings.

3.3 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than five (5) percent. When measuring a single point, repeat readings until two (2) consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.4 PERFORMING TESTING, ADJUSTING, & BALANCING

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. Test and document a minimum of eight (8) measured points for the variable flow pumping systems to verify system pumping performance.
- C. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- D. Patch insulation, ductwork, and housings, using materials identical to those removed.
- E. Seal ducts and piping, and test for and repair leaks.
- F. Seal insulation to re-establish integrity of the vapor barrier.
- G. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- H. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.5 HVAC CONTROL SYSTEM TEST & BALANCE

- A. The TAB agency shall work with the EMCS contractor to ensure the most effective total system operation is within the design limitations, and to obtain mutual understanding of the intended control system performance.
- B. Verify that all control devices are properly connected and operated by the intended controller.

- C. Observe that all valves are properly installed in the piping system in relation to direction of flow and location.
- D. Observe the calibration of all controllers.
- E. Verify the proper operation and application of all normally open and normally-closed valves.
- F. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media.
- G. Verify that the sequence of operation for any control mode is in accordance with approved shop drawings and the engineer's specifications.
- H. Verify the operation of all interlock systems.
- I. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow

3.6 TESTING FOR SOUND & VIBRATION

- A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

Sound: Read and record sound levels at up to 15 locations in the building designated by the engineer. All measurements shall be made using an octave band analyzer. All tests shall be conducted when the building is quiet and in the presence of the engineer, if required by the engineer.

Vibration: Record vibration readings on all equipment where motor horsepower is equal to or greater than 10 HP (7.46 kW)

3.7 RECORD & REPORT DATA

- A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.
- C. Record the total CFM measured at all of the outlets and compare to the total air flow measured at the unit.

END OF SECTION 23 05 93

SECTION 23 07 00 – MECHANICAL INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and its intended use. Submit schedule showing manufacturer's product number, R-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE, & HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.5 STANDARDS

2023 Florida Building Code, 8th Edition
Fiberglass Piping Insulation: ASTM C 547.
Cellular Glass Insulation: ASTM C 552
Flexible Unicellular Insulation: ASTM C 534
Jackets for Insulation: ASTM C 921
Rigid Fiberglass Insulation ASTM C 612
Flexible Fiberglass Insulation: ASTM C 553

NOTE: All insulation in Plenums must have fire/smoke 25/50 rating.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - Armstrong World Industries, Inc.
 - Babcock & Wilcox; Insulating Products Div.
 - CertainTeed Corp.

Kingspan Corp.
Knauf Fiber Glass GmbH.
Manville Products Corp.
Owens-Corning Fiberglas Corp.
Pittsburgh Corning Corp.
Rubatex Corp.
Cell-U-Foam Corp.

2.2 MISCELLANEOUS INSULATION ACCESSORIES & COMPOUNDS

- A. General: Provide band wires, tape, anchors, corner angles, cement, adhesives, coatings, sealants, protective finishes, mastics, metal covers, wire netting, etc. as recommended by insulation manufacturer for application indicated.
- B. Paper laminated jackets shall be permanently fire and smoke resistant. Chemicals used for treating paper in laminated jacket shall not be water soluble and shall be unaffected by water and humidity.

2.3 PIPING SYSTEM INSULATION

- A. Fiberglass Pipe Insulation: Owens Corning ASJ/SSL-11 pipe insulation. Fittings to be fiberglass insulation inserts and PVC fitting covers. PVC fittings shall be Manville "Zeston 200" or Proto "Low smoke".
- B. Inorganic glass fibers, bonded with a thermosetting resin. Jacket shall be all-purpose, factory applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap. ASTM C 612, Class 2, semi-rigid foil scrim kraft jacketed board.
- C. Thermal Conductivity shall be 0.24 (BTU-in/hr - ft² - Deg F) average maximum, at 75°F mean temperature. Density, 6 pcf average. Adhesive produced under the UL classification and follow-up service.
 - 1. Non-flammable, solvent-based, minus 20 to 180°F.
- D. Vapor barrier sealant shall be flexible elastomer based, vapor barrier sealant designed to seal fiberglass joints, water vapor permeance, 0.02 per maximum, minus 50 to 250°F, of a color gray.
- E. Cellular Glass Insulation: Pittsburgh Corning "Foamglass" or Cell-U-Foam Corp. "Ultra-Cuf" insulation for above grade pipe insulation and below grade pipe insulation with conductivity of 0.40 BTU/SF/F at 75°F and a permeability of 0.00 perms.
- F. Finish for machine rooms and piping subject to heavy traffic and chilled or hot water piping exposed to weather shall include Pittcote 404, Foster 30-70, or 30-80 reinforced with white glass fabric of not less than 7.8 ounces per yard. Then apply a second coat of Pittcote 404, Foster 30-70 or 30-80 and brush lightly with a wet brush to a smooth finish. Elbows, valves, and fittings shall be finished with Pittcote 404, Foster 30-70 or 30-80 reinforced with white glass fabric and aluminum jacket.
- G. Finish above ground insulation with white Kraft or vinyl-foil laminated fire-rated all-service jacket, all joints and laps sealed with fire-rated adhesive. Finish elbows, valves, fittings, etc., with Pittcote 404 reinforced with white glass fabric. All exposed piping shall have aluminum jacket unless indicated otherwise.
- H. Flexible Elastomeric Insulation: Armstrong "AP Armaflex" pipe insulation and Armstrong "Armaflex II" sheet and roll insulation, 25/50 compliance.
- I. General: Provide insulation of thickness and type indicated on the following schedule (NOTE: Provide finish and jacketing as indicated above; provide additional field applied jacketing as indicated below.) (NOTE: Comply with schedules noted below or FBC 2023 8th Ed., whichever is greater):

PIPE INSULATION SCHEDULE

INTERIOR DOMESTIC COLD WATER, HOT WATER & RECIRCULATED HOT WATER PIPING

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	Armaflex AP 25/50	1	NO	(A)(SS)*
1-1/2 TO 4	Armaflex AP 25/50	1 1/2	NO	(A)(SS)*
5 TO 10	Armaflex AP 25/50	1 1/2	NO	(A)(SS)*

INTERIOR CHILLED WATER PIPING (35 TO 100 DEG) EXPOSED & CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	CELLULAR GLASS	1	YES	(A)(SS)*
1-1/2 TO 4	CELLULAR GLASS	1-1/2	YES	(A)(SS)*
5 TO 10	CELLULAR GLASS	1-1/2	YES	(A)(SS)*

INTERIOR HYDRONIC (100 TO 250 DEG F) EXPOSED & CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 4	GLASS FIBER	1-1/2	NO	(A)(SS)
	CELLULAR GLASS	1-1/2	NO	(A)(SS)
5 TO 10	GLASS FIBER	2	NO	(A)(SS)
	CELLULAR GLASS	2-1/2	NO	(A)(SS)
12 TO 36	GLASS FIBER	2-1/2	NO	(A)(SS)
	CELLULAR GLASS	3	NO	(A)(SS)

*Note: Field applied jacket not required for concealed piping.

DUCT SYSTEMS INSULATION SCHEDULE

INTERIOR CONCEALED HVAC SUPPLY, OUTSIDE AIR, EXHAUST AIR AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	WRAP	2 (1.5# Density)	YES	NONE

INTERIOR EXPOSED MECHANICAL ROOM HVAC SUPPLY, OUTSIDE AIR, EXHAUST AIR, & RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD-RECT.	2 (3# Density)	YES	(A) (SS)

P = Paper A = Aluminum PVC = White PVC Jacket K = Kraft SS = Stainless Steel

2.4 CONDENSATE DRAINS

- A. Insulate condensate drain piping above concealed spaced and in all mechanical rooms with 3/4" thick "AP" Armaflex (25/50 compliance) or approved equal. Insulate all condensate lines located in return air plenums (in their entirety) with 3/4" thick AP Armaflex (ASTM E84, 25/50 Compliance) pipe insulation. Exposed piping shall be primed and painted; color by Architect.

2.5 HANDICAPPED FIXTURES

- A. Insulate hot water and cold-water valves, supplies, and drains at handicapped lavatories with 1/2" thick "AP" Armaflex insulation, secured with Armstrong 520 adhesive. Insulate drains at handicapped lavatories with insulation jackets of similar composition to Armaflex with a vinyl cover.

2.6 PLUMBING VENTS, FLOOR DRAINS & HUB DRAINS

- A. Insulate the body, trap, and all horizontal piping from floor drains, hub drains, and floor sinks receiving cold condensate water with 1" thick AP Armaflex (ASTM E84, 25/50 Compliance) pipe insulation.
- B. Insulate the first 10 feet of piping from plumbing vents receiving cold condensate water with 1" thick AP Armaflex pipe insulation.

2.7 STORM WATER PIPING

- A. Insulate roof drain bodies and horizontal rainwater leaders of storm water piping. All exposed piping shall be primed and painted, color selection by architect.

2.8 FLEXIBLE CONNECTIONS

- A. Provide 1" thick "AP" Armaflex (25/50 compliance) insulation at all flexible connectors. Armaflex shall extend adequately beyond the foamglass or other rigid pipe insulation and secured by stainless steel bands.

2.9 DUCTWORK

- A. Insulate all galvanized steel supply, return and outside air ductwork. Exhaust ducts shall not be insulated, except internally lined with insulation 10 feet of ductwork attached to and including the discharge plenums at exhaust louvers for noise considerations. Insulate exterior exhaust duct. Insulate outside air ducts.
- B. Duct wrap shall be specifically designed for wrapping heating and air conditioning ductwork and include 2" overlap facing tab to provide for continuous vapor seal. Duct wrap shall be 2" thick, 1.5 lb. density, foil-scrim-Kraft laminated vapor barrier facing, minimum installed R-value equal to 6.0, and a maximum flame spread/smoke development rating of 25/50 per ASTM E84.
- C. Insulate HVAC plenums and unit housings not pre-insulated at factory or lined with 2" thick, 3.0 lb density (minimum) board insulation with foil scrim Kraft vapor barrier.

2.10 AIR DEVICES

- A. Insulate all exposed metal surfaces on back and neck of ceiling diffusers with 1" thick fiberglass with vapor barrier.

2.11 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth (for fiberglass and calcium silicate insulation only): Woven glass fiber fabrics, plain weave, pre-sized a minimum of 8 ozs. per sq. yd.
 - 1. Cloth Standard: MIL-C-20079H, Type I.
- B. Bands: 3/4" wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: type 304, 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.01 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.

- C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.
- D. Corner Angles: 28-gage, 1" x 1" aluminum, adhered to 2" x 2" Kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 GENERAL

- A. Insulation shall be applied on clean, dry surfaces.
- B. All insulation shall be continuous through floor, wall and ceiling openings (including sleeves).
- C. Insulation on all cold surfaces where vapor barrier jackets are used must 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.

3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints; bond with sealant or adhesive on closed cell insulation. Stagger joints on double layers of insulation.
- B. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- C. Apply insulation with a minimum number of joints.
- D. Exterior Wall Penetrations: For penetrations of exterior walls, extend metal jacket for exterior insulation through penetration to a point 2" from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.
- E. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory applied moisture barrier over insulation. Extend 2" from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer.
- F. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with fire-stopping or fire-resistant joint sealer.
- G. Flanges, Fitting, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight, bond with adhesive.
 - 1. Use same material and thickness as adjacent pipe insulation.
 - 2. Overlap nesting insulation by 2" or 1 pipe diameter, whichever is greater.
 - 3. Insulate elbows and tees with premolded insulation or insulation material segments. Use at least three (3) segments for each elbow.

4. Cover insulation except for metal jacketed insulation, with two (2) layers of lagging adhesive to a minimum thickness of 1/16". Install glass cloth between layers. Overlap adjacent insulation by 2" in both directions from joint with glass cloth and lagging adhesive.
- H. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install shields, as specified in Division 23, Section 232529 – "Hangers and Supports."
 1. Shields: Cover hanger shields with jacket material matching adjacent pipe insulation.
- I. Apply insulation continuously through sleeves and manholes, except as specified above for exterior wall penetrations.

3.4 CELLULAR GLASS PIPE INSULATION INSTALLATION

- A. Cellular Glass Insulation: Butter pipes and joints of foamglass insulation with Pittseal 444, Foster 95-60 or 95-44, or Childers CP-70. Apply insulation to pipe and fittings with all joints tightly fitted.
- B. Secure with aluminum bands (not greater than 12" on center) so that each length of insulation shall be secured with two bands (minimum). Insulation shall be applied with all joints fitted to eliminate voids. Voids shall be eliminated by refitting or replacing insulation. Do not fill voids with joint sealer.
- C. Mastic finish application: Prior to application of the finish, the insulation shall be inspected for voids, cracked segments and open joints between segments. Cracked or broken segments, and open joints shall be refitted. Voids shall be filled with pieces of cellular glass insulation.
- D. Cut the PC Fabric 79 or 4224 MAST-A-FAB to fit around the pipe or fitting allowing for 3" to 4" overlap. Using a glove or trowel, apply a tack coat of PITTCOAT 404, Foster 30-70 or 30-80 coating to a section of the insulation. The tack coat should be applied at a rate of 3-4 gal/100 sf.
- E. Embed the PC Fabric 79 or 4224 MAST-A-FAB in the tack coat using a trowel, squeegee or glove to push the fabric in. Work the fabric into the coating until the appearance is uniform and there are no wrinkles or pinholes.
- F. As an alternate method, the PC Fabric 79 or 4224 MAST-A-FAB may be applied to the insulation first and the tack coat of PITTCOTE 404 coating troweled or gloved through the fabric.
- G. Apply another section of mastic overlapping the previous section by 3" and embed PC Fabric 79 or 4224 MAST-A-FAB as described in the above step. Each successive fabric section should overlap the previous one 3".
- H. Continue working following the procedure above, until the entire line has received the PITTCOTE 404, Foster 30-70 or 30-80 coating tack coat and PC Fabric 79. Care should be taken to ensure the mastic is pinhole free.
- I. Allow the first coat to dry a minimum of 24 hours (a minimum of 48 hours when relative humidity is higher than 80%) prior to application of the second coat.
- J. With a glove or trowel, apply a second coat of PITTCOTE 404, Foster 30-70 or 30-80 coating at a rate of 2-3 gal/100 sf. Here again, it is important that the mastic be applied pinhole free.

3.5 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purposes.

- B. Insulation shall be continuous throughout the duct length and shall comply with NFPA Bulletin 90A requirements for flame spread and smoke developments. Insulation shall be applied to the duct with a solid surface of fire retardant adhesive equal to Insul-Coustic 215 Sure-Stik.
- C. Insulation applied to the top surface of horizontal duct shall overlap the side pieces to provide maximum support. In addition, insulation shall be secured with pins and clips not to exceed 12" on center. All exposed edges of board insulation shall receive brush coat of coating equal to Insul-Coustic 110.
- D. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor barrier on ductwork insulation and protect it to prevent puncture and other damage.
- F. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- G. Install Blanket Wrap Insulation as Follows: Install uniform and smooth. Secure to ducts having long sides or diameters as follows:
 - 1. Smaller Than 24": Bonding adhesive applied in 6-inch-wide transverse strips on 12" centers.
 - 2. 12" and Larger: Anchor pins spaced 12" apart each way. Apply bonding adhesive to prevent sagging of the insulation.
 - 3. Overlap joints 3".
 - 4. Seal joints, breaks, and punctures with glass fabric and mastic. **(Tape is not allowed.)**
- H. Install rigid board insulation as follows:
 - 1. Adhesive and Band Attachment: Secure board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12" apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
 - 2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 12" apart each way and 3" from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.
- I. Cellular Glass Insulation: Install in same manner as cellular glass pipe insulation, including aluminum jacketing.

3.6 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment while hot or cold.
- E. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- I. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, and aluminum jacketing on all exterior equipment.

3.7 INSULATION JACKETS

- A. Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.
- B. Install corrugated aluminum (ASTM B209, 3003 alloy, H-14 temper 0.02" thick) jacket with 2" overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints and longitudinal joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with aluminum or stainless-steel draw bands 12" on center and at butt joints. Jacket shall be continuous. Include screws or bands on elbows and other fittings as necessary.
- C. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2" laps at longitudinal joints and 3" wide butt strips at end joints.
- D. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

3.8 FINISHES

- A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply two coats of protective coating to exposed insulation. Color selected by Architect.
- B. Exposed Insulation shall have Aluminum Jacket or painted as indicated in the Construction Documents.

3.9 INSULATION REPAIR

- A. Repair damaged sections of mechanical insulation damaged during this construction period.

3.10 PROTECTION & REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.11 PAINT:

- A. Refer to Section 23 05 12 and Drawings for painting requirements. All exposed insulation shall be primed and painted; color selected by Owner.

END OF SECTION 23 07 00

SECTION 23 09 70 – VARIABLE FREQUENCY (SPEED) DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Specifications:

1. Division 26 sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A.** Extent of variable frequency drive work is indicated by drawings and by requirements of this section.
- B.** Coordinate with requirements of Division 26 and include all associated costs in bid.
- C.** Coordinate with requirements of Controls Division 25 and include all associated costs in bid.

1.3 QUALITY ASSURANCE

- A.** Manufacturers: Firms regularly engaged in manufacture of variable frequency drives, of types, ratings, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than FIVE (5) years.
- B.** Installer's Qualifications: Firm with at least FIVE (5) years of successful installation experience with projects utilizing variable frequency drives similar to that required for this project.
- C.** NEC Compliance: Comply with applicable NEC requirements pertaining to wiring methods, materials, construction, and installation of electrical equipment.
- D.** UL Compliance: Provide variable frequency drive components and accessories which are UL-listed, labeled, and tested to ANSI/UL STD 508.
- E.** IEEE Compliance: Comply with applicable requirements of IEEE Std 59, pertaining to rectifier components and IEEE STD 519 criteria for induced system noise.
- F.** NEMA Compliance: Comply with applicable requirements of NEMA Pub 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)".
- G.** Comply with EC second environmental, conducted, and radiated limits.
- H.** Line Noise: Compliance to IEEE 519 - Harmonic analysis for particular job site including total voltage harmonic distortion and total current distortion.
- I.** Building Automation System: All VFD's must be provided from the factory the proper communication card, etc to communicate directly with the Building EMCS.
- J.** Tests:
1. The unit shall be subject to a series of in plant quality-controlled inspections before approval for shipment from manufacturers' facilities.
 2. The integrated circuits shall undergo minimum 160 hour "burn-in" to test reliability. During the "burn-in", the temperature shall be cycled between 0 and 70°C.
 3. The completed unit shall undergo a fully loaded 24-hour "burn-in".

1.4 SERVICE AND REPLACEMENT PARTS

- A.** The VSD supplier must maintain within two (2) hour drive of service area of site, factory trained service representatives on a permanent basis.

- B. The service support group will provide as a minimum, the following services:
1. Factory coordinated start-up service.
 2. Perform 3 years parts and labor warranty (Note: Warranty response time must be within two (2) hours).
 3. Operation instructions to Owner's maintenance department.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's data on variable frequency drives including types, ratings, capacities, warranties, and performance data. Clearly indicate optional equipment provided.
- B. Provide the following additional information in submittals:
1. Typical efficiency vs. speed graph for variable torque load.
 2. Compliance to IEEE 519 - Harmonic analysis for particular job site including total voltage harmonic distortion and total current distortion.
 - a. The VSD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VSD manufacturer to ensure compliance with IEEE standard 519-1992. Guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to VSD installation.
 - b. Prior to installation, the VSD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VSD's. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provided and the user.
 - c. If the voltage THD exceeds 5%, the VSD manufacturer is to supply the additional equipment required to reduce the voltage THD to an acceptable level.
 - d. VSD's shall have EMI/RFI filters on the line side of the input. The filter will be designed to limit conducted noise to EC second environmental, conducted, and radiated limits.
- C. Shop Drawings: Submit dimensioned drawings of variable frequency drives indicating equipment layout and their spatial relationship to associated equipment.
- D. Maintenance Data: Submit maintenance data indicating required steps of maintenance and repair.
- E. Wiring Diagrams: Submit power and control wiring diagrams for variable frequency drives including connections to power and control panels, and feeders.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver variable frequency drives and accessories individually packaged in factory-fabricated containers.
- B. Handle variable frequency drives carefully to prevent internal component damage, impact, breakage, denting, and scoring enclosure finishes. Do not install damaged variable frequency drives; replace and return damaged units to equipment manufacturer. Store variable frequency drives in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering variable frequency drives which may be incorporated in the work include the following*:

Asea Brown Boveri
Danfoss

*NOTE: AHU or pump manufacturer rebranded drives, which are originally manufactured by the above manufacturers (equal to their own drives), shall also be acceptable.

2.2 VARIABLE SPEED DRIVES

General:

- A. Furnish complete variable frequency VSDs as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VSD enclosure, unless otherwise specified. VSD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VSD's UL listing shall allow mounting in plenum or other air handling compartments. Provide a NEMA 3R enclosure (including Bypass) for plenum and AHU compartment's locations in the airstream and exterior/wet locations.
- B. The VSD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.
- C. With the motor's rated voltage applied to the VSD input, the VSD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VSDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation. The VSD shall include an input full wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- C. The VSD and options shall be tested to ANSI/UL Standard 508. The complete VSD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VSD and option panel, in the case where these are not contained in one panel. Both VSD and option panel shall be manufactured in ISO 9001 certified facilities.
- D. The VSD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VSDs without DC link reactors shall provide a minimum 5% impedance line reactor.
- E. The VSD's full load amp rating shall meet or exceed NEC Table 430-150. The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- F. Each VSD shall include fast-acting current limiting input fuses, input power disconnects, motor overload relay wired to indicate "run" and "fault" conditions. The VSD shall include the following devices door mounted: "auto-manual-off" selection switch, output voltage meter, output current meter and output frequency meter. (NOTE: a single display window may be provided in lieu of meters.)
- G. VSD shall be capable of full interface with facility energy management and control system (coordinate with owner's EMCS vendor prior to bid and include all costs for full interface).
- H. The following basic and self-protective features shall be provided:
 - 1. The current limiter shall be capable of the following: limiting output current to 110% of the inverter rating and shall function automatically to prevent over current trip due to momentary overload conditions. Provide IEEE compliance noise filters.
 - 2. Instantaneous overcurrent trip shall safely limit the output current to 120% of rated current in 50 microseconds or less.
 - 3. Under-voltage trip shall activate automatically when the line voltage drops 10 - 15% below rated input voltage.

4. Overvoltage trip shall occur if voltage levels exceed 10 - 15% of nominal line voltage.
 5. Over temperature trip shall be capable of the following: protect the inverter from elevated temperatures in excess of component rating; an indicator shall illuminate indicating the unit is tripped on over-temperature; when the internal temperature is reduced to an acceptable level, the unit will automatically restart.
 6. Inverter logic shall automatically reset and restart from the above trip conditions upon correction of the trip condition. If restart does not occur after five (5) attempts the inverter shall require manual restart.
 7. LED or LCD Status illuminated readout indication shall be provided for the trip conditions described herein, and as follows:
 - a. Front Panel:
 - 1) Power on.
 - 2) Unit running.
 - 3) Output speed.
 - 4) Drive enable condition.
 - 5) Internal safety trip.
 - 6) External safety trip.
 - 7) Input voltage.
 - 8) KW draw or Amp draw per leg or phase.
 - 9) Bypass status.
 - b. Microprocessor Board:
 - 1) Over current.
 - 2) Low input line voltage.
 - 3) Phase sequence.
 - c. A SPDT contact shall be provided for remote indication of trip condition and drive "run" condition.
 8. Drive logic shall be microprocessor based and shall be isolated from power circuitry. Provide isolated 115-volt control circuit and dedicated control transformer.
 9. In the event of power loss, the unit shall be designed to shutdown safely without component loss or failure. Upon return of power, the unit shall safely restart and return to normal operation.
 10. Inverter shall safely shutdown without component failure if phase-to-phase short circuit or loss of an input phase occurs.
 11. No damage shall occur to the inverter if input or output contactor, disconnect switch, or circuit breaker is opened or closed while control is activated. Prevention of damage on quick shut-off at any speed without lockout to restart from remote location.
 12. To facilitate startup and service, the inverter shall be designed to operate without a motor connected to the inverter.
 13. A "Hand/Off/Auto" switch and manual speed potentiometer with minimum/maximum adjustable speed control and speed override.
 14. A NEMA 1 enclosure (except provide NEMA 3R enclosure for exterior/wet locations).
 15. Linear timed acceleration and deceleration.
 16. 15-65 HZ controller speed range.
 17. Start/stop.
 18. Line-to-line fault protection.
 19. Line-to-ground short circuiting and accidental motor grounding protection.
 20. Insensitive to incoming power phase.
 21. Fast acting current limiting input fuses, rated with 200,000 interrupting amperes capability.
 22. Protection against being adversely affected by radio frequency interference.
 23. Output frequency terminal for remote metering.
 24. Provisions for all EMCS interface points (BACNET).
 25. AC transient protection system consisting of MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- I. The VSD shall have the following adjustments via keypad:
1. Maximum Frequency: 0 - 65 HZ

2. Minimum Frequency: 0 - 65 HZ
 3. Acceleration: Linear 1 to 50 seconds
 4. Deceleration: Linear 1 to 50 seconds
 5. Voltage Boost: 0 to 30 volts.
- J. The VSD shall be designed and constructed to operate within the following service conditions:
1. Ambient temperature range: 0oC to 40oC
 2. Atmosphere: Non-Condensing relative humidity to 95%
 3. A-C Line voltage variation: -5% to +10%
 4. A-C Line frequency variation: +1.8 HZ
- K. Input Control Signal and Interface: Inverter shall be able to respond to input signals 3 analog programmable inputs to accept any of the following 0 - 5-volt DC speed signal, a 0 - 10-volt DC signal, a 4 - 20 ma DC speed signal or a 3 - 15 psig pneumatic speed signal. The unit shall be provided with an input signal offset adjustment to allow zero speed operation from input signals above zero, and an input signal gain adjustment to allow full speed operation from signals which do not reach full nominal control signal.
- L. The single drive bypass system (Electronic Bypass E-Clipse or pre-approved equal) shall consist of an enclosure with:
1. "Drive-Off-Bypass" door mounted selector switch;
 2. Factory UL Listed drive and bypass assembly. The drive and bypass shall be designed with a common back plate and UL labeled with a 100,000 AIC for the entire assembly.
 3. The bypass consists of a main disconnect, drive and bypass contactors, thermal overload relay, 120V transformer with primary and secondary fuses, under voltage and phase loss protection for contactors and relays. The panel shall be constructed of steel.
 4. Drive and Bypass status lights.
 5. VSD and bypass contactors capable of interrupting the locked rotor rating of the motor. Bypass and load contactors must be interlocked to prevent simultaneous closure.
 6. Motor overload relay (to protect motor when operating from the drive and bypass option).
 7. Dedicated terminal strip to allow the unit to be inter-connected with external contacts from energy management controllers and input signals.
 8. One (1) magnetic starter mechanically and electrically interlocked with contactors, bypass controller with separate power supply, and main circuit breaker. Provide reduced voltage starter for motors 15 hp and greater.
 9. The drive/bypass shall provide single-phase motor protection in both the VSD and bypass modes.
- M. The redundant drive bypass system shall consist of an enclosure with:
1. "Hand – Off – Auto" door mounted selector switch.
 2. "VFD 1 – LEAD – VFD 2" door mounted selector switch for drive selection in "Hand" mode. "Lead" selection shall auto-transfer to lag VFD on lead VFD failure; "Lead" selection shall automatically equalize VFD run time. (Only one drive operates at a time.)
 3. Factory UL Listed dual drive assembly in single enclosure. The drives shall be designed with a common enclosure and UL labeled with a 100,000 AIC for the entire assembly.
 4. Single point power connection. Main fusible disconnect switch with thru-door handle mechanism. The bypass consists of a main disconnect, drive and bypass contactors, thermal overload relay, 120V transformer with primary and secondary fuses, under voltage and phase loss protection for contactors and relays. The panel shall be constructed of steel.
 5. Drive status lights.
 5. Redundant VFD contactors capable of interrupting the locked rotor rating of the motor. Contactors must be interlocked to prevent simultaneous closure.
 6. Individually fused for each drive.
 7. Dedicated terminal strip to allow the unit to be inter-connected with external contacts from energy management controllers and input signals.
- N. Control and safety devices shall be interlaced through the bypass controller to provide automatic start-stop capabilities, fire stats and/or smoke detector safety interlocks, other specified

interlocks, and motor current overload protection when the drive is in either the "drive" mode or the "bypass" mode with power disconnected to the VSD.

- O. The VSD shall include all standard control features, including floating point control, provided by the manufacturer.
- P. If the controller causes line notching of more than 16,800-volt micro-seconds or voltage distortion in excess of 5% as defined by IEEE 519-92, A Guide for Harmonic Control and Reactive Compensation of Static Power Converters.
- Q. Where VSD is not in sight of motor being controlled, provide motor disconnect switch with early break contactors to shut down drive prior to motors electrical disconnection. Wire early break contactors into VSD's function loss circuit.
- R. New VSD installation shall not require the addition of different motors for proper VSD operation. The new VSD shall not cause damage to the driven motors.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Installer must examine areas and conditions under which variable frequency drives are to be installed and notify Engineer in writing of those conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF VARIABLE FREQUENCY DRIVES

- A. Install variable speed drives as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that variable frequency drives comply with requirements of NEMA standards and NEC, and applicable portions of NECA's "Standard of Installation", for installation of units.
- B. Install electrical protective devices, for each variable frequency drive.
- C. Provide all hardware necessary to mount drives on brick or block walls, columns or unistrut as required.
- D. Install VSD mounted fan if ambient conditions are such that VSD is not functioning properly due to heat load.

3.3 GROUNDING

- A. Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground, for variable frequency drives equipment as required.

3.4 CLEANING

- A. Touch-up scratched and marred surfaces of equipment to match original finishes; remove dirt and construction debris.

3.5 FIELD QUALITY CONTROL

- A. Upon completion of installation of variable frequency drives, and after circuitry has been energized with rated power source, test variable frequency drives to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance, otherwise remove and replace with new units and proceed with retesting. Submit report of test results.

3.6 TRAINING

- A. Train Owner's maintenance personnel on maintenance and operational procedures. Schedule training at site with Owner. Schedule training with minimum 7 days in advance notice. Notify Engineer in writing as to time and place of training.

END OF SECTION 23 09 70

SECTION 23 21 00 – BASIC PIPING MATERIALS AND METHODS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY:

- A. This Section specifies piping materials and installation methods common to more than one section of Division 23 and includes joining materials, piping specialties, and basic piping installation instructions.

1.3 RELATED SECTIONS:

- A. Division 23 Mechanical Requirements section applies to the work at this Section.
- B. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Divisions 2 and 23.
- C. Valves are specified in a separate section and in individual piping system sections of Division 23.
- D. Supports and Anchors are specified in a separate section of Division 23.
- E. Mechanical Identification is specified in a separate section of Division 23.
- F. Fire Barrier Penetration Seals are specified in Division 7 and/or Section 23 05 12 and Drawings.

1.4 SUBMITTALS

- A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
 - Escutcheons
 - Dielectric Unions and Fittings
 - Mechanical Sleeve Seals
 - Strainers

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Escutcheons:
Chicago Specialty Mfg. Co.
Sanitary-Dash Mfg. Co.
Grinnell
2. Dielectric Waterway Fittings:
Epco Sales, Inc.
Victaulic Company of America
3. Dielectric Unions:
Eclipse, Inc.
Perfection Corp.
Watts Regulator Co.
4. Strainers:
Armstrong Machine Works.
Hoffman Specialty ITT; Fluid Handling Div.
Metraflex Co.
R-P&C Valve; Div. White Consolidated Industries, Inc.
Spirax Sarco.
Trane Co.
Tour and Andersson
Victaulic Co. of America. (Low pressure applications only)
Watts Regulator Co.
5. Mechanical Sleeve Seals:
Thunderline Corp.

2.2 PIPE & FITTINGS

- A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

2.3 JOINING MATERIALS

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

2.4 LEAD SOLDER

- A. Contractor shall be responsible for the removal and replacement of any material used on the project which contains lead solder.
- B. Contractor shall provide a notarized statement addressed to the Owner stating that no lead solder material has been used or installed on the Project. This statement shall be submitted to the Engineer prior to authorization of Final Payment.
- C. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed, and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.5 PIPING SPECIALTIES

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is

insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings as indicated on drawings.

- B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service (i.e., over 80 psi); hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- C. Dielectric Unions: Provide Class 250 dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150-or 300 psig (1035kPa or 2070kPa) minimum pressures to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150-or 300 psig (1035kPa or 2070kPa) minimum working pressure to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling, having inert and non-corrosive, thermoplastic lining, with threaded ends and 300-psig (2070kPa) minimum working pressure at 225°F (107°C) temperature.
- H. Dielectric Nipples: Electroplated steel nipple, having inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070kPa) working pressure at 225°F (107°C) temperature.
- I. Connections between PVC and flanged steel or cast-iron pipe shall be made with a ductile iron bolt-on adaptor flange, equal to Uni-Flange Corp. Series 900.
- J. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin.
- K. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.
 - 1. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.
 - 2. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
 - 3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 - 4. Butt Welded Ends, 2-1/2" and Larger For Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 - 5. Butt Welded Ends, 2-1/2" and Larger For High Pressure Application: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 - 6. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.
- L. Sleeves:
 - 1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
 - 2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

- a. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- b. Sleeves for Copper or Brass Pipe: Same material as pipe.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.2 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Exterior Wall Penetrations: Use steel pipe sleeves for all penetrations smaller than 6" - and 10-gauge sheet metal for all penetrations over 6".
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Exterior Wall Penetrations (Sleeve Seals): Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Refer to Division 7 and Section 230512 for special sealers and materials.

3.3 FITTINGS & SPECIALTIES

- A. Use domestically manufactured fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

- D. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- E. Install Weld-Neck Flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
- F. Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.
- G. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).
- H. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.4 JOINTS

A. Steel Pipe Joints:

- 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- 2. Pipe Larger Than 2":
 - a. Weld pipe joints in accordance with ANSI/AWS D10/12 - 89, Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.
 - b. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets.
 - c. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:

- 1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0 - Standard Code for Pressure Piping, Power Piping and ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration.
- 2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- 3. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Joints for other piping materials are specified within the respective piping system sections.

3.5 FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

END OF SECTION 23 21 00

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes piping systems for hot water heating, chilled water cooling, condenser water, make-up water for these systems, blow down drain lines, and condensate drain piping. Piping materials and equipment specified in this Section include:

- Pipes, fittings, and specialties
 - Special duty valves
 - Hydronic specialties

1.2 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.3 SUBMITTALS

- A. Product Data, including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.
- B. Furnish flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer's testing.
- C. Maintenance Data for hydronic specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 23, Section "Basic Mechanical Requirements".
- D. Welders' certificates certifying that welders comply meet the quality requirements specified in Quality Assurance below. Certificates must be current (within the last 12 months) and pertain to the type and position of welds required in the Work.
- E. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.
- F. Reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
 - 3. ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators
 - 4. 2023 Florida Building Code, 8th Edition

1.5 SEQUENCING & SCHEDULING

- A. Coordinate the size and location of equipment supports with other trades.
- B. Coordinate the installation of pipe sleeves for foundation, floor, and wall penetrations.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:

Pre-Insulated Piping Systems:

Perma Pipe
Thermacor
Thermal Pipe Systems

Calibrated Globe Balancing Valves:

Armstrong, Inc.
Tour and Anderson
Mepco

Calibrated Plug Valves and Balancing Valves:

Bell & Gossett ITT; Fluid Handling Div.
Taco, Inc.
Griswold

Air Vents (manual and automatic):

Armstrong Machine Works.
Bell & Gossett ITT; Fluid Handling Div.
Hoffman Specialty ITT; Fluid Handling Div.
Spirax Sarco.

Y-Pattern Strainers:

Armstrong Machine Works.
Hoffman Specialty ITT; Fluid Handling Div.
Metraflex Co.
Spirax Sarco.
Trane Co.
Victaulic Co. of America.
Watts Regulator Co.

2.2 CHILLED/HOT WATER PIPING

- A. General: Where more than one piping product is listed for a system, the contractor shall provide material to match field piping (i.e. black steel to existing black steel and copper to existing copper).
- B. Above Ground, Pipe Size 10" and Smaller: Schedule 40 black steel ASTM A53 seamless or ERW pipe with class 150 malleable-iron threaded fittings for 2" and under, butt welded fittings for over 2". Elbows 2-1/2" and larger to be long radius. Weld-o-lets may be used on pipes 3" and smaller in lieu of tees.
- C. Above Ground, Pipe size 2" and Smaller: Type 'L' hard drawn copper ASTM B42 with wrought copper solder joint fittings.
- D. Above Ground, Pipe Size 12" and Larger: Standard weight black steel ASTM A53 seamless or ERW pipe with butt welded fittings; elbows to be long radius.

2.3 CONDENSATE DRAIN PIPING

- A. Type "L" copper with wrought copper or cast brass solder joint fittings. Provide cleanout at all changes of direction. Piping shall be supported at 5' intervals and pitched for complete drainage.

2.4 FITTINGS

- A. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing.

Material Group: 1.1.

End Connections: Butt Welding.

Facings: Raised face.

- B. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250°F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4" misalignment.

2.5 JOINING MATERIALS

- A. Solder Filler Metals: 95-5 tin-antimony for condenser water, chilled water, and make-up water and drain piping.
- B. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.
- D. Wrought – Copper Fittings: ANSI B16.22, streamlined pattern.

2.6 GENERAL DUTY VALVES

- A. General duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 23 Section "Valves". Special duty valves are specified below by their generic name; refer to Part 3, Article "VALVE APPLICATION", for specific uses and applications for each valve specified.

2.7 SPECIAL DUTY VALVES

- A. Calibrated Balancing Valves: 125 psig water working pressure, 250°F maximum operating temperature, bronze body, globe valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2" and smaller shall have threaded connections and 2-1/2" valves shall have flanged connections.

2.8 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 225°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8" discharge connection and 1/2" inlet connection.

PART 3 – EXECUTION

3.1 PIPING INSTALLATIONS

- A. Use fittings for all changes in direction and all branch connections. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- B. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- C. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

- D. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- E. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Refer to drawing details.
- F. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.
- G. Smoke Tight Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, seal all around pipe to maintain smoke tight rated integrity.
- H. Install piping at a uniform grade of 1" in 40' toward all drain points.
- I. Install manual air vents at the high points in piping system.
- J. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
- K. Install unions in pipes 2" and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- L. Install dielectric unions to join dissimilar metals.
- M. Install flanges on valves, apparatus, and equipment having 2-1/2" and larger connections.
- N. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.
- O. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated.
- P. Install nipple and ball valve in blow down connection of strainers 2" and larger.
- Q. Anchor piping to ensure proper direction of expansion and contraction.

3.2 HANGERS & SUPPORTS

- A. General: Hanger, supports, and anchors devices are specified in Division 23, Section 232529.

3.3 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

3.4 CAUTION:

- A. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
- B. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
- C. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
- D. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
- E. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

- F. Align threads at point of assembly.
- G. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- H. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
- I. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- J. Welded Joints: Comply with the requirement in ASME Code B31.9-"Building Services Piping."
- K. Flanged Joints: Align flanges surfaces parallel. 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 using torque wrench.

3.5 VALVE APPLICATIONS

- A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
- B. Shut-off duty: Use gate, ball, and butterfly valves.
- C. Throttling duty: Use globe, ball, and butterfly valves.
- D. Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- E. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.
- F. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.

3.7 FIELD QUALITY CONTROL

- A. Preparation for Testing: Prepare hydronic piping in accordance with ASME B31.1 and B31.9 and as follows:
- B. Leave joints including welds uninsulated and exposed for examination during the test.
- C. Flush system with clean water. Clean strainers.
- D. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
- E. Install relief valve set at a pressure no more than one-third higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.
- F. Testing: Test hydronic piping as follows:
- G. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

- H. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.
- I. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated.
- J. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
- K. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. If 1.5 times the design pressure is less than 100 psi, pressure test shall be performed at a minimum of 100 psi, per FBC Mechanical 1208.1. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code For Pressure Piping, Building Services Piping.
- L. After the hydrostatic test pressure has been applied for at least 2 hours with no loss in pressure, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
- M. A final Leak Detection Panel Test is required with the Owner's representative present, along with the Contractor and the pre-insulated pipe manufacturer's Field Service Representative.

3.8 ADJUSTING & CLEANING

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- B. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

3.9 COMMISSIONING

- A. Fill system and add chemical treatment. Coordinate with Owner for chemical treatment requirements specific to system equipment.
- B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
- D. Open valves to full open position.
- E. Remove and clean strainers.
- F. Check pump for proper direction of correct improper wiring.
- G. Set automatic fill valves for required system pressure.
- H. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- I. Set temperature controls so all coils are calling for full flow.
- J. Check operation of automatic bypass valves.
- K. Check and set operating temperatures of chillers to design requirements.

L. Lubricate motors and bearings.

3.10 PAINT

A. See "Paint" requirements in Specification Section 230512.

END OF SECTION 23 21 13

SECTION 23 25 29 – HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.2 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- B. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
 - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic cement-type grout that is non-staining, non-corrosive, non-gaseous and is recommended for both interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
 - 3. Water: Potable.
 - 4. Packaging: Premixed and factory-packaged.

PART 3 – EXECUTION

3.1 HANGER & SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER & SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20' in length.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal runs 20' or longer.
 - 3. Pipe roller complete – MSS Type 44 for multiple horizontal runs, 20' or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.

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D. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	3/8
2-1/2	11	9	1/2
3	12	10	1/2
3-1/2	13	11	1/2
4	14		5/8
5	15		5/8
6	15		3/4
8	15		7/8
10	15		7/8
12	15		7/8
14	15		1
16	15		1
18	15		1-1/4
20	15		1-1/4
24	15		1-1/2
30	15		1-1/2

- E. Support vertical steel pipe and copper tube at each floor.
- F. Support plastic pipe and tubing in accordance with manufacturer's recommendations.
- G. Install Cast-Iron Pipe with piping supports located at end of each length of pipe in horizontal lines, at each bend, and vertical supports at maximum intervals of 14'. Locate supports near couplings, not in center of pipe.
- H. Install supports with maximum spacing complying with MSS SP-69.
- I. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- J. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- K. Install concrete inserts in new construction prior to placing concrete.
- L. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4" (100 mm) thick.
- M. Install mechanical anchor fasteners in concrete after concrete is placed and completely cured.
- N. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4" (100 mm) thick.
- O. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- P. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- Q. Support fire protection systems piping independent of other piping.
- R. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- S. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- T. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- U. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
¼ to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

Pipes 8" and Larger: Include wood inserts.

Insert Material: Length at least as long as the protective shield.

Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor. Refer to Drawing Details (and Architectural Drawing/Spec's) for roof supports.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Also, refer to Section 230512 for painting requirements.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 FIELD QUALITY CONTROL

- A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 23 25 29

SECTION 23 31 00 – DUCTWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 00 and 01 Specification Sections, apply to this Section.
- B. Requirements of Division 23 Sections apply to this section (including, but not limited to):
 - 1. Basic Mechanical Requirements
 - 2. Basic Mechanical Materials and Methods

1.2 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2" to plus 10" water gage.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 23 Section "Mechanical Insulation" for exterior duct and plenum insulation.
 - 2. Division 23 Section "Duct Accessories" for flexible duct materials, dampers, duct-mounted access panels and doors, and turning vanes.
 - 3. Division 23 Section "Air outlets and Inlets."
 - 4. Division 23 Section "Testing, Adjusting, and Balancing."
 - 5. Division 25 Section "Controls" for automatic volume control dampers and operators.

1.3 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
- B. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
- C. Joints: Joints include girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.
- B. The duct system shall be tested for leakage in accordance with SMACNA HVAC Duct Leakage Test Manual – Latest Edition. Medium pressure duct (i.e. ductwork upstream of VAV boxes) shall meet Class 6 requirements (rectangular) or Class 3 (round).
- C. Construct, Secure and Support Exterior Ductwork to Comply with FBC Wind Loads.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

Sealing Materials
Fire-Stopping Materials

- C. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in Section 23 05 10, Section "Basic Mechanical Requirements".
- D. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 05 10, Section "Basic Mechanical Requirements" and Division 01.
- E. Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 23 Section "Basic Mechanical Requirements" and Division 01.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

PART 2 – PRODUCTS

2.1 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts – Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass fiber (minimum (R-6), 1" thick in conditioned areas, 1-1/2" thick in non-conditioned spaces) insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in the inner liner.
 - 2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fiber glass tape, and nylon hanging cord.
 - 3. Inner Liner: Polyethylene film.
- C. Acoustical Medium Pressure Flexible Duct:
- D. Provide where indicated on drawings Flexmaster (or approved equal) Type 8M UL181 Class 1 Air Duct.
- E. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel.
- F. The internal working pressure rating shall be at least 10" w.g. positive and 4" w.g. negative with a bursting pressure of at least 2 ½ times the working pressure.
- G. The duct shall be rated for a velocity of at least 4000 feet per minute.
- H. The duct must be suitable for continuous operation at a temperature range of -20°F to +250°F.
- I. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:
 - 1. The insertion loss (dB) of a 10-foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	7	31	40	38	40	27
8" Diameter	13	29	36	35	38	22
12" Diameter	21	28	29	33	26	12

2. The radiated noise reduction (dB) of a 10-foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	5	8	7	8	11	15
8" Diameter	10	7	7	8	10	13
12" Diameter	9	6	6	5	9	13

3. The self generated sound power levels (LW) dB re 10^{-12} watt of a 10-foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed.

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	42	31	23	18	17	21
8" Diameter	41	34	27	19	18	21
12" Diameter	54	45	38	31	27	23

- J. Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least $R=6.0$ at a mean temperature of 75°F.

- K. Cover the insulation with a fire-retardant metalized vapor barrier jacket reinforced with cross-hatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

- L. Manufacturers Flexible Duct Connectors:

Clevaflex
Genflex type
Wiremold
Flexmaster

2.2 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged, and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

- C. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless-steel ducts provide reinforcing of compatible materials.
- D. Tie Rods: Galvanized steel, 1/4" minimum diameter for 36" length or less; 3/8" minimum diameter for lengths longer than 36".

2.3 SEALING MATERIALS

- A. Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FSTT-S-001657, Type I; formulated with a minimum of 75% solids; High Pressure Sealant.
- B. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O, high pressure sealant.

2.4 FIRE STOPPING

- A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - Dow Corning Fire Stop Sealant; Dow Corning Corp.
 - 3M Fire Barrier Caulk CP-25; Electrical Products Div./3M.
 - RTV 7403; General Electric Co.
 - Fyre Putty; Standard Oil Engineered Materials Co.

2.4 HANGERS & SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4" thick.
- B. Hangers: Galvanized sheet steel, or round, steel, threaded rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform to Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2.5 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
- B. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

- C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- D. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 - 1. Supply Ducts Upstream of Terminal Boxes: 8" water gage, positive.
 - 2. Supply Ducts Downstream of Terminal Boxes: 4" water gage, positive.
 - 3. Return Ducts: 4" water gage, negative pressure.
 - 4. Exhaust Ducts: 2" water gage, positive and negative.
 - 5. Outside Air Ducts: 4" water gage, positive and negative.
- E. Cross-breaking or Cross Beading: Cross-break or bead duct sides that are 19" and larger and are 20 gage or less, with more than 10 sf. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard."

2.6 RECTANGULAR DUCT FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.
- B. Double Wall Rectangular (Insulated) Ducts & Fittings: Duct is of galvanized steel construction, double-wall with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions. Double Wall Duct shall be manufactured by McGill Airflow's K-27 or approved equal.
 - 1. Thermal Conductivity: 0.27 Btuh/sq. ft./deg F/inch thickness at 75°F mean temperature.
 - 2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Appearance of outer shell shall be as "clean" as possible for exposed view by occupants.
 - 3. Insulation: Unless otherwise indicated, provide 1-inch-thick, 1.5 # density fiberglass insulation. Provide insulation ends where internally insulated duct connects to single wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
 - 4. Solid Inner Liner: Construct inner liners with solid sheet metal with sealed seams.
 - 5. Maintain clearance of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.
 - 6. Turning vanes: Provide turning vanes in all 90° Elbows.
 - 7. System Pressure Classification: Material thickness from galvanized steel shall be in accordance with SMACNA'S HVAC Duct Construction Standards for 4"+ water gauge pressure. Provide stiffeners and reinforcement as required.
 - 8. Joint Sealing: Pittsburgh lockseam construction with TDC end connectors and gaskets. The system tightness shall be factory warranted to meet SMACNA's Leakage Class 6 Performance.
 - 9. Painting: Prime and paint duct & fittings. Color selected by Architect.

2.7 ROUND DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct. Except where interrupted by fittings, provide round in lengths not less than 12'.
- B. Round Ducts: Provide round supply and return ducts and fittings as indicated with spiral lock-seam construction, except for diameters greater than 72". Use longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.
- C. System Pressure Classifications: Refer to rectangular duct fabrication for minimum pressure applications.
- D. Note: Snap-lock duct is Prohibited.

2.8 ROUND FITTINGS FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
 - 1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
 - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
 - b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2" to 10":
 - 3 to 14": 24 gage.
 - 15 to 26": 22 gage.
 - 27 to 50": 20 gage.
 - c. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.
 - 2. Round Elbows - 8" and Smaller: Die-formed elbows for 45° and 90° elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or ½" diameter (e.g. 3-1/2" and 4-1/2") elbows with gored construction.
 - 3. Round Elbows - 9 Through 14": Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or ½-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
 - 4. Round Elbows - Larger Than 14" Elbows: Gored elbows, except where space restrictions require a mitered elbow.
 - 5. Die-Formed Elbows for Sizes Through 8" and All Pressures: 20 gage with 2-piece welded construction.
 - 6. Round Gored Elbows Gages: Same as for non-elbow fittings specified above.
 - 7. Pleated Elbows Sizes Through 14" and Pressures Through 10": 26 gage.
- D. System Pressure Classifications: Refer to rectangular duct fabrication for minimum pressure applications.
- E. Double-Wall Round (Insulated) Ducts & Fittings: Duct is of spiral lock-seam construction, double-wall with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions. Double Wall Duct with push joint fittings shall be manufactured by Lindab or approved equal.
 - 1. Thermal Conductivity: 0.26 Btuh/sq. ft./deg F/inch thickness at 75°F mean temperature.
 - 2. Outer Shell: Base outer shell gage on actual outer shell dimensions.
 - 3. Insulation: Unless otherwise indicated, provide 1-inch-thick, 1.5 # density fiberglass insulation. Provide insulation ends where internally insulated duct connects to single wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
 - 4. Solid Inner Liner: Construct inner liners with solid sheet metal.
 - 5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from

- dislocation by mechanical means.
6. System Pressure Classification: Material thickness from galvanized steel shall be in accordance with SMACNA'S HVAC Duct Construction Standards for 10"+ water gauge pressure.
 7. Joint Sealing: Fitting ends shall be equipped with factory installed double-lipped, U-profile gaskets. The system tightness shall be factory warranted to meet SMACNA's Leakage Class 3 Performance.
 8. Painting: Prime and paint duct & fittings. Color selected by Architect.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Flexible duct runs shall be a maximum of 6' and shall be supported every 3' with minimum 1 1/2" strap. Maximum permissible sag is 1/2" per foot.
- B. Flexible duct connections shall include 3 wraps of approved tape and stainless-steel draw band. Insulation jacket shall be sealed with 3 wraps of approved UL 181B tape.
- C. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- D. Seal ALL duct seams, joints, etc with generous coating of High-Pressure Duct Sealant (except double wall duct which shall be sealed with push joints or other means for "clean finished" look).
- E. Install ducts with the fewest possible joints.
- F. Use fabricated fittings for all changes in directions, changes in size and shape, and connections. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel, and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Provide clearance of 1" where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- J. Install insulated ducts with 1" clearance outside of insulation.
- K. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- L. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- N. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".

3.2 HANGING & SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.
- B. Support horizontal ducts within 2' of each elbow and within 4' of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16' and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding one fourth of the failure (proof test) load but are not limited to the specific methods indicated.
- E. Install concrete insert prior to placing concrete.
- F. Install powder actuated concrete fasteners after concrete is placed and completely cured.
- G. Provide all supplemental steel as required to support new ductwork. Comply with SMACNA HVAC Duct Construction Standards and Manufacturer's recommendations.
- H. All Exterior Ductwork shall be fabricated, supported, and secured to comply with FBC Wind Loads.

3.3 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Duct Accessories".
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.
 - 1. Note: Branch Take-Off's shall have a 1 inch gasketed flange collar. Spin-in collars are NOT acceptable.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.
- D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.
- E. Double Wall Duct Connections: Shall comply with MFR's Requirements and SMACNA "HVAC Duct Construction Standards." Connections between single wall duct and double wall duct shall be done in such a way that no exposed insulation is in the airstream. Overlap insulation work as required to prevent duct sweating.
- F. Double Wall Insulated Duct: Shall be used for all exposed to view duct.
- G. Flexible Duct: Maximum length shall be eight (8) feet.

3.4 FIELD QUALITY CONTROL

- A. The Contractor will contract with an independent testing agency to perform, record, and report leakage tests in the presence of the Engineer.
- B. Remake leaking seams and joints as required and apply sealants to achieve specified maximum allowable leakage.

3.5 ADJUSTING & CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 23 31 00

SECTION 23 33 00 – DUCT ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 00 and 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Flexible Connections
 - 2. Manual Volume Control Dampers
 - 3. Fire Dampers
 - 4. Fire/Smoke Dampers & Smoke Dampers
 - 5. Turning Vanes
 - 6. Duct-Mounted Access Doors and Panels
 - 7. Accessories Hardware
 - 8. Duct Silencers
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 23 Section "Air Outlets and Inlets" for diffusers, registers, and grilles.
 - 2. Division 23 Section "Air Terminals" variable air volume units.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Manual volume control dampers.
 - 2. Fire dampers.
 - 3. Duct-mounted access panels and doors.
- C. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:
 - 1. Special fittings and volume control damper installation (both manual and automatic) details.
 - 2. Fire damper installations, including sleeves and duct-mounted access door and panel installations.
- D. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels, and airflow performance data, static pressure loss, and dimensions and weights.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 80, "Standard for Fire Doors and Other Opening Protective's"
 - 2. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 – PRODUCTS

2.1 FLEXIBLE CONNECTIONS

- A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric (or as required for duct pressure classification) crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and capable of absorbing vibrations of connected equipment.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering flexible connections which may be incorporated in the work include, but are not limited to, the following:

American/Elgen Co.; Energy Div.
Duro Dyne Corp.
Flexaust (The) Co.
Ventfabrics, Inc.

2.2 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking quadrant device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft, which must extend through insulation.
- B. Standard Volume Control Dampers: Multiple-blade, opposed-blade design (20 gauge) as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications. Blades shall not exceed 6" and shall be selected for fit in each specific application. Select and install damper for easy access to manual operator.
 1. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 18 gage, and with mitered and welded corners.
 2. Provide flangeless frames where indicated for installation in ducts.
 3. Roll-Formed Steel Blades: 20-gage galvanized steel.
 4. Blade Axles: Galvanized steel.
 5. Tie Bars and Brackets: Galvanized steel.

2.3 FIRE DAMPERS

- A. General: Provide fire dampers for all fire rated partitions, walls, and floors as defined by the Architectural drawings and specifications. For renovation projects, contractors shall field verify existing conditions prior to submitting their bids. Fire dampers shall be UL labeled according to UL Standard 555 "Standard for Fire Dampers."
- B. Fire Rating: 1-1/2 hr. for 1 hr. and 2 hr. rated walls and 3 hr. for 3 hr. and 4 hr. rated walls as indicated by the fire rating of the wall to be penetrated. Refer to architectural drawings.
- C. Frame: Type B; with frame and retracted blades outside of airstream fabricated with roll-formed, 21-gage, galvanized-steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory-installed or field-installed galvanized steel. Breakaway connections shall be utilized. Rigid connections require specific approval by the Engineer.
 1. Minimum Thickness: 20 gauge for ducts 84" wide and smaller. Sleeve gauge shall in no case be less than the connecting ducts.

- 2. 18 gauge for ducts 85" wide and larger.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 21-gage galvanized steel. In place of interlocking blades, provide full-length, 21-gage, galvanized-steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless steel negator closure spring.
- H. Fusible Link: Replaceable, 165 deg F.
- I. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include the following:
 - Air Balance, Inc.
 - American Warming and Ventilating, Inc.
 - Arrow Louver and Damper; Div. of Arrow United Industries Inc.
 - Louvers and Dampers, Inc.
 - Penn Ventilator Co.
 - Phillips-Aire.
 - Ruskin Mfg. Co.
- J. Motor Driven Fire/Smoke Dampers & Smoke Dampers: Provide motor-driven fire/smoke dampers and smoke dampers (damper and actuator must comply with UL 555, UL 555S and NFPA 90A) in types and sizes indicated, with frame constructed with minimum 16 gage galvanized steel, and factory supplied sleeve constructed of 20 gage galvanized steel for dampers 84" wide or smaller and 18 gage galvanized steel for dampers 85" and up (except, sleeve gage must be at least equal to the gage of the duct) with bonded red acrylic enamel finish, fusible link 160 to 165°F (71 to 74 deg. C), unless otherwise indicated, for fire dampers, and steel inter-locking blades, with electric motor equipped with instant closure clutch (i.e. power to open, spring closed), stainless steel cable damper blade linkage, motor mounting bracket, and 32" long wire leads for connecting to smoke detector, and with the following construction feature:
- K. Unit Assembly: Motor mounted outside air stream. 120-1-60 (Coordinate prior to Bidding and Ordering with electrical & fire alarm subcontractors).
- L. Fire/Smoke damper and smoke damper must be fully operational while HVAC system is in operation.
- M. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to, the following:
 - Air Balance, Inc.
 - American Warming & Ventilating, Inc.
 - Arrow Louver and Damper; Div. of Arrow United Industries Inc.
 - Louvers and Dampers, Inc.
 - Penn Ventilator Co.
 - Phillips-Aire.
 - Ruskin Mfg. Co.

2.4 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Manufactured Turning Vanes: Fabricate of 1 ½" wide, curved blades set at ¾" in center, support with bars perpendicular to blades set at 2" on center and set into side strips suitable for mounting in ducts.

2.5 DUCT-MOUNTED ACCESS DOORS & PANELS

- A. General: Refer to the Access Door Materials Schedule at the end of this Section for frame and door thickness, number of hinges and locks, and location of locks. Provide construction and airtightness suitable for duct pressure class.
- B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of hinges and locks as indicated for duct pressure class. Provide vision panel where indicated. Provide 1" by 1" butt hinge or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.
- E. Insulation: 1" thick fiber glass or polystyrene foam board.

2.6 ACCESSORIES HARDWARE

- A. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4", zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

2.7 ABSORPTIVE SILENCERS

- A. General Specification: Furnish and install Silencers of the sizes, configuration and performance as described on plans and silencer schedules. Silencer inlet and outlet connections shall be equal to the duct sizes shown on the drawings. Duct transitions shall be provided by the Contractor and are not permitted unless shown on the drawings and approved by the Engineer. If discrepancies between the suggested specifications and the silence schedule occur, the latter takes precedence.
- B. Performance: Silencer performance characteristics, including insertion loss, pressure drop, and generated noise, shall be attained through testing in accordance with the latest ASTM E477 test standard for acoustical duct silencers.
- C. Submittal: Manufacturer's performance data for dynamic insertion loss, generated noise, and pressure drop shall be provided and shall be obtained in accordance with ASTM E477-13. Data for each scheduled silencer shall be provided with the size, configuration, air volume, and air flow direction as it appears on the drawing and / or schedule.
- D. Construction: Absorptive Silencers shall consist of solid steel casings, perforated sheet metal liners, absorptive acoustic fiberglass media, and fiberglass cloth. Construction gauges indicated are a minimum for Galvanized Steel-Stainless Steel or Aluminum gauges shall be adjusted accordingly.
- E. Absorptive Rectangular Silencers: As scheduled.
- F. Absorptive Elbow Silencers: As scheduled.
- G. High Transmission Loss 1: 16 ga galvanized casing 22 ga galvanized perforated liner.
- H. Acoustic Media: Refer to Silencer Schedule on drawings for Media requirements.
- I. Combustion Ratings: Acoustic media shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL723, and NFPA255.
- J. Flame Spread Classification: < 25.
- K. Smoke Development Rating: < 50.
- L. Absorptive Silencer manufacturers include Price, Vibro-Acoustics, or pre-approved equal.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.
- B. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- C. Install fire dampers and smoke dampers according to the manufacturer's UL approved printed instructions.
- D. Provide access doors in ductwork and in hard ceilings for maintenance of fire dampers, smoke dampers and fire/smoke dampers, damper operators, etc.
- E. Install fusible links in fire dampers. Demonstrate to Engineer access and replacement of fusible links; adjust duct size, access door size (note min 12"x12" but larger size shall be used to improve ease of access) and placement, duct configuration, etc as required for ease of maintenance and access of fire dampers and linkages.
- F. Fire and Fire/Smoke Dampers: Install properly rated damper in rated construction as required to maintain rating of construction.
- G. Activation of the fire alarm panel shall close all smoke dampers and immediately shutdown associated AHU(s). Smoke Damper shall open automatically upon restoration of the fire alarm "all clear" signal. Smoke Dampers shall open automatically upon restoration of building power. Coordinate the wiring of the smoke damper and combination fire/smoke damper with the Fire Alarm Contractor accordingly.
- H. Label access doors according to Division 23 Section "Mechanical Identification" and NFPA 80, NFPA 101 and FBC Mech, Ch 6, with letters min 1/2" high.
- I. Install electric duct heater in strict accordance with manufacturer's instructions and NEC, FBC, and UL requirements

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

ACCESS DOOR MATERIALS SCHEDULE

DUCT PRESSURE CLASS	DOOR SIZE INCHES	NUMBER OF HINGES	NUMBER OF LOCKS	METAL GAUGE		
				FRAME	DOOR	BACK
2 INCHES & LESS*	12X12	2	1-S	24	26	26
	16x20	2	2-S	22	24	26
	24X24	3	2-S	22	22	26
3 INCHES*	12X12	2	1-S	22	22	26
	16X20	2	1-S,1-T,1-B	20	20	26
	24X24	3	2-S,1-T,1-B	20	20	24
4 TO 10** INCHES	12X12	2	1-S,1-T,1-B	20	20	26
	16X20	3	2-S,1-T,1-B	20	18	24
	24X24	3	2-S,2-T,2-B	18	18	24

S: SIDE

T: TOP

B: BOTTOM

*NOTE: Ruskin M#ADH-24 or pre-approved equal.

**NOTE: Ruskin M#ADH-24HP or pre-approved equal.

END OF SECTION 23 33 00

SECTION 23 34 00 - EXHAUST FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 00 and 01 Specification Sections, apply to this Section.
- B. Requirements of Division 23 Sections apply to this section (including, but not limited to):
 - 1. Basic Mechanical Requirements
 - 2. Basic Materials and Methods

1.2 SUMMARY

- A. This Section includes the following types of air-handling units:
 - 1. Inline Centrifugal Fans
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 25 Section "Integrated Automation" (Multiple Sections).
 - 2. Division 26 Section "Disconnects and Enclosed Circuit Breakers" for disconnect switches and motor starters.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product data for selected models, including specialties, accessories, and the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound power ratings.
 - 3. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 4. Materials gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- D. Coordination drawings, in accordance with Division 23 Section "Basic Mechanical Requirements," for fan room layouts, and reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
 - 1. Roof and wall framing and support members relative to duct penetrations.
 - 2. Ceiling suspension members.
 - 3. Method of attaching hangers to building structure.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
- F. Product certificates, signed by manufacturers of air-handling units, certifying that their products comply with specified requirements.
- G. Maintenance data for air-handling units, for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 23 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

- A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."
- B. UL Compliance: Fans and components shall be UL listed and labeled.
- C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of equipment supports.
- B. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to, the following:
 - 1. Centrifugal Roof Ventilators:
 - Cook (Loren) Co.
 - Greenheck Fan Corp.
 - Penn Ventilator Co.

2.2 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required:
 - 1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
 - 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.3 FANS, GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

- B. Fans: Statically and dynamically balanced per AMCA Standard 204-05 and designed for continuous operation at the maximum rated fan speed and motor horsepower. Wheel shall be centrifugal, backward inclined, constructed of 100% aluminum, with precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone.
- C. Motors: Motor shall be an electronically commutated motor (ECM) rated for continuous duty and furnished with leads. Motor leads shall connect to manufacturer provided 0-10VDC external speed controller. Coordinate with Control Vendor prior to Bid and provide interface for building controls (refer to Control Sequences and Schematics).
- D. Dampers: Provide with gravity backdraft dampers, either integral to fan outlet or installed in duct, downstream of fan.
- E. Factory Finish: The following finishes are required:
 - 1. Sheet Metal Parts: Prime coating prior to final assembly.
 - 2. Exterior Surfaces: Hot-dipped galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated and/or shown.
 - 1. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
 - 2. Arrange installation of units to provide access space around air- handling units for service and maintenance.

3.3 CONNECTIONS

- A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- B. Electrical Connections: The following requirements apply:
 - 1. Electrical power wiring is specified in Division 26.
 - 2. Temperature control wiring and interlock wiring are specified in "Integrated Automation".
 - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:
 - 1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
 - 2. Prepare a written report on findings and recommended corrective actions.

3.5 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.

- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 COMMISSIONING

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - 1. Remove shipping blocking and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connection for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations.
 - 5. Lubricate bearings and other moving parts with factory-recommended lubricants.
 - 6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
 - 7. Disable automatic temperature control operators.
- B. Starting procedures for fans:
 - 1. Energize motor: verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor electrical values for voltage and amperage.
- C. Shut unit down and reconnect automatic temperature control operators.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.7 DEMONSTRATION

- A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:
 - 1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
 - 2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 01 Section "Project Closeout" and Division 23 Section "Basic Mechanical Requirements."
- B. Schedule training with at least 7 days advance notice.

END OF SECTION 23 34 00

SECTION 23 36 00 – VAV AND CV AIR TERMINALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of air terminals work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of air terminals specified in this section include the following:
 - 1. Variable Air Volume Terminals
 - 2. Constant Volume Air Terminals
- C. Refer to other Division 23 sections for testing, adjusting and balancing of air terminals; not work of this section.
- D. Refer to other Division 25 sections for temperature controls which are to be furnished by others but installed as work of this section.
- E. Refer to Division 26 sections for the following work; not work of this section.
- F. Power supply wiring from power source to power connection on air terminals. Include disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
- G. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:
- H. Control wiring between field-installed controls and air terminals.
- I. Control wiring specified as work of Division 25 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ADC Compliance: Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.
 - 2. ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.
 - 3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems."

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location,

number furnished, model number, size, and accessories furnished; and installation and start-up instructions. **Sizes shall not exceed physical dimensions of the Basis of Design.**

- B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit ladder type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
- D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver air terminals wrapped in factory fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.
- B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide air terminals of one of the following:
 - 1. Enviro-Tech, Environmental Technologies, Inc.
 - 2. Price Industries
 - 3. Titus
 - 4. Trane (The) Co.

2.2 AIR TERMINALS

- A. General: Provide factory fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.
- B. Variable Air Volume Terminal Casings: Construct of galvanized, double-wall sheet metal of the following minimum thicknesses:
- C. Upstream Pressure Side: Steel 22 - ga.
- D. Downstream Pressure Side: Steel 22 - ga.
- E. Provide hanger brackets for attachment of supports.
- F. Standard Height Variable Air Volume Terminal Double-wall Insulated Construction: VAV Terminal shall have double-wall construction with internal insulation material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1" and a minimum density of 1.5-pound fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements, ASTM E 84, UL 723 and UL 181 Standards. The insulation shall be covered with 22 gage galvanized steel. There shall be no exposed edges of insulation (complete metal encapsulation).
- G. Low-Profile Variable Air Volume Terminal Double-wall Insulated Construction: VAV Terminal shall have double-wall construction with internal insulation material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 3/4" and a minimum density of 1.5-pound fiberglass insulation.

Insulation shall be UL listed and meet NFPA 90A requirements, ASTM E 84, UL 723 and UL 181 Standards. The insulation shall be covered with 22 gage galvanized steel. There shall be no exposed edges of insulation (complete metal encapsulation).

- H. VAV Box (including Heating Coil) shall not impose a total pressure loss in excess of 0.3" w.g. at design CFM (or as scheduled, whichever is less). VAV boxes shall also be selected for a maximum velocity of 2000 fpm at the orifice and not exceeding discharge sound levels and radiated sound levels of NC 30. Provide sound data in accordance with ADC 1062 and ISO 3741.
- I. Air Valve/Damper: Shall consist of minimum 22-gauge cylindrical body (18 ga damper) that includes embossment rings for rigidity (or rectangular inlet for Low Profile VAV Boxes). Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. The **solid metal** shaft shall include a damper position indicator visible from the exterior of the unit. Provide maximum volume dampers, pressure independent, that are calibrated in CFM, factory adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru valve for minimum to maximum, in response from signal from thermostat/temperature sensor. Air valve leakage shall not exceed 1% of maximum inlet rated airflow at 4" w.g. inlet pressure.
- J. Velocity Sensor: Provide velocity pressure pick-up devices, hereafter referenced as sensors. Sensors with a single pick-up point are unacceptable. Air flow sensors shall be multiple point two dimensional, or multiple point, averaging flow sensing ring.
 - 1. Provide calibration chart affixed to the side of each box for calibration of pressure differential to CFM.
 - 2. Coordinate power requirements with Division 26.
- K. Controls: Provide electric operators (24 volts) installed at the factory. Motors shall be bi-directional devices for 24 volts + ON (clockwise) direction, 24 volts - ON (Counter-clockwise) direction and maintain position with power removed from operator. Provide 24-volt transformer.
 - 1. Install electric powered controls, compatible with electric temperature "Controls" Specification Section(s). Coordinate with controls contractor furnishing control modules.
- L. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjustment, or maintenance. Bottom access panels are unacceptable.
- M. Leakage: Construct casings such that when subjected to 3.0 in w.g. pressure for high pressure ducts, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0-in w.g. inlet pressure with damper closed, total leakage does not exceed 10% of specified air flow capacity.
- N. Identification: Provide label on each unit indicating Plan Number, CFM range, CFM factory-setting, and calibration curve (if required).
- O. ~~Electric Heating Coils: Provide heating coils constructed of electric resistance elements in galvanized steel casing with control box and factory wiring.~~
 - 1. ~~Provide over temperature safety protective devices for each heater, consisting of automatic reset thermal cutout placed in the control circuit and secondary replaceable thermal cutout. Heaters exceeding 48 amperes line current shall be divided into sections and separate fuse blocks per N.E.C. Entire assembly shall be factory wired to a single set of main power lugs.~~
 - 2. ~~Provide a factory wired built-in control transformer with primary fusing, primary voltage rated for heater voltage and secondary voltage as required to operate control devices.~~
 - 3. ~~Provide SCR controller, air flow switch (adjustable), fan interlock relay, insulated terminal box, 80% ni. 20% chr. element wire derated to 35 watts per square inch. Heaters shall satisfy all requirements of the National Electrical Code and the Underwriter's Laboratories, Inc. and shall be UL listed for zero clearance.~~
 - 4. ~~All electrical components of units shall be internally wired and fused for a single point electrical power connection. Provide door interlocking disconnect switch.~~

- P. Heating Hot Water Coils: Factory mounted hot water coils provide full fin collars for accurate fin spacing and maximum fin-tube contact. Provide 3/8-inch O.D. seamless copper tubes mechanically expanded into the fin collars. Coils shall be leak tested at 300 psig air pressure under water.
- Q. Hardware: Provide hardware as detailed and required to complete ceiling system including unit mounting brackets, trim pieces, alignment channels, return air diffusers, dummy diffusers, etc.
- R. Air Terminals: Shall comply with above plus:
 - 1. Transformer: The 50-VA transformer is factory installed in the control box to provide 24 VAC for controls.
 - 2. Disconnect Switch: Provide with integral disconnect switch.
 - 3. Outlet Connection: Flanged connection.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR TERMINALS

- A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit high as possible (but not greater than 18 inches above ceiling), level and accurately in position indicated in relation to other work; **and maintain sufficient clearance for normal service and maintenance**, but in no case less than that recommended by manufacturer. Electric Heater Service Clearances must be in accordance with NEC; field locate Air Terminals as required. Transition ductwork to and from Air Terminals as required. **Where clearance issues are in question, coordinate in advance with Owner.**
- C. **Locate Air Terminal Box to provide Code required clearances in front of the Heater Controls/Disconnect.**
- D. Duct Connections: Connect ductwork to air terminals in accordance with Division 23 ductwork sections.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.
- B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING

- A. Clean exposed factory finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 23 36 00

SECTION 23 37 00 – AIR OUTLETS AND INLETS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of air outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers.
 - 2. Registers and grilles.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets."
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets."
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual."
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters."
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
 - 8. Florida Product Approval

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature, and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01.

1.4 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 – PRODUCTS

2.1 CEILING AIR DIFFUSERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity, and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Insulation: For lay-in ceiling installation, provide with manufacturer's factory insulation for diffuser backpan; strictly adhere to manufacturer's installation instructions. For hard ceiling installation, provide field applied insulation per 23 07 00.
- E. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule.
- F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:
 - Anemostat Products Div.; Dynamics Corp. of America.
 - Carnes Co.; Div. of Wehr Corp.
 - Krueger Mfg. Co.
 - Metalaire
 - Price
 - Titus Products Div., Philips Industries, Inc.
 - Tuttle & Bailey; Div. of Interpace Corp.

2.2 REGISTERS AND GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity, and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall and Duct Compatibility: Provide duct grilles with border styles that are compatible with adjacent wall and duct systems and that are specifically manufactured to fit into wall and duct construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and duct construction which will contain each type of register and grille.
- D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on the schedule.
- E. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

Anemostat Products Div.; Dynamics Corp. of America.

Carnes Co.; Div. of Wehr Corp.
Krueger Manufacturing Company
Price
Metalaire
Titus Products Div.; Philips Industries, Inc.
Tuttle and Bailey

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate and support ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules and support independently from ceiling.

3.3 SPARE PARTS

- A. Furnish to Owner, with receipt, three (3) operating keys for each type of air outlet and inlet that require them.

END OF SECTION 23 37 00

SECTION 23 73 23 - CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes central station air handling units with coils for indoor installations. The manufacturer is responsible for furnishing equipment that will fit the existing mechanical room space in the configuration shown. Access doors are required in all sections and shall open to allow full access to the air handler system components. AHU shall be configured and positioned in MER to allow for coil pull, filter replacement, motor servicing, etc.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product data for each central-station air-handling unit indicated, including the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound power ratings.
 - 3. Certified coil performance ratings with system operating conditions indicated.
 - 4. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 5. Materials gages and finishes.
 - 6. Filters with performance characteristics.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Shop drawings from manufacturer detailing dimensions, required clearances, components, and location and size of each field connection.
 - 9. Coordination drawings for central-station air-handling units in accordance with Division 15 Section "Basic Mechanical Requirements."
 - 10. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field- installed wiring.
 - 11. Product certificates signed by manufacturers of central-station air-handling units certifying that their products comply with specified requirements.
- C. Field quality control test reports specified in Part 3 of this Section.
- D. Maintenance data for central-station air-handling units for inclusion in Operating and Maintenance Manual specified in Division 1.

1.3 WARRANTY

- A. Provide one (1) year complete parts and labor warranty. Warranty period shall start on date of Substantial Inspection approval.

1.4 QUALITY ASSURANCE

- A. ARI Certification: Central station air handling units and their components shall be factory tested in accordance with the applicable portions of ARI 430 - Standard for Central-Station Air-Handling Units and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- C. Deliver central-station air-handling units as a factory-assembled unit to the extent allowable by shipping and installation limitations, with protective crating and covering.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.
- B. Coordinate the size and location of structural steel support members.

1.7 EXTRA MATERIALS

- A. Furnish one additional complete set of filters for each central- station air-handling unit.
- B. Furnish one additional gasket for each sectional joint of each central-station air-handling unit.
- C. Furnish one additional complete set of UV-C lamps for each central- station air-handling unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

Carrier Air Conditioning
Tentrol
Trane Co. (The)

2.2 MANUFACTURED UNITS

- A. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing dampers/section.
- B. Types: Central station air handling units included in this project are of the following types: Draw through.

2.3 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

- A. All electrical components shall be U.L. listed. All wiring components and devices shall conform to the National Electrical Code (NEC).

2.4 CABINET – GENERAL

- A. Materials: Formed and reinforced galvanized & stainless-steel panels (double wall) and accessories, with Thermal Breaks, and joints between sections sealed. All major internal components shall be removable for service.
- B. Modular AHUs require Class 'A' Thermal Breaks such that condensation will not form on the exterior of AHU with SA temperature scheduled as well as ambient conditions scheduled.
- C. Casing: Unit shall be constructed of a complete frame (welded or bolted) with removable panels. Removal of side panels must not affect the structural integrity of each module. Closed cell foam gasketing shall be applied where modules are joined. All panels shall be sealed with closed cell foam gasketing.
- D. Unit shall be double wall constructed in each module to prevent fiberglass erosion into the airstream, and to allow cleaning of the unit interior. A minimum two-inch, 1 1/2-pound density insulation (or spray foam insulation - no gaps) R-13 shall be sandwiched between a solid interior wall and the exterior wall. Interior wall shall be minimum 20-gauge stainless steel and shall not allow the exposure of any insulation to the air stream. It shall be fabricated from solid sheet steel without any perforations (unless otherwise noted). Provide thermal breaks to prevent condensation forming on exterior of AHU.

- E. The unit housing side and roof systems shall be constructed from a minimum 18-gauge galvanized steel.
- F. The maximum allowable deflection of any panel shall not exceed 1/200th of the span in any direction at the designed working pressure. If panels cannot meet this deflection, internal reinforcing shall be added. These requirements are designed to assure structural integrity and prevent oil canning.
- G. The side panels shall be attached to each other, to the roof, and to the unit floor using zinc plated bolts.
- H. Each non-removable panel seam shall be sealed with an acrylic latex sealant which meets ASTM C834-76 (1981) Standards for Latex Sealing Compounds. This sealant shall be applied in a continuous bead along the entire seam prior to assembling the panels. After completion of the assembly and after all the panels have been securely attached, an additional bead of sealant shall be run along the entire length of the exposed outside joints of all adjoining panels.
- I. All duct connection flanges must extend beyond the standing seam, a minimum of 1".

2.5 ACCESS DOORS

- A. Hinged, double wall, insulated, easy removal access doors shall be provided in all fans, access, and filter sections.
- B. The exterior door skin shall be constructed from minimum 18-gauge steel matching the material used for the exterior panel system. 12-gauge reinforcement straps shall be provided when the unit operating pressure dictates additional support to prevent air leakage.
- C. The doors interior liner shall be constructed from minimum 20-gauge stainless steel matching the material used for the interior liner. The door liner shall be solid.
- D. Access doors shall be fully gasketed with a closed cell, replaceable neoprene gasket. The gasketing material shall be installed to allow for easy removal and replacement.
- E. The door and latch assembly system shall be manufactured such that a tight seal can be maintained without the assistance of operating pressure.
- F. The latch shall provide a method of releasing cabinet operating pressure while maintaining a safety catch to the door.
- G. Doors that open to UV-C compartments shall be equipped with a thermal pane viewing window with one wire mesh safety glass pane and one clear pane shall be provided. The frame shall have a no-through-metal thermal break design. Windows shall use glass that is resistant to UVC transmission.

2.6 INSULATION

- A. Comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems," for insulation.
- B. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels.
- C. Double Wall Drain Pans: Formed sections of mastic coated 16-gauge stainless steel. Fabricate pans in sizes and shapes to collect condensate from cooling coils including coil piping connections and return bends when units are operating at the maximum cataloged face velocity across the cooling coil. Fill space between double- wall construction with minimum 1" thick foam insulation and seal moisture tight. Drain pan shall be sloped to provide positive drainage of condensate. All drain pans connections shall have a threaded connection, extending a minimum of 2-1/2" beyond the unit base, and shall be made from the same material as the drain pan.

- D. Units with stacked coils shall have an intermediate drain pan or a drain trough to collect condensate from top coil.

2.7 FANS SECTION

- A. Testing Requirements: The following factory tests are required:
- B. General: Sound power level ratings shall comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from Laboratory Test Data" and shall be the result of tests made in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- C. Unit's fans performance ratings for flow rate, pressure, power, air density, speed of rotation, and efficiency shall be factory tested and ratings established in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.
- D. Fan Section Construction: Fan section shall be equipped with a formed steel channel base(s) for integral mounting of fan(s), motor(s), and casing panels. Fan section interior panels shall be perforated for sound attenuation.
- E. Direct Drive Plenum Fan(s): The fan type shall be provided as required for quiet, stable operation and optimum efficiency. Single width, single inlet multi-blade type direct drive plenum fan. Motor bearing life not less than L-10 250,000 hours. Fan shall be certified as complying with AHRI Standard 430 for airflow performance. Fans shall be tested and rated in accordance with AHRI Standard 260 for sound performance.
- F. Fans shall be selected with inverter balancing and shall first be dynamically balanced at design RPM. Fans shall then be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications and that there are no resonant frequency issues throughout this operating range. (NOTE: Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the Contractor will be responsible for rebalancing in the field after unit installation.) Fans shall have a maintenance free grounding assembly installed on the fan motor to discharge both statics and induced shaft currents to ground.
- G. Provide with fan inlet bell(s) for sound attenuation.
- H. For units with multiple direct drive fans; Provide with overload panel for powering the multi-fan array with a single Variable Frequency drive.
- I. Motors: Mounted integral to the isolated fan assembly, internal to the unit's fan section.
- J. Two Inch Spring Isolators: Direct drive fan and motor assemblies shall be internally isolated from the unit casing with 2" deflection spring isolators.
- K. Fan Drives: Factory mounted and aligned prior to shipment.
- L. Motors: Mounted integral to the isolated fan assembly, internal to the unit's fan section.
- M. Access Door: See above requirements, and UV-C requirements below.

2.8 MOTORS

- A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.
- B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range. Motors over one horsepower shall be energy efficient (see section 230510 for additional motor requirements).

- C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class B Insulation).
- D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
- E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B, built in accordance with IEEE, ASA and NEMA standards. (Note: Provide premium efficiency inverter duty motors.)
- F. Bases: Adjustable, slide bases with rails.
- G. Bearings: The following features are required:
- H. Ball or roller bearings with inner and outer shaft seals.
- I. Grease lubricated.
- J. Designed to resist thrust loading where drives produce lateral, or axial thrust in motor.
- K. Enclosure Type: The following features are required:
- L. Open drip-proof motors where satisfactorily housed or remotely located during operation.
- M. Guarded drip-proof motors where exposed to contact by employees or building occupants.
- N. Overload protection: Built-in, automatic reset, thermal overload protection.
- O. Noise rating: Quiet. Refer to Fan Acoustics Schedule.
- P. Efficiency: Energy efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B. Refer to Section 15010.
- Q. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

2.9 COILS

- A. Testing Requirements: The following factory tests are required:
- B. Coil Performance Tests: Cooling and heating coils, except sprayed surface coils, shall be factory tested for rating in accordance with ARI 410 - Standard for Forced-Circulation Air- Cooling and Air-Heating Coils.
- C. Coil Sections: Common or individual insulated, stainless-steel casings for heating and cooling coils. Coil section shall be designed and constructed to facilitate removal of coil for maintenance and replacement and to assure full air flow through coils.
- D. Medium- and high-pressure units shall have double gaskets between sections and coil connection penetrations through casing sealed to minimize leakage.
- E. Coils, General: Vented and drainable, extend vents and drains to unit exterior; rigidly supported across the full face of the coil, and pitched to allow drainage.
- F. Fins: Aluminum or copper (.008" thick), constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.
- G. Tubes: Seamless copper 5/8" O.D. with .016" walls and .049" return bends.
- H. Coil Casing: Stainless Steel.

- I. Headers for Water Coils: Steel or cast iron, with connections for drain valve and air vent and threaded piping connections.
- J. Air Bypass Arrestor: Provide foam sealing strip located between casing channels and fins along top and bottom.
- K. Custom Split Chilled Water Coils: Provide Custom coils, split as scheduled. Custom split coils shall be full face interlaced with two inlet connections and two outlet connections per coil.

2.10 FILTER SECTIONS:

- A. General: Filter area, types, efficiencies, and locations shall be as scheduled. Filters shall comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems". Provide permanent blank-off plates in filter sections as required to prevent bypass air. AHCA will not accept accordion style blank-off plates. Caulk all around filter racks so that no air can bypass filter sections
- B. AHU Inlet Filters: Filter section shall house 2" thick pleated media type filters. 2" filter efficiency shall not be less than MERV 13 when tested in accordance with ASHRAE 52-76 test standard and shall have a minimum average arrestance of 90% when tested in accordance with ASHRAE 52-68 test standard.
- C. Filter Section: Cabinet material and finish shall match the air handling unit cabinet, with filter media holding frames arranged for flat or angled orientation as indicated and gaskets to prevent air from bypassing the filter. Side access section shall have hinged easy removal access doors with quick-opening latches, gasketed to prevent air leaks on free side of the unit.
- D. Filter Gauges: Provide adjustable 0-2" magnahelic differential pressure gauges mounted on each filter bank for reading pressure drop across filters.
- E. Differential pressure indicating transmitter shall be diaphragm operated with sensing element motion restrained by a calibrated spring affixed with a strain gauge transducer. Electrical signal shall be internally conditioned to a two-wire standard 4-20 mA control loop output. Transmitter shall have local pointer dial indication of sensed pressure with white dial, black figures, and graduations and pointer zero adjustment. Transmitter shall be Dwyer Instruments, Inc., Catalog No. 605 or approved equal.
- F. Ultraviolet (UV-C) Lights
 - 1. UV-C light systems shall be High Output Air Disinfection type, factory installed and wired.
 - 2. UV-C Lamp and fixture shall be factory assembled and tested. UV-C systems shall consist of a housing, power source, ballasts, lamp sockets, UV lamps and safety switches. All components shall be constructed to withstand HVAC Design environments. System shall be UL/C-UL Listed under category Code ABQK (Accessories, Air Duct Mounted), UL Standards: 153, 1598 and 1995. Fixtures shall meet the UL drip-proof design criteria.
 - 3. Housing shall be constructed of type 304 stainless steel and equipped with both male and female power plugs--one type at each to facilitate simple fixture to fixture plug in for A/C power. Fixtures may be used as built-up or as side access. Each fixture incorporates all components into one integral assembly that maximizes serviceability. Fixtures shall be designed to be mounted anywhere in a HVAC system. Unless indicated otherwise, locate UV-C Lamps downstream of the Cooling Coil, evenly spaced, with minimum 10 Watts/SF of coil face area equally distributed to the surfaces at the plenum sides, top and bottom. The UV-C energy striking the intended coil and drain pan surfaces shall not be less than 550 microwatts per square centimeter and provide not less than 99 percent disinfection efficiency. The minimum intensity at any point on the surface plane of the coil must exceed 100 microwatts per square centimeter.
 - 4. Power Source shall be an electronic, high frequency, rapid type with overload protection. 120V and designed to maximize radiance and reliability at UL/C-UL Listed temperatures of 52-135°F. It shall include exclusive RF and EMI suppression.

5. Sockets shall be medium bi-pin, single click safety, twist lock type. They shall be constructed of a UV-C resistant polycarbonate.
6. UV Lamps shall be a normal-output, hot cathode, T8 diameter, medium bi-pin type that produces UVGI of 254 nm. Each lamp produces the specified output at 550 fpm and air temperature of 52°F. UV-C lamp life shall be 9,000 hours minimum with no more than a 20% loss of output after two years of continuous use. Each lamp shall contain less than 5.5 milligrams of mercury. Lamps shall be hermetically sealed within a layer of UV-C transmissible FEP to provide protection against lamp breakage and to ensure Lamp contents from a broken Lamp, are contained.
7. Independent Testing: UV-C systems shall be independently tested to verify conformance to UL/C-UL Listed under category Code ABQK (Accessories, Air Duct Mounted), UL Standards: 153, 1598 and 1995.
8. Access doors with inspection windows shall be provided at the location of each UV-C light. Windows with visual access to UV light shall use protective UV-C resistant glass to assure UV-C energy emitted through it is below the threshold limits specified by NIOSH and ACGIH. Access to any section with visual access to UV-C light shall include automatic kill switches to de-energize the lamps. Each UV-C Section shall also be equipped with an externally mounted on-off/disconnect/shut-off switch that disconnects power to the UV-C lights. The switch shall be equipped with a lock-out/tag-out to prevent unwanted operation of the UV-C lights.
9. All polymeric materials that come into direct or indirect (reflected) contact with UV-C light shall be in conduit or shielded with metal. All work shall have complete & professional appearance.

2.11 ADDITIONAL CONSIDERATIONS

- A. One-year parts and labor warranty shall be provided. Manufacturer shall guarantee in writing that the unit will perform in accordance with specified operating conditions shown on the contract documents.
- B. Adjustment of isolators, fans, bearings, and start-up are to be by local factory authorized technician of unit manufacturer. Report to be submitted to engineer showing proof of adjustments, fan rpm, voltage, amps, initial drop across filter bank, etc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of central station air-handling units.
- B. Examine rough-in for hydronic, condensate drainage piping and electrical to verify actual locations of connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install central-station air-handling units' level and plumb, in accordance with manufacturer's written instructions.
- B. Support floor mounted units on base rails and housekeeping pads high enough to properly trap condensate and route to floor drain. Secure units to concrete base.
- C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 EQUIPMENT BASES

- A. Construct concrete equipment pads as follows:

- B. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4 inches larger in all directions than the overall dimensions of the supported unit, minimum 4 inches high (high enough to properly trap condensate and route to floor drain).
- C. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
- D. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
- E. Place concrete and allow to cure before installation of units. Use Portland Cement conforming to ASTM C 150, 4,000 psi compressive strength, and normal weight aggregate.
- F. Extend up floor drains through concrete pad as required.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
 - 1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
 - 2. Connect condensate drain pans using full size Type L copper tubing. Extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- B. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- C. Electrical Connections: The following requirements apply:
- D. Electrical power wiring is specified in Division 26.
- E. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:
- B. Inspect the field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
- C. Prepare a written report on findings and recommended corrective actions.

3.6 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust water coil flow, with control valves to full coil flow, to indicated GPM.
- B. Adjust damper linkages for proper damper operation.
- C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face. Comb out any coil fin imperfections.

3.7 COMMISSIONING

- A. Final Checks Before Start Up: Perform the following operations and checks before start-up:
Remove shipping, blocking, and bracing.

- B. Verify unit is secure on mountings and supporting devices and that connection for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
- C. Perform cleaning and adjusting specified in this Section.
- D. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system.
- E. Lubricate bearings and other moving parts with factory-recommended lubricants.
- F. Set outside-air and return-air mixing dampers to minimum outside-air setting.
- G. Comb coil fins for parallel orientation.
- H. Install clean filters.
- I. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
- J. Disable automatic temperature control operators.
- K. Starting procedures for central-station air-handling units:
- L. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
- M. Measure and record motor electrical values for voltage and amperage.
- N. Shut unit down and reconnect automatic temperature control operators.
- O. Confirm UV-C Safety switch operation and document in Close-Out Documents.

3.8 DEMONSTRATION

- A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:
- B. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
- C. Familiarization with contents of Operating and Maintenance Manuals specified in Division 01 Section "Project Closeout."
- D. Schedule training with at least 7 days' advance notice.

END OF SECTION 23 73 23

SECTION 23 82 19 – FAN COIL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Specification sections, apply to work of this section.
- B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of fan coil unit work is indicated by schedules and by requirements of this section.
- B. Types of terminal units required for project include the following:
 - Fan Coil Units – Horizontal Cabinet, Concealed
- C. Refer to other Division 23 sections for piping; ductwork; controls and testing, adjusting and balancing of units; not work of this section.
 - 1. Interlock wiring between electrically-operated terminal units; and between terminal units and field-installed control devices.
 - 2. Interlock wiring specified as factory-installed is work of this section.
- D. Refer to Division 26 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on terminal unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than ten (10) years.
 - 1. ARI Compliance: Test and rate fan-coil units in accordance with ARI Standard 440 "Room Fan-Coil Air Conditioners".
 - 2. ARI Compliance: Test and rate coils in accordance with ARI Standard 410.
 - 3. UL Compliance: Construct and install fan-coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".
 - 4. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.
 - 5. NFPA Compliance: Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- B. Manufacturer: Subject to compliance with requirements, provide fan-coil units of one of the following (or pre-approved equal):
 - Carrier Corp.
 - Enviro-Tec
 - IEC International Environmental Corp.
 - Trane (The) Co.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01.

1.5 WARRANTY

- A. Manufacturer shall supply a minimum on (1) year parts and labor warranty from day of Substantial Completion. Provide manufacturers standard warranty if greater than one year.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fan coil units, fully assembled and in operable condition, to the job site. Coordinate with Owner and installing Contractor for delivery schedule. Provide minimum seven (7) days notice prior to on-site delivery. Arrange and pay for off-loading; storage FCUs on-site where directed by Owner.
- B. Handle fan coil units and components properly to prevent damage, breaking, denting, and scoring. Do not deliver damaged fan coil units or components; replace with new.
- C. Store fan coil units and components in clean dry space. Protect from weather, dirt, fumes, water, construction debris, and physical damage. Storage temperatures for unit controls are not to exceed 185°F (85°C).
- D. Comply with Manufacturer's rigging and installation instructions for unloading fan coil units and moving them to final location.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS – HORIZONTAL CABINET, EXPOSED

- A. General: Provide fan-coil units having cabinet sizes, and in locations indicated, and of capacities (in accordance with ARI Standard 440), style, and having accessories as scheduled. Include in basic unit chassis, coils, fan board assembly, drain pan assembly, fans, housing, motor, filter, insulation, all required wiring, piping, controls, and accessories.
- B. Sound: Units shall be tested and rated in accordance with ARI Standard 443.70.
- C. Chassis: Construct chassis of heavy gauge galvanized steel with flanged edges.
- D. Insulation: Foil faced, heavy density glass fiber, one inch thick with a minimum density of 1 1/2 pcf or 1/2" closed cell insulation.
- E. Cabinet: Construct of 18-ga steel removable panels, 16-ga front and bottom. Provide insulation over entire coil section. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer. Cabinet shall have final powder-coat paint finish; color shall be Manufacturer's standard.
- F. Supply Air: Ducted supply air with supply air duct connection.
- G. Return Air: Ducted return air with return air duct connection.
- H. Cooling Coils: Construct of 1/2" seamless copper tubes mechanically bonded to configured aluminum fins. Design for 300 psi working pressure, and leak test at 450 psi under water.

Provide automatic air vent. Copper tubes must comply with ASTM B-75. Fin thickness shall be 0.0045" and tube thickness shall be 0.016". Provide stainless steel coil casings.

- I. ~~Heating Coils: Construct of 1/2" seamless copper tubes mechanically bonded to configured aluminum fins. Design for 300 psi working pressure, and leak test at 450 psi under water. Provide automatic air vent. Copper tubes must comply with ASTM B-75. Fin thickness shall be 0.0045" and tube thickness shall be 0.016".~~
- J. Drain Pans: Construct of stainless steel and slope to drain connection. Insulate with polystyrene or polyurethane insulation. Provide drain connection. Drain pan shall extend the entire width of the coil.
- K. Fans: Provide direct drive double width, double inlet centrifugal forward curved wheels of galvanized steel, in galvanized steel fan scrolls. Blower wheels shall be statically and dynamically balanced. A heavy guage plenum shall enclose the entire fan coil unit assembly. Fans shall be easily removable.
- L. Motors: Provide brushless DC Electrically Commutated Motors (ECM), factory tested and programmed. Provide motor controller with factory control enclosure, integrated user interface and LED Tachometer. Motors shall be variable speed and ramp between speeds. Provide with integral overload protection. Permanently sealed ball bearings.
- M. Filters: Provide 2" thick MERV 8 throwaway type filters in fiberboard frames. ~~Filters shall be removable through a hinged access door.~~ Filters shall be mounted in ceiling mounted return air grille; do not install filter in FCU; include filter pressure drop in total static pressure. Provide one extra filter and install after construction is complete and prior to test and balance.
- N. Required Accessories:
 - 1. Disconnect Switch (factory installed) (NOTE: Installation must maintain Code required clearances.)
 - 2. High level condensate switch.
 - 3. Variable Speed ECM Controller.
 - 4. Automatic air vents and drains on coils.
 - 5. Transformer for 24v power for controls.
 - 6. Vibration isolating hangers and hardware.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which fan coil units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF FAN COIL UNITS – HORIZONTAL CABINET, CONCEALED

- A. General: Install Fan Coil Units as indicated and in accordance with manufacturer's installation instructions. Provide custom equipment stands, prime and paint.
- B. Locate Fan Coil Units as indicated; coordinate with other trades as required for fit, relocation of obstructions, provide FCU supports, fire or smoke damper access, CHW valve train access, controller's access, etc.
- C. Provide all supplemental steel as required to support FCU.
- D. Install piping as indicated.
- E. Protect units with protective covers during balance of construction.
- F. Control: Coordinate field-installed automatic temperature control requirements with Control Installer prior to Bid. Provide and install complete, operable controls.

3.3 ELECTRICAL WIRING

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.4 ADJUSTING AND CLEANING

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filter units for fan coil units.

3.5 START UP SERVICE FOR FAN COIL UNITS

- A. The Contractor shall be responsible for the installation of the equipment and any associated piping and wiring in accordance with the manufacturer's recommendations and the contract documents.
- B. The Contractor shall be responsible for all control work. He shall provide a representative at the job-site for coordinating the start-up and Test & Balance and shall notify the manufacturer at least ten days prior to the requested start-update.
- C. Provide factory start-up and submit report.

3.6 TRAINING

- A. Contractor shall provide a representative to assist MFR in Training Owner's Staff. Contractor shall document Training and include in O&M Manuals.
- B. Schedule training with Owner, provide at least seven (7) day notice to Contractor and Engineer of training date.
- C. Utilize O&M Manual and Train Owner's Maintenance Staff. Document attendance and submit report.

END OF SECTION 23 82 19

SECTION 25 00 00 - INTEGRATED AUTOMATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the general requirements for the Integrated Automation systems.
- B. Related Sections:
 - 1. All sections within Division 25.
- C. Where architectural features govern location of work, refer to architectural/mechanical drawings and coordinate with other trades.

1.2 PREQUALIFICATIONS REQUIREMENTS

Submit with the Bid - Documentation for the following:

- A. Contractor shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BAS System specified (Niagara) and similar in size and complexity to this project. Submit a list of five (5) projects completed in the last three (3) years.
- B. Contractor shall have in-place support facility within 50 miles of the site with technical staff, service personnel, spare parts inventory and necessary test and diagnostic equipment for the last three (3) years. (Distributors are not acceptable.)
- C. On-Site Project manager must be competent in BAS System specified and shall have a minimum ten (10) years experience for this type of work, responsible for direct supervision of the design, installation, start-up and commissioning of the System.

1.3 REFERENCES

- A. This section includes any rules and regulations of Federal, State, local authorities, and utility companies in force at the time of execution of contract.
- B. Agencies or publications referenced herein refer to the following:
 - 1. ADA Americans with Disabilities Act
 - 2. ANSI American National Standards Institute
 - 3. ASHRAE American Society for Heating, Refrigeration, Air-Conditioning Engineers
 - 4. ASTM American Society for Testing and Materials
 - 5. BICSI Building Industry Consulting Services International
 - 6. EIA Electronic Industries Association
 - 7. FCC Federal Communications Commission
 - 8. ICEA Insulated Cable Engineers Association
 - 9. IEEE Institute of Electrical & Electronics Engineers
 - 10. ISO International Organization for Standards
 - 11. NEC National Electrical Code
 - 12. NECA National Electrical Contractors Association
 - 13. NEMA National Electrical Manufacturers Association
 - 14. NETA National Electrical Testing Association
 - 15. NIST National Institute of Standards & Technology
 - 16. OSHA Occupational Safety and Health Administration
 - 17. TIA Telecommunications Industries Association
 - 18. UL Underwriters Laboratories, Inc.
- C. DMS Naming Conventions – Attachment 1
(<https://dms-media.ccplatform.net/content/download/170331/file/Attachment%201%20-%20DMS%20Naming%20Convention.pdf>)

1.4 DEFINITIONS

A. AHU	Air Handling Unit
B. ATC	Automatic Temperature Control
C. ATU	Air Terminal Unit
D. AWG	American Wire Gauge (standard wire size measurement)
E. BAS	Building Automation System (BAS designation shall be equivalent to EMCS (Energy Management Controls System))
F. CRAC	Computer Room Air Conditioner
G. Device	Intelligent controller or other automated monitoring piece of equipment
H. CD	Compact Disc used for data storage
I. Commissioning	Process to ensure installation and functionality is per design
J. FCU	Fan Coil Unit
K. IBS	Integrated Building Systems
L. I/O	Hardware inputs and outputs
M. Instrument	Device used to sense inputs or control outputs or both
N. Integration	Connection of disparate systems to a common platform using communication protocols.
O. IP Address	Internet Protocol node address
P. IT	Information Technologies
Q. Object	Hardware or Software component such as a device or point.
R. Plugfest	Demonstration of multiple systems integrations and interoperability.
S. Point	Single hardware input/output or software data objects such as setpoints and attributes.
T. Pointlist	List of inputs, outputs, and parameters for specific systems
U. RFI	Request for Interpretation
V. Stand-Alone	The ability to function upon loss of communication

1.5 SYSTEM DESCRIPTION

- A. The integrated automation system shall utilize Tridium Niagara to control HVAC equipment and capable of lighting control. Utility metering shall be interfaced with Schneider Electric energy management system.
- B. The integrated automation system includes integration, control, and monitoring of the various systems throughout the facility including:
 - 1. Procurement and installation of integrated automated devices.
 - 2. Integration of data from various systems to allow for seamless monitoring and control of the various systems.
- C. The functionality of the integrated automation system must include:

1. The ability to communicate with systems shown, utilizing protocols specified.
 2. Stand-alone functionality of controlled equipment.
 3. BAS user interfacing shall be accomplished via a web-server environment or employing the platform-specific software launcher (e.g. Niagara N4).
- D. Integrated Automation includes but is not limited to labor and materials for terminations, pathways, installations, certifications, testing, system verification, project commissioning, integration equipment, instrumentation and controls, and integrated automated devices.

1.6 SUBMITTALS

- A. Submit complete schedule/outline of product submittals prior to submittal submission. Submit each section independent and separate from other sections. For each product submission:
1. Specification Section and Product number.
 2. Include only products within referenced specification section submission.
- B. Submit Control drawings with sequence of operations, bill of materials and location of instruments.
1. Sequence of Operations. (shown on Systems Drawing)
 2. System drawing showing relative locations of instrumentation.
 3. Bill of Material, with part numbers for all instrumentation.
 4. Riser diagram showing all systems and equipment connected to the automation network.
- C. Product Data: For each product submission, include the following:
1. Table of contents for each submission.
 2. Submit each section independent and separate from other sections. Include only products within referenced specification section submission.
 3. Product data sheets for all required components and accessories.
 4. Identify actual product model number used for each drawing.
 5. Identify any proposed modifications to system design. (Specifications or Drawings)
 6. Organize product data based on specification Section, Part, and Article.
 7. A paragraph-by-paragraph specification compliance report indicating compliance for each numbered paragraph. The following format shall be used in completing the compliance report:
 - a. Comply—without exception.
 - b. Qualify—meet the functional intent. For each paragraph, the contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.
 - c. Does not comply—cannot meet specified function.
 - d. Does not apply – not used or not required.
- D. Integration Plan
1. Network architecture and communications concepts/diagrams. Network architecture includes but is not limited to:
 - a. Nodes
 - b. Switches and Routers
 - c. Integrated systems and/or sub-systems
 - d. Dedicated I/O locations
 2. Coordination of vendor protocol and point list submission. Include an integration matrix detailing systems and protocols to be used.
 3. Workflow processes to integrate systems
 4. Include communication hardware, software, and protocols to implement full systems integration.
 5. Identify proposed enhancements or deviations from project documents. Include specific drawings or specifications impacted.

6. Provide coordination efforts to accommodate complete integration of systems including:
 - a. Vendor protocol requirements
 - b. Vendor point list
 - c. Plugfest for integrated systems
- E. Start-up Plan:
1. Coordination of equipment controlled and monitored
 2. Workflow process to start equipment
 3. Equipment start-up requirements
 4. Manufacturer's and Commissioning Checklist
 5. Intended sequence of work items
 6. Start dates of individual work items
 7. Duration of individual work items
 8. Planned delivery dates for major material and equipment, and expected lead times
 9. Milestones indicating possible restraints on work by other trades or situations
- F. Owner Instruction and Training Plan:
1. Organized list of specific equipment or systems that require training
 2. Separate agendas for each training session including but be not limited to:
 - a. Construction Document review of systems
 - b. Installation and as-built conditions
 - c. Theory of operation
 - d. Demonstration of operation
 - e. Operation and Maintenance Document
 - f. Servicing and Maintenance Schedules
 - g. Interlocks and Safeties
 3. Manufactures recommended classroom training and schedule
- G. Record Documents:
1. Include field condition updates
 2. Document material, make and model numbers where appropriate
 3. Update details, schedules, risers, etc.
 4. I/O point as-builts
 5. Sequence details, modifications, or updates
 6. Control loops including final set-points and parameters
 7. Mark and detail on coordination drawings, exact locations of equipment installed
 8. Panel details for each unique panel
- H. Operation Manuals:
1. Include a table of contents
 2. Tab manual based on specification chapters or sections
 3. Network architecture and communications concepts/diagrams
 4. Uploading and downloading software to the field hardware
 5. Finely detailed descriptions of all software programs
 6. Complete set of software engineering manuals
 7. Complete system design and engineering manual same as used by manufactures personnel
 8. Application Programming
 9. CD of any configuration tools used in project
 10. Operator instructions or User Manual
 11. Calibration and/or verification sheets
- I. Project Maintenance Manuals:
1. Include a table of contents
 2. 1 copy on CD or "thumb" drive

3. Organize by manual by specification section number
4. Index sheet listing contents in alphabetical order
5. Include the following:
 - a. Installation instructions
 - b. Manufacturer's operating and maintenance instructions (not product submittals)
 - c. Factory and field-test records, including calibration and factory setup
 - d. Printout of application control programs (typical)
 - e. Snapshot printout of each system installed
 - f. Signed checklist of each system
 - g. Factory training schedule and course description catalog
 - h. Archived backup of software, drawings, and record documents
 - i. Installation contractor and service representative information
 - j. Licensing and warranty information
- J. Submit a User Workstation Planning Session Plan for each subject.
 1. Integration of systems
 2. Graphics Generation
 3. Point naming
 4. Alarm management
 5. Energy management
 6. Automated work order generation
 7. Recommended Operation & Maintenance procedures

1.7 QUALITY ASSURANCE

- A. Provide material with UL label or be UL listed, unless UL label or listing is not available for that type of material.
- B. All systems, equipment, components, accessories, and installation hardware must be new, free from defects, and currently in production.
- C. Demonstrate project compliance to Engineer's satisfaction including plugfest, construction and integration.
- D. Provide the same manufacturer components of a given type product throughout project.
- E. Support future compatibility for no less than 7 years with the ability to upgrade existing field panels and extend new field panels on an installed network.
- F. Digital equipment furnished under this contract shall have been tested and made to comply with limits of Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.
- G. Maintain NEC workspace clearances.
 1. Install and operationally check systems utilizing factory-trained competent technicians skilled in the setting and adjustment of equipment used in this project.
- H. Test, adjust, and calibrate all end instruments.
- I. Follow project communication protocol for all correspondence. Any changes, decisions, etc. must be properly documented. The Engineer will not issue verbal directions. Verbal interpretations, clarifications, conversations, etc., are non-binding without proper documentation.
- J. Request for Interpretation (RFI) shall include:
 1. Referenced drawing and/or Specification Section number
 2. Single request per RFI
 3. Single proposed solution per RFI
 4. Attached sketch of solution (if applicable)
 5. Attached specification verbiage (if applicable)
 6. Incomplete RFI's will be returned without response.

7. Contact person

- K. RFI answers are for clarification only and do not authorize additional work or change orders.
- L. Install devices in appropriate enclosure and in an accessible location.
- M. Install systems and devices in a neat, workmanlike manner and in accordance with manufacturer's recommendations.
- N. Continually monitor the field installation for code compliance and quality workmanship.
- O. Remove and re-install any systems or devices where installation is deemed of poor quality by Owner or Engineer.
- P. Provide software and firmware updates prior to and within 2 months of substantial completion.
- Q. Lead the coordination effort and associated plugfest activities to ensure integration of various systems prior to installation.
- R. Comply with all health and safety regulations.
- S. Include automatic restart logic for loss of power, safeties, fire alarm shutdown, etc.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products according to manufacturer's recommendations.
- B. Store products in original manufacturers packaging.
- C. Do not store products more than 3 months prior to schedule installation.
- D. Coordinate deliveries of material with construction schedule and appropriate trades.

1.9 SCHEDULING

- A. Included in this project are connections to equipment provided by others. Coordinate deliveries, final locations, factory mounting, and various connections required.
- B. Coordinate activities with contract project schedule.
 - 1. Ensure integration activities are incorporated into project schedule.
 - 2. Communicate requirements to prevent potential damage from paint, dust, water, weather, etc. Monitor and take measure to assure protection for all equipment.
- C. Coordinate all IT requirements with Owner and contract project schedule.

1.10 WARRANTY

- A. Submit warranty documentation upon completion of project or phase and acceptance by Engineer and Owner.
 - 1. Warranty start date shall be the date of substantial completion.
 - 2. Warranty period shall be 1 year unless otherwise noted.
- B. Repair or replace systems or parts found defective at no cost to Owner including but not limited to:
 - 1. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period.
 - 2. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer archived software disks.
 - 3. Include parts, labor, and necessary travel during warranty.

- C. Scheduled preventive maintenance (p.m.) visit twice a year to audit system performance.
 - 1. Each p.m. visit shall include exercising each control loop and control sequence for performance.
 - 2. A log of each loop tested, and each control sequence verified shall be reviewed with the Owner.
- D. Provide vendor specific warranty information.
- E. Provide services incidental to proper performance.

1.11 SYSTEM STARTUP

- A. Start equipment according to manufactures recommendation.
- B. Document system start up time and date.
- C. Document person(s) performing startup.
- D. Provide completed vendor specific start up documentation.

1.12 OWNER'S INSTRUCTIONS

- A. Provide a factory-trained instructor to give full instructions to designated personnel in the operation, maintenance, and programming of each piece of equipment or system. Instructors shall be thoroughly familiar with all aspects of the subject matter.
- B. The training shall be specifically oriented to the system and interfacing equipment installed.
- C. Include classroom instruction and field demonstration.
- D. Classroom instruction should include at a minimum:
 - 1. Detailed review of as-built documentation and conditions
 - 2. In depth discussion of theory or sequence of operations
 - 3. Review organization and usability of O&M documentation
 - 4. Maintenance procedures and schedules
- E. Field instruction should include at a minimum:
 - 1. Normal maintenance procedures
 - 2. Demonstration of operation
 - 3. Demonstration of safeties and interlocks
 - 4. Troubleshooting process to identify and correct commonly observed system issues.

1.13 COMMISSIONING

- A. Participate in the commissioning process. Participate in T&B process.
- B. Refer to Commissioning specifications for additional requirements for Division 25 work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to start of any work, check, verify, and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- B. Promptly request clarification and instruction or report any conflicts, inadequate conditions, or missing information in the Project Documents. Report unacceptable conditions immediately.

- C. Inspect site to verify that equipment can be installed as shown.
- D. Examine drawings and specifications for work of others.
- E. Perform necessary changes in specified work caused by failure or neglect to report discrepancies.
- F. Coordinate with owner on continuation and continuity of existing controls; develop transition plan with Owner, Cx, Engineer & CM.

3.2 INSTALLATION

- A. Lead the effort to communicate or integrate to the various building systems. Effort includes integration plan, communication protocol meetings, request for vendor specific information, etc.
- B. Provide additional, supplementary, or miscellaneous items, products, and labor incidental to or necessary for a complete and operable system including but not limited to:
 - 1. Uninterruptable Power Supplies (UPS)
 - 2. Surge suppression devices
 - 3. Transformers and power supplies
 - 4. Programming modifications
- C. Request IP addresses and other IT requirements from Owner to accommodate project schedule, and 3rd party commissioning, prior to substantial completion.
- D. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- E. Provide sufficient slack, flexible connections, and isolation to allow for equipment vibration.
- F. Verify elevations and measurements prior to installation of materials.
- G. Beginning installation means contractor accepts existing conditions.
- H. Conceal wiring in conduit in mechanical spaces, above hard ceilings, and other spaces where exposed wiring could be damaged.
- I. Provide temporary service, routing of service, or other temporary requirements to minimize downtime of service.
- J. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain-tight, explosion proof, dust tight, or any other special type as required.)
- K. Arrange for necessary openings in building to allow for admittance of all apparatus.
- L. Install equipment with ample space allowed for removal, repair, or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.
- M. Coordinate all systems to minimize the need for access doors.
- N. Coordinate final locations, sizes, and rough-in dimensions for access doors.
- O. Verify door swings for proper clearance before installing.
- P. Perform work in a safe and competent manner and use of industry accepted installation procedures required for the work.

3.3 FIELD QUALITY CONTROL

- A. Testing:

1. Conduct a complete performance test for all systems to assure compliance with the contract documents.
 - a. Any components on systems found defective or not performing satisfactorily shall be readjusted and retested after necessary corrective measures are performed.
 - b. Corrective measures may include modification or addition of equipment and devices, control strategies and/or software program.
 2. Coordinate required plugfest, testing with commissioning activities.
 3. When testing is to be witnessed by Engineer or Inspector. Schedule Engineer at least 10 days prior to testing date.
 4. Conduct and lead the coordination effort to present a plugfest of integrated systems. Verify communication capabilities of each integrated vendor prior to installation of each system. Provide documented integration capabilities.
 5. Certify in writing, successful equipment and system test results. Include in certifications the following:
 - a. Identification of system tested.
 - b. Date
 - c. Test criteria
 - d. Print name, title and company of person signing test certification documents.
 - e. Alternative solutions implemented to successfully complete test.
- B. Coordinate with the Owner and execute a User Workstation Planning Sessions including 1-2 day sessions (for each subject) to finalize details for the following:
1. Integration of systems
 2. Graphics Generation
 3. Point naming
 4. Alarm management
 5. Energy management
 6. Automated work order generation
 7. Recommended Operation & Maintenance procedures
- C. Repair, reprogram or replace any equipment or work that fails test.

3.4 CLEANING

- A. Upon completion of each phase, system, panel, etc., clean all system panels, enclosures and field device enclosures.
- B. Clean debris from equipment, control panels, security panels, and fire panel enclosures, junction boxes and pull boxes and arrange wire neatly with surplus length cut off prior to installation of covers.
- C. Thoroughly clean equipment of stains, paint spots, dirt, and dust. Remove temporary labels not used for instruction or operation.

3.5 DEMONSTRATION

- A. Demonstrate operation of systems with Owner or Engineer.
- B. Coordinate with commissioning activities. Refer to Commissioning specifications.

3.6 PROTECTION

- A. Protect installation against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Maintain protection for work and equipment until inspected, tested, and accepted.
- C. Protect material not immediately installed.

- D. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- E. Material sensitive to temperature, dust, humidity, or other elements and found unprotected shall be replaced.
- F. Material with showing signs of exposure shall be replaced.

END OF SECTION 25 00 00

SECTION 25 05 13 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes Integrated Automation conductors and cable for signal transmission, communications, power, and other miscellaneous cables for complete integration of systems specified.
- B. Related Sections:
 - 1. 25 05 28 Pathways
 - 2. 25 05 53 Identification

1.2 REFERENCES

- A. NEC 725 Class 1, Class 2, and Class 3 Remote Control, Signaling and Power-Limited Circuits
- B. NEC 800 Communication Circuits

1.3 DEFINITIONS

- A. AWG American Wire Gauge
- B. EMI Electromagnetic Interference
- C. kVA One thousand Voltamps
- D. Noise Unwanted electrical or electromagnetic energy
- E. Signal Wire Wire used to transmit an electrical signal such as voltage, amps, or resistance.
- F. PVC Polyvinyl Chloride

1.4 SYSTEM DESCRIPTION

- A. Final connectors to control device.
- B. Communication cables for integrated systems.
- C. Signal cables for Integrated Automated systems.
- D. Power cables for Integrated Automated systems.
- E. Final terminations of conductors and cables not specifically shown but required for systems operation.

1.5 SUBMITTALS

- A. Submit installation plan including:
 - 1. Recommended modifications to design documents.
 - 2. Documentation for vendor specific limitations or modifications.
 - 3. Sequence of installation.
 - 4. Coordination requirements.

1.6 QUALITY ASSURANCE

- A. All work shall meet the requirements of the National Electrical Code.

- B. All wiring shall be done in accordance with all local and national codes and authorities having jurisdiction.
- C. Ground and Bond according to manufacturer's recommendations. Refer to Division 26 specifications for grounding and bonding requirements.
- D. Splicing communication and instrumentation cables is prohibited.
- E. Kinked cable is prohibited and must be replaced.
- F. Conform to requirements of National Electrical Code Articles 725 and 800, as well as local electrical codes, where required by the various systems.
- G. Insure cable is free of tension at both ends. In cases where cable must bear stress, provide Kellom grips to spread stress over longer length of cable.
- H. Adhere to the following minimum distances to reduce effects of EMI:
 - 1. Five (5) inches from power lines of 2kVA
 - 2. Eighteen (18) inches from high voltage lighting (including fluorescent)
 - 3. Thirty-nine (39) inches from power lines of 5kVA or greater
 - 4. Thirty-nine (39) inches from transformers and motors
- I. Maintain separation of signal wire and wire carrying more than 100 VAC.
- J. Separate cable from other building systems.
- K. Install cables parallel and perpendicular to building walls. Coordinate space requirements with other trades.
- L. Conceal wiring in conduit in mechanical spaces, above ceilings, and other spaces where exposed wiring could be damaged. Refer to Section 25 0528 for pathway requirements.
- M. Remove all abandoned wiring. Engineer to identify abandoned wiring and coordinate with DMS before removal.
- N. Refer to Section 25 05 53 for label requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Store all products according to manufacturer's recommendations.
- B. Protect stored cable from vandalism and weather.
- C. Store cable and equipment no more than 6 weeks prior to installation.
- D. Maintain a minimum storage temperature of 50 Deg F.

PART 2 - PRODUCTS

2.1 FLOOR LEVEL COMMUNICAITON CABLE

A. Cabling Requirements:

- 1. Min Size: 24 AWG solid annealed copper pairs
- 2. Min Number of Conductors: 2 twisted pairs or as needed
- 3. Jacket: UL listed Teflon
- 4. Jacket color: Orange

2.2 INSTRUMENTATION SIGNAL CABLE

A. Cabling Requirements:

- 1. Min Size: 18 AWG stranded (except vendor specific instrument)

2. Min number of Conductors: 2 –4 (application specific)
3. Jacket: PVC
4. Jacket Color: Blue
5. Shield: Per manufacturer recommendations

2.3 POWER WIRE (50 VOLTS OR LESS)

A. Cabling Requirements:

1. Min Size: 18 AWG stranded
2. Number of Conductors: 2
3. Jacket: PVC
4. Jacket Color: Grey

2.4 POWER WIRE (GREATER THAN 50 VOLTS)

- A. Refer to Division 26 specifications/drawings.

PART 3 - EXECUTION

3.1 COVERAGE AREA CABLE

- A. Install cable in approved pathways only.
- B. Provide appropriate shielding to eliminate equipment noise from VFD's and other equipment.
- C. Provide additional shielding and grounding per applicable manufacturer's recommendations and/or job site conditions.
- D. Label cable according to Section 25 05 53.

3.2 INSTRUMENTATION SIGNAL CABLE

- A. Provide signal cables for instrumentation.
- B. Install cable in approved pathways.
- C. Provide appropriate shielding to eliminate equipment noise from VFD's and other equipment.
- D. Provide isolated instrument grounding system as per manufacturer's recommendations.
- E. Terminate instrument cables at terminal blocks or terminal strips in cabinets.
- F. Label cable according to Section 25 05 53.

3.3 POWER WIRE (50 VOLTS OR LESS)

- A. Unless otherwise specified or noted, provide final power connections including conduit, wire, and/or control panel disconnect switches to all control devices from appropriate electrical junction box.
- B. Provide power cables for instrumentation and devices.
- C. Install cable in approved pathways.

3.4 POWER WIRE (GREATER THAN 50 VOLTS)

- A. Provide final power cables and connections for instrumentation and devices.
- B. Install cable in approved pathways.

3.5 FIELD QUALITY CONTROL (TESTING)

- A. Verify cable shield or coupled bonding conductor for end-to-end continuity.

END OF SECTION 25 05 13

SECTION 25 05 28 - PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes complete pathway system and requirements for Integrated Automation including but not limited to:
 - 1. Conduit and fittings
 - 2. Outlet boxes
 - 3. Pull and junction boxes
 - 4. Sleeves
- B. Related Sections:
 - 1. 25 05 13 Conductors and Cables

1.2 DEFINITIONS

- A. Pathways-Support and protection system for conductors and cabling.
- B. Sleeves - Protection for wall and other penetrations.

1.3 SYSTEM DESCRIPTION

- A. All integrated automation systems must be in approved pathways.
- B. Approved pathways include:
 - 1. Conduit as specified in Division 26 specifications/drawings.
 - 2. Cable tray as specified in Division 27 specifications/drawings.
- C. Includes conduit pathway for the Integrated Automation System where not in cable tray.
- D. Includes a complete independent conduit pathway system for the Smoke Control System and any components of the Smoke Control System.
- E. Where specifically allowed or specified, pathway system includes hangers, bridle rings, j-hooks and other supports for cabling not required to be in conduit.

1.4 SUBMITTALS

- A. Refer to Division 26 specifications/drawings.

1.5 QUALITY ASSURANCE

- A. Install pathways parallel and perpendicular to building structure. Coordinate space requirements with other trades. Avoid horizontal runs through walls.
- B. Provide protection for penetrations appropriate to the type of assembly penetrated.
- C. For fire-rated construction, seal penetrations to maintain fire rating of construction penetrated.
- D. In addition to other pathway requirements, low voltage cable must be in an enclosed pathway system for exposed areas, inaccessible spaces (including walls), electrical and mechanical spaces, etc.
- E. Do not install pathways on floor structure or in any way that may obstruct access to equipment, spaces, walkways, etc.
- F. Support pathways appropriately to avoid movement, vibration, etc.
- G. Refer to Division 26 specifications/drawings for additional requirements.

H. Where conduit is not required:

1. Space J-hook cable supports every 4 ft or in accordance with cable manufacturer's specifications, whichever distance is shorter. Use of tie-raps, structure, ductwork, wire, etc. for support is prohibited.

I. Cable shall be free of tension at both ends. In cases where cable must bear stress, provide Kellems grips to spread stress over longer length of cable.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 26 specifications/drawings.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Verify routing and termination locations of pathways prior to rough-in.

B. Coordinate equipment, floor, wall and roof penetrations with appropriate trades.

1. Provide penetrations for pathways.
2. Provide appropriate sleeves for penetrations.
3. Provide fire-stopping as described in Architectural or Electrical specifications.

C. Provide pathways for all work within this division.

1. Provide non-continuous pathway systems from wall sensor conduit stub to associated controller.
2. Provide non-continuous pathway system from controller to Information Management Outlet (IMO).
3. Provide non-continuous pathway system from controllers to Horizontal Connection Points (HCPs).
4. Provide non-continuous pathway system for air terminal reheat valves and discharge air sensors.
5. Provide continuous enclosed conduit pathway systems in mechanical spaces, electrical spaces, exposed areas and in any areas not specifically allowed to be non-continuous pathways.
6. Provide continuous enclosed conduit pathway systems for Smoke Control System.

D. Size conduit and boxes by circular mil size of cable in conduit or box.

E. Minimum conduit size is 3/4" unless otherwise noted.

F. Maximum length of flexible conduit is 3 feet.

G. Refer to Division 26 specifications/drawings for additional requirements.

2.2 PROTECTION

A. Conduit and raceway penetrations through walls, floors, and ceilings require firestopping.

B. Provide sleeves for penetrations. Coordinate sleeve selection and application with Division 26 specifications/drawings.

C. Furnish information as to size and location of built-in openings required.

D. Do not cut, remove, or pierce general or mechanical insulation, fire rated walls, ceilings, or steelwork without prior permission and instruction.

E. Provide conduit to protect pneumatic tubing outside of panels.

F. Provide appropriate protection for all work within this division.

G. Refer to Division 26 specifications/drawings for additional requirements.

END OF SECTION 25 05 28

SECTION 25 05 53 - IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section defines labeling requirements for control panels, instrumentation, including, control valves, control room instruments, panel instruments, wire, cable, and tubing.
- B. Related Sections:
 - 1. 25 05 28 Pathways
 - 2. 25 35 19 Control Valves
 - 3. 25 35 23 Control Dampers
 - 4. ~~25 35 24 Smoke Dampers~~
 - 5. 25 12 23 Client-Server Information/Database Integration
 - 6. 25 14 00 Local Control Units
 - 7. 25 14 23 Field Equipment Panels

1.2 SUBMITTALS

- A. Sample valve, damper and other instrument tags.
- B. Sample wire, cable and tubing tags.
- C. Sample panel tags.
- D. Sample tagging abbreviations (if used).
- E. Installation methods for each type and condition.

1.3 QUALITY ASSURANCE

- A. Tag each valve, damper and instruments according to contract documents.
- B. Where major devices are above ceiling, provide identification on ceiling grid to assist in locating device.
- C. Tags shall be machine generated and easily readable.
- D. Tags shall be appropriate for the environment installed.
- E. Do not mark on instruments with permanent markers, i.e. felt pens or paint sticks.
- F. Install tags for easy readability.
- G. All identification in a single infrastructure must have the same format where possible.
- H. Equipment, panel, and instrumentation tags should be coordinated for consistency with Owners' automation system and work order management system.

PART 2 - PRODUCTS

2.1 INSTRUMENT IDENTIFICATION

- A. Construction:
 - 1. 1/16" thick laminated phenolic plastic, white with black core.
 - 2. Nominal size of 1" high by 1 to 4" wide.
 - 3. Stamped in 1/4" high block characters.
- B. Self-adhesive identification is not acceptable where conditions will allow for permanent mounting.

2.2 CONTROL PANELS IDENTIFICATION

A. Construction:

1. 1/16" thick laminated phenolic plastic, white with black core.
2. Nominal size of 2" by 4".
3. Stamped 1" high block letters.

B. Self-adhesive is acceptable where conditions will allow for permanent mounting.

2.3 VALVE AND DAMPER IDENTIFICATION

A. Construction:

1. 1/16" thick laminated phenolic plastic, white with black core or minimum 0.032" thick, polished brass or 316 stainless steel.
2. Nominal size of 2" by 4".
3. Stamped 1" high block letters.

B. Hanging type only, self-adhesive is not acceptable for permanent mounting.

2.4 WIRE, CABLE AND TUBE IDENTIFICATION

A. Heat Shrink Tubing:

1. Manufacturer: Rhino or Brady Bradysleeve.
2. Labels shall be heat shrink tubing type. Heat shrink labels shall be used on wire, cable, and tubing except for vendor specific cables which may not be cut.

B. Self-Laminating Wrap-On Labels:

1. Manufacturer: Rhino or Brady WML series.
2. Self-Laminating Wrap-On Type Labels shall be self-laminating wrap-on type. Self-laminating, wrap-on labels shall be used only on wire, cable, which may not be cut, and on tubing.

C. Self-adhesive is acceptable where conditions will allow for permanent mounting

2.5 CONDUIT IDENTIFICATION

A. Blue paint and black stencil lettering on junction box covers

B. Blue paint on automation conduit.

PART 3 - EXECUTION

3.1 INSTRUMENT IDENTIFICATION

A. Label each instrument with hardware tag and software name.

1. Instrument hardware tagging shall be according to symbols and tag numbers used on control diagrams.
2. Instrument software name shall be according to database generated point name. Coordinate with section 25 12 23.

B. Size label to accommodate instrument tag number and description.

C. Affix label to permanent to instrument or housing (if direct instrument mounting is unreasonable).

D. Fastening Methods for indoor applications:

1. Self-adhesive or double-side adhesive tape.
2. Epoxy Cement as required

- E. Fastening Methods for weather exposed or other conditions where self-adhesive is impractical:
 - 1. Field tags: Use Round head, No. 0 x 3/16", Type U, metallic drive screw, (0.075 diameter, blunt), size 51 (0.067") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.
 - 2. Panel face: Use Phillips panhead, No. 2-56 x 5/16", Type T, self-tapping sheet metal screw (0.086 diameter., blunt, notched), size 48 (0.076") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.
- F. Provide control panel interior mounted instrument tags. Engraved legend shall be instrument tag number

3.2 CONTROL PANEL IDENTIFICATION

- A. Provide control panel face mounted instrument tags as required. Engraved legend form and follows:

PROCESS EQUIPMENT IDENTIFICATION
DEVICE FUNCTION
INSTRUMENT TAG NUMBER

- 1. Instrument tag number shall be; device address # (node) and the equipment controlled.
- 2. Coordinate label tags and format prior to purchasing or installation.
- 3. Provide phenolic tag for each controller.

3.3 VALVE AND DAMPER IDENTIFICATION

- A. Provide valve and damper tags for controlled equipment.
- B. Valve and damper tags number shall be per contract documents and owner's standard.
- C. Coordinate label tags and format prior to purchasing or installation.

3.4 WIRE, CABLE AND TUBE IDENTIFICATION

- A. Provide cable sheaths labeling on both ends approximately 6 inches from the termination in case the cable becomes separated from its termination.
- B. Provide a complete documented cable record for Integrated Automation systems.
- C. Label Coverage area cables at each end:
 - 1. Label terminating end with distribution location identification serving terminal device.
 - 2. Label distribution end with terminal device destination.
- D. Label instrumentation cable and tubing at each end:
 - 1. Label terminating end with panel device tag.
 - 2. Label distribution end with instrument device tag.

END OF SECTION 25 05 53

SECTION 25 12 19 - INTEGRATION PROTOCOLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Network protocol for all Integrated Automated Systems.
- B. Related Sections:
 - 1. Section 25 12 23 - Client-Server Information / Database Integration
 - 2. Section 25 13 13 - Control and Monitoring Supervisory Control
 - 3. Section 25 15 00 - Software

1.2 REFERENCES

- A. ANSI/ASHRAE Standard 135-2016 Data Communication Protocol for Building Automation and Control Systems.

1.3 DEFINITIONS

- | | |
|-----------------|--|
| A. BACnet | Building Automation and Control Network open communication protocol |
| B. BBMD | BACnet Building Management Device |
| C. BTL | BACnet Testing Laboratory |
| D. COV | Change of Value |
| E. DDC | Direct Digital Control |
| F. Fox | Proprietary Niagara protocol for communication with JACE controllers |
| G. FLN | Floor Level Network |
| H. GUI | Graphical User Interface |
| I. JACE | Java Application Control Engine |
| J. Internetwork | Integration of subnetworks into a large, site-wide network |
| K. I/O | Input/Output |
| L. IP | Internet Protocol |
| M. PICS | Protocol Implementation Conformance Statement |
| N. PID | Proportional, Integral, and Derivative Control |
| O. Protocol | An agreed-upon format for transmitting data between two devices |
| P. VACL | VLAN Access Control List |
| Q. VLAN | Virtual Local Area Network |

1.4 SYSTEM DESCRIPTION

- A. All enterprise level interconnected networks shall consist of integrated controls systems communicating via Tridium Fox Protocol.
 - 1. ASHRAE 135 BACnet/IP communication is permitted when approved by Project Owner.

- B. JACE units shall be used to facilitate translation of BACnet/MSTP protocol communication from floor level devices to Fox.
 - 1. Appropriate device drivers and/or licenses must be configured to accommodate this open protocol communication translation.
- C. JACE units shall be used to facilitate translation of proprietary Siemens protocol communication from FLN devices to Fox.
 - 1. Appropriate device drivers and/or licenses must be configured to accommodate this open protocol communication translation.
- D. LonWorks and Modbus network protocols may be used for certain system communications where BACnet/IP and MS/TP configurations are not possible.

1.5 SUBMITTALS

- A. Integration Plan:
 - 1. Proposed communication architecture including integration protocols
 - 2. Include latest version of protocol profiles used
 - a. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal.
 - b. LonWorks profiles, Modbus profiles and registry lists.

1.6 QUALITY ASSURANCE

- A. BACnet products shall be BTL compliant.
- B. Refer to 25 15 00 Software for additional information.

1.7 WARRANTY

- A. Refer to 25 1500 Software for additional information.

PART 2 - PRODUCTS

2.1 ENTERPRISE COMMUNICATION

- A. The following communication protocols shall be used for enterprise-level communication –
 - 1. BACnet/IP
 - 2. Fox (Tridium/Niagara based systems only, Default TCP port: 1911)
- B. BAS servers (physical or virtual) shall communicate via BACnet/IP or Fox protocol via DMS provided BAS Ethernet network VLAN or VACL.
- C. As necessary, provide BACnet Router units to facilitate data transfer between field-level (MS/TP) and enterprise-level networks.
- D. As necessary, provide BBMD units for each IP subnetwork.
 - 1. All system shall be configured for static BBMD only, not dynamic.

2.2 FLOOR LEVEL COMMUNICATION

- A. The following communication protocol(s) shall be used –
 - 1. ASHRAE 135 BACnet MS/TP
 - a. Set UDP port number for BACnet controllers to 47808 (Default BAC0).

- b. Siemens P1/P2 protocols may be used when BACnet MS/TP is not an option. An appropriate JACE unit must be installed to facilitate necessary translation of proprietary protocols.

END OF SECTION 25 12 19

SECTION 25 12 23 - CLIENT-SERVER INFORMATION /DATABASE INTEGRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. The database generation and integration of the Integrated Automated Systems to the Building Management System.

B. Related Sections:

1. 25 12 19 Integration Protocols

1.2 REFERENCES

- A. ANSI/ASHRAE Standard 135-2016 Data Communication Protocol for Building Automation and Control Systems.
- B. DMS Naming Conventions – Attachment 1
(<https://dms-media.ccplatform.net/content/download/170331/file/Attachment%201%20-%20DMS%20Naming%20Convention.pdf>)

1.3 DEFINITIONS

- A. Archive - Data storage.
- B. Command Priorities - The order in which commands can be executed.
- C. EBMS - Enterprise Building Management System
- D. Escalation - Alarm advancement after delay to the next level of notification.
- E. Event - Alarm, transaction, or sequence.
- F. Global Strategies - Strategies requiring integration of different systems.
- G. Mapping - The act of integrating data points from different systems back to the Building Management System.
- H. Normalize - Create consistency among dissimilar data for a specific use.
- I. Real-time - Up to the minute.
- J. Trend - Record data for specified time intervals.

1.4 SYSTEM DESCRIPTION

- A. The integration of the various systems throughout the facility using protocols specified in Section 25 12 19.
- B. Remote read/write capabilities of Integrated Automated Systems using open communication protocols, BACnet/IP and BACnet MS/TP. Fox protocol will be used for communication between JACE units and enterprise-level supervisory systems.
- C. Integrated Automation System shall have the capability to integrate with the following:
1. Web Services
 2. Fox
 3. BACnet/IP
 4. Lon/IP
 5. Modbus/IP

D. Scope includes but not limited to:

1. Data collection
2. Database generation
3. Graphics generation
4. Global control strategies generation and implementation
5. Scheduling generation
6. Permanent trending and storage of all points for 7 years
7. Alarm generation and management
8. Web Page Development
9. Reports generation
10. Coordination of integration activities

E. Provide supplementary or miscellaneous items, products, and labor incidental to, or necessary for complete integration of systems to the Integrated Automation System.

F. Contractor to lead the coordination effort with vendors for integration activities.

G. Server(s) is (are) existing and located at DMS Operations and Controls Center (OPCON).

1.5 SUBMITTALS

A. Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

B. Submit shop drawings which include the following in the project's control system drawing set:

1. Control system drawings title sheet
2. List of I/O Points and naming convention
3. Control system components list
4. Control system schematics
5. HVAC equipment electrical ladder diagrams
6. Component wiring diagrams
7. Terminal strip diagrams
8. BACnet communication architecture schematic
9. Sequence of operations

C. Submit all product data information for integrated controls, associated hardware and software.

1. Direct digital controllers
2. JACEs
3. BACnet Protocol Analyzer (traffic monitoring)
4. Coordinate Protocol Analyzer requirement with DMS for each project.
5. DDC Software
6. BACnet Operator Workstation DDC Software
 - a. Include BACnet PICS for Operator Workstation software.
7. Notebook Computer with appropriate software for Maintenance Department
8. Sensors and Input Hardware
9. Output Hardware
10. Surge and transient protection
11. Design Data
12. Contractor's Qualifications
13. Operation and Maintenance Data
14. Controls System Operators Manuals
15. Closeout Submittals
16. Training documentation

1.6 QUALITY ASSURANCE

- A. Scope and products included in this section shall be compatible and consistent with existing Integrated Automation System.
- B. Limit temperature readings to 1 decimal unless otherwise noted.
- C. All new control hardware must be manufactured and labeled 'Made in America'.

1.7 WARRANTY

- A. Refer to 25 00 00.

1.8 OWNER'S INSTRUCTIONS

- A. Refer to Commissioning Specifications for requirements.
- B. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar BACnet DDC systems.
- C. Provide 32 hours of off-site training by factory trained instructor for 4 people. Include travel and hotel accommodations.
- D. Provide an additional 24 hours of on-site training by factory trained instructor of Owner specific subject, after 6 months of occupation and prior to end of warranty.
- E. Coordinate and schedule training with Owner.
- F. The project's approved Controls System Operators Manual shall be used as the training basis.
 - 1. The Contractor shall ensure the manuals are submitted, approved, and provided to the trainees before the start of training.
- G. All training shall be recorded by the HVAC or relevant contractor. Two copies of recorded training material shall be provided to the Project Owner's Facilities personnel.
 - 1. Provide physical copies of visual aids used (e.g. PowerPoint presentation).
- H. At minimum, the off-site training must include the following:
 - 1. Global control strategies explanation and BACnet fundamentals (objects, services, addressing)
 - 2. Web services data management, functions, and toolkit
 - 3. Design requirements and sequence of operations
 - 4. Network architecture and site layout
 - 5. Project's list of control system components and list of points and objects
 - 6. Using O&M documents
 - 7. Basic and advanced operator functions (e.g.: setpoint adjustments, overrides, etc.)
 - 8. Graphic generation and modifications
 - 9. Report features and generations
 - 10. Exporting data to third party software
 - 11. Creating, editing, and viewing trends
 - 12. Creating, editing, and acknowledging alarms
 - 13. Creating, editing, and viewing operating schedules and schedule objects
 - 14. General adjustments and troubleshooting
 - 15. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics
 - 16. Creating new graphics and adding new dynamic data displays and links
 - 17. Alarm and event management
 - 18. Modifying and downloading control program changes
 - 19. Using each operator interface to find, read, and write to specific controllers and objects.
 - 20. Drawings and Specification review

1.9 COMMISSIONING

- A. Refer to Commissioning Specifications for requirements.

PART 2 - PRODUCTS

- A. Enterprise Level: Tridium Niagara 4 platform and JACE integrators
- B. Necessary BACnet routers to ensure proper network communications per control design drawings.

PART 3 - EXECUTION

3.1 DATA COLLECTION

- A. Provide mapping of points from various automated systems. Provide the ability to read and display any value of any used property of any object from any networked device including properties available and supported optional properties, as well as proprietary extensions.
- B. Normalize and archive data simultaneously at minimum every 15 minutes.
- C. Timestamp all data.
- D. Normalize data points shown in contract documents for ease of database management, graphic displays, readability, and simple identification.
- E. Provide real-time dynamic screen updates for all points.

3.2 Database GENERATION

- A. Develop relational database of data objects, time stamps, events, alarms, and transactions.
- B. Provide the ability to modify loop Object setpoints, alarm limits, tuning parameters, routing, scheduling etc. initiated through operator interaction with graphics displays.
- C. Archive all data points, graphics, reports, alarms, trends, events, and transactions.
 - 1. Store data for 7 years.
 - 2. Make data available for industry standard 3rd party applications and application implementation.
- D. Develop databases including:
 - 1. Applications
 - 2. Configuration
 - 3. Trending or historical Data Event storage
- E. Include construction document Tag for Hardware objects.
- F. Coordinate point naming standards with Owner, prior to any database generation.

3.3 Trends

- A. Configure all analog inputs, digital inputs, analog outputs, digital outputs, and software value trends as shown on control drawings.
- B. Analog points shall be trended at 15-minute intervals.
- C. Digital points shall be trended on change of value or state.
- D. Normalize trend data for common reporting and archiving.
- E. Provide initial trend graphs and reports per Owner request.

- F. Coordinate with Owner and Engineer for list of points to have dual trends. The first set of trends will be per items 2 and 3 above. Configure the following points for an additional set of trends at 1-minute intervals:
1. Air Handling Units
 - a. Outside air damper command
 - b. Outside air flow meter
 - c. Outside airflow setpoint
 - d. Return air flow meter
 - e. Return air fan speed
 - f. Return air static pressure
 - g. Return air static pressure setpoint
 - h. Return air damper command
 - i. Relief air damper command
 - j. Return air CO2
 - k. Mixed air temperature
 - l. Heating hot water coil control valve command
 - m. Heating hot water leaving air temperature
 - n. Heating hot water coil leaving air temperature setpoint
 - o. Cooling coil control valve command
 - p. Cooling coil leaving air temperature
 - q. Cooling coil leaving air temperature setpoint
 - r. Supply air flow meter
 - s. Supply fan VFD speed command
 - t. Supply static pressure setpoint
 - u. Supply static pressure
 - v. Supply discharge air temperature
 2. Air Terminal Devices
 - a. Supply airflow
 - b. Supply damper command
 - c. Supply airflow setpoint
 - d. Hot water control valve command
 - e. Electric reheat command
 - f. Discharge air temperature
 - g. Return/exhaust airflow
 - h. Return/exhaust air damper command
 - i. Return/exhaust airflow setpoint
 3. Laboratories and Related Exhaust Systems
 - a. Exhaust air static pressure
 - b. Exhaust fan VFD speed command
 - c. Exhaust air static pressure setpoint
 - d. Lab offset
 - e. Total supply air
 - f. Total fume exhaust
 - g. Total general exhaust
 4. Chilled Water Systems
 - a. Differential pressure
 - b. Differential pressure setpoint
 - c. Pump speed
 - d. Building chilled water return temperature
 - e. Building supply chilled water flow
 - f. Building supply chilled water temperature
 - g. Bypass chilled water valve command
 5. Condenser Water Systems

- a. Cooling tower fan speed
- b. Cooling tower leaving water temperature
- c. Cooling tower leaving water temperature setpoint

6. Hot Water Systems

- a. Building supply hot water temperature
- b. Building return hot water temperature
- c. Differential pressure setpoint
- d. Differential pressure
- e. Boiler return water flow
- f. Pump speed

3.4 Global STRATEGIES

- A. Coordinate initial global control strategies with Owner.
- B. Implement initial global strategies including but not limited to:
 - 1. Economizer (based on weather data)
 - 2. Energy Calculations

3.5 Schedules

- A. Coordinate initial schedules requirements with Owner.
- B. Input initial equipment schedules per Owner request.
- C. Input initial report schedules per Owner request.

3.6 Alarm MANAGEMENT

- A. Provide alarms including:
 - 1. Any point reaching a high or low limit
 - 2. Anytime feedback does not equal command
 - 3. Points overridden
- B. Provide alarms for all points. Coordinate with Owner and include the following:
 - 1. Point Name and Description
 - 2. Alarm differentials (automatically adjust with setpoints)
 - 3. Units
 - 4. Coordinate settings (limits or state) with Owner
 - 5. Instrument tag
 - 6. Priority
 - 7. Message
- C. Coordinate and implement alarm notifications and routing with the Owner. Include:
 - 1. Email
 - 2. Group and network notifications
 - 3. Alarm acknowledgement
 - 4. Existing Maintenance Management System
- D. Provide hardware or interface required to implement alarm notification and routing.
- E. Provide state-based alarming to prevent alarms during specific equipment states.
 - 1. Interlock equipment status and/or modes to lock out associated alarms during shutdowns.
 - 2. Interlock acknowledgement to lock out associated alarm for limited adjustable time period.

F. Provide alarms suppression, to minimize nuisance alarms resulting from higher level alarms.

1. Hot water and chilled water alarms master to AHU temperatures.
2. AHU alarms master to associated ATU and room temperatures.
3. Fire alarms master to associated HVAC equipment.

System	Alarm Inputs	Associated Equipment Alarm Suppression					
		All Temperature Alarms	AHU Temperature Alarm High	AHU Temperature Alarm Low	Zone Temperature Alarm High	Zone Temperature Alarm Low	Zone Flow Alarm Low
Fire Alarm	General Alarm	X					
Schedules	Unoccupied	X	X	X	X	X	X
Chiller System	Status Off (Alarm or Normal)		X		X		
Chiller System	Supply Temperature - High		X		X		
Chiller System	Differential Pressure - Low		X		X		
HHW System	Status Off (Alarm or Normal)			X		X	
HHW System	Supply Temperature - Low			X		X	
HHW System	Differential Pressure - Low			X		X	
AHU	Status Off (Alarm or Normal)		X	X	X	X	X
AHU	Supply Temperature - High		X		X		
AHU	Differential Pressure - Low		X	X	X	X	X
Building CHW Pumps	Status Off (Alarm)		X		X		X
Building CHW Pumps	Differential Pressure - Low		X		X		X
Building HHW Pumps	Status Off (Alarm)		X		X		X
Building HHW Pumps	Differential Pressure - Low			X		X	

G. Filter and route alarms based on user log in.

H. Allow alarms to be sorted and displayed chronologically, priority, filtering, etc.

I. Provide alarms for conditions such as offline and poor communication performance.

J. Archive all data in standard database platform Microsoft Data Engine or Microsoft SQL. Including but not limited to:

1. I/O points
 2. Software points such as:
 - a. Alarm limits
 - b. Setpoints
 - c. Parameters
 3. Schedules
 4. Alarm messages
- K. Configure the following alarms in categories as identified.
1. Critical Mechanical
 - a. Air Handling Units
 - 1) Supply air static pressure
 - 2) Supply air temperature
 - 3) Supply air fan status
 - 4) Return air fan status
 - 5) Outside air fan status
 - 6) Exhaust air fan status
 - 7) Supply VFD status
 - 8) Exhaust VFD status
 - 9) Supply fire smoke damper command
 - b. Energy Recovery Units
 - 1) Exhaust air fan low static status
 - 2) Exhaust air fan status
 - 3) Outside air VFD status
 - c. Chilled Water Systems
 - 1) Chiller status
 - 2) Pump status
 - 3) Plant chilled water supply temperature
 - 4) Leaving chilled water temperature
 - 5) Entering chilled water temperature
 - 6) Manual reset
 - d. Condenser Water Systems
 - 1) Cooling tower fan status
 - 2) Pump status
 - 3) System flow
 - 4) Tower sump level transmitter
 - e. Hot Water Systems
 - 1) Boiler alarm status
 - 2) Pump status
 - 3) Building supply hot water temperature
 - 4) Condensate pump status
 - 5) Heat exchanger hot water supply temperature
 2. General
 - a. Condenser Water System
 - 1) Leaving condenser water temperature
 - 2) Entering condenser water temperature
 3. Maintenance
 - a. Air Handling Units

- 1) Pre-filter differential pressure
- 2) Final-filter differential pressure
- b. Energy Recovery Units
 - 1) Exhaust air filter status
 - 2) Outside air filter status
- c. Condenser Water System
 - 1) Cooling tower vibration transmitter

3.7 REPORTS

- A. Coordinate report requirements with Owner.
- B. BAS shall provide on-screen commands to generate and format reports for displaying on active Workstation, printing, and exporting.
 1. Dynamic operation of the system shall not be interrupted by report generation.
- C. BAS shall allow for automatic or manual generation of reports. For automatic reports, the operator shall be able to specify the time the initial report is to be generated, the time interval between reports, ending period, and the report's output format. For manual reports, the operator shall be able to request and generate at any time while using the system.
- D. Provide reports in standard or 3rd party formats for the following:
 1. Points and objects
 2. Alarms and frequency
 3. Schedules
 4. Utilities or Energy Management
 5. Trends
 6. Historical
 7. Transactions
 8. Point overrides and lock-outs
 9. Diagnostic or system status
 10. Commissioning reports
 11. Disabled points
 12. Equipment runtime
- E. Provide initial reports per Owner request.
- F. Schedule initial reports printouts daily per Owner request including:
 1. Alarms and frequency
 2. Point overrides and lock-outs
 3. Disabled points
- G. Schedule initial reports printouts monthly per Owner request including:
 1. Utilities or Energy Management
 2. Diagnostic or system status
 3. Commissioning reports
 4. Equipment runtime

3.8 AUDITING

- A. The BAS software shall maintain a historical file logging all system and user activity.
 1. Software must maintain log files for a minimum of 2 years and provide suitable storage space.
- B. The file shall maintain the following at a minimum –

1. Operator Logins
2. Alarm Acknowledgments
3. Commands Issued
4. Database Modifications

3.9 USER ACCESS CONTROL AND SECURITY PERMISSIONS

- A. BAS software shall interface with a suitable user authentication platform such as the following:
 1. Microsoft Active Directory
 2. Lightweight Directory Access Protocol (LDAP) Server
 3. Local BAS Software Platform
- B. User accounts and system access shall be assigned by software administrators and unique for all users.
- C. Standard user permission levels (from most restrictive to most permissive) shall include –
 1. Visitor
 - a. View Data and Trends
 2. Operator
 - a. View Data, Trends, and Reports
 - b. Acknowledge Alarms
 - c. Override Points
 - d. Change Setpoints
 - e. Change Schedules
 3. Engineer (tasks in addition to those in Operator level)
 - a. Add Devices
 - b. Change Device Addresses
 - c. Create Applications
 - d. Download Applications
 - e. Configure ASCs
 - f. Setup Trends and Reports
 - g. Modify Alarm Settings
 - h. Create and Modify System Graphics.
 4. Administrator (tasks in addition to those in Engineer level)
 - a. Assign, Manage, and Edit User Access Control
- D. Passwords shall be unique to each account and not displayed during log-in process
- E. BAS shall provide automatic log-out functionality when no user activity is detected at the workstation (keyboard and mouse). The default time-out period (5 minutes) may be modified by the system administrator. The workstation shall notify the user of an automatic log-out via display message on graphical display.

3.10 CALCULATIONS

- A. Provide calculations for dynamic points including:
 1. Real Time chilled water consumption (KTons) - As Applicable
 2. Real Time cost per KTons of cooling - As Applicable
 3. Real Time steam consumption (lbs/hour) - As Applicable
 4. Real Time hot water consumption (KBTUH) - As Applicable
 5. Real Time Electric consumption
 6. Real Time Domestic Water consumption - As Applicable
 7. Real Time total building energy cost (\$/sq. ft.)

B. Provide calculations for totalization points including:

1. Runtime Hours on major equipment
2. Monthly Energy Cost
3. Yearly Energy Cost

3.11 NIAGARA COMPONENT NAMING

A. In a Niagara station, components shall be properly named using the following set of rules:

1. Only alphanumeric (A-Z, a-z, 0-9) and underscore(_) characters are allowed. Spaces, hyphens, and other symbols are prohibited.
2. The first character in the name must be a letter.
3. Name must be unique for every component in the same parent component.
4. Naming is case sensitive. For example, zone1 and Zone1 are unique names.
5. Abbreviations are the preferred method of naming components. Only the approved abbreviations in paragraph G shall be used in component names.
6. Absent an approved abbreviation, word names shall be treated as title case with the first letter of each word capitalized. For example, Return Air Temp.
7. Component names shall not use leading zeros. For example, AHU1.

3.12 POINT OBJECT NAMING CONVENTION

A. Point objects describe a point, such as analog or binary inputs and outputs. Point objects may be derived from the standard BACnet catalog or customized via vendor. BACnet defines the following object types of standard objects and defines their required minimum behavior.

1. Binary Input, Output, and Value
2. Analog Input, Output, and Value
3. Averaging / Totalization
4. Life Safety Zone and Life Safety Point
5. Multi-state Input, Output, and Value
6. Loop
7. Calendar
8. Notification Class
9. Command
10. File
11. Program
12. Schedule
13. Trend Log
14. Group
15. Event Enrollment
16. Device

B. Point Object Naming Configuration

1. Level 1 – Site / Building
2. Level 2 – Area / Floor / Room
3. Level 3 – Equipment and System Type
4. Level 4 –Object/Point Map Legend

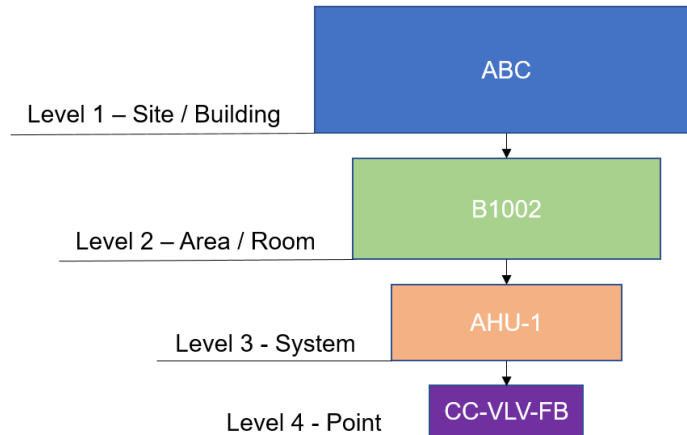
C. Object/Point Identifiers

1. BACnet Object names and IDs shall be unique within each programmed device
2. BACnet Device names and IDs shall be unique within the entire BACnet system
3. BACnet Network Numbers shall be unique and consistent within the entire BACnet network.
4. Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor's discretion but shall be approved by the Project Owner.

D. Object/Point Naming Example

1. Feedback valve on the cooling coil of AHU-1 in area B1002 at the site ABC

- a. ABC.B1002.AHU-1.CC-VLV-FB



E. BACnet NAME AND ADDRESS CONVENTION

1. Coordinate with Project Owner and employ unique names and addresses for BACnet networks, integrated devices, and objects (as applicable via Section 3.11.A.1-11) per instructions from the Project Owner.
2. MAC Address
 - a. Every BACnet device shall have a unique assigned and documented MAC Addresses to its network. For Ethernet/IP, document the MAC Address assigned at its creation. For MS/TP, assign from range as provided in vendor documentation.
3. Network Numbering
 - a. Assign unique numbers to each new network installed on the BACnet internetwork. Provide capability for modifying network number via devices switches, network computer, or field operator interface. The BACnet internetwork (all possible network configurations) can contain up to 65,534 possible unique network broadcasts.
4. Device Object Identifier Property Number
 - a. Assign unique Device “Object Identifier” property numbers or device instances for each device on the BACnet internetwork. Provide capability for future modification of the device instance number via device switches, network computer, or field operator interface. (Note: BACnet permits up to 4,194,302 possible unique devices per internetwork.)
5. Object Name Property Text (non-Device Objects)
 - a. The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include “Zone 1 Temperature” and “Fan Start/Stop”.
6. Object Identifier Property Number (non-Device Objects)
 - a. Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor’s discretion but shall be approved by the Project Owner. In this case, they shall be documented and unique for like object types within the device.

F. Level 3 – System Types

Name	Description
AHU	Air Handling Unit
BLR	Boiler
CAV	Constant Air Volume Terminal Unit
CH	Chiller
CHW	Chilled Water Circuit
CHWP	Chilled Water Pump
CRAC	Computer Room Air Conditioning Unit
CT	Cooling Tower
CW	Condenser Water Circuit
CWP	Condenser Water Pump
DTW	Dual Temperature Water Circuit
EF	Exhaust Fan
EH	Electric Heater
FCU	Fan Coil Unit
FP_VAV	Fan Powered Variable Air Volume Terminal Unit
HHW	Heating Hot Water Circuit
HHWP	Heating Hot Water Pump
HX	Heat Exchanger
LAB	Laboratory Space
MX	Mini-split
RF	Return Fan
RM	Room
RTU	Roof Top Unit
SF	Supply Fan
VAV	Variable Air Volume Terminal Unit

G. Level 4 – Point Types

Name	Description
ALM	Alarm
BP_DMPR	Bypass Damper
CC	Cooling Coil
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
CLG	Cooling Mode

Name	Description
COP	Coefficient of Performance
CV	Constant Volume
DA	Discharge Air
DH	Duct Heater
DISC	Disconnect
DMPR	Damper
DP	Differential Pressure
DR	Drain
EA	Exhaust Air
ENA	Enable
FB	Feedback
FFILT	Final Filter
FILT	Filter Assembly
FLOAT	Float Switch
FLOW	Measured Flow (air or water)
FW	Fan Wall
H	Humidity
HC	Heating Coil
HEPA	HEPA Filter
HHW	Heating Hot Water
HHWR	Heating Hot Water Return
HHWS	Heating Hot Water Supply
HL	High Limit
HPS	High Pressure Steam
HSP	High Static Pressure
HTG	Heating Mode
HUM	Humidifier
LL	Low Limit
LPS	Low Pressure Steam
LSP	Low Static Pressure
LT	Low Temperature
MA	Mixed Air
MAX	Maximum
MIN	Minimum
MUA	Makeup Air
MZ	Multizone

Name	Description
OA	Outdoor Air
OCC	Occupancy Schedule
OCC_CLG	Occupied Cooling Mode
OCC_HTG	Occupied Heating Mode
P	Pressure
PFILT	Prefilter
PHC	Preheat Coil
PL	Plenum
PRV	Pressure Relief Valve
RHC	Reheat Coil
SA	Supply Air
SMK	Smoke Detector
SP	Setpoint
SPEED	Fan Speed
SRV	Service
ST	Status
STM	Steam
STATIC	Static Pressure
T	Temperature
TSTAT	Thermostat
UNOCC_CLG	Unoccupied Cooling Mode
UNOCC_HTG	Unoccupied Heating Mode
UV	Ultraviolet Light
VFD	Variable Frequency Drive
VLV	Valve
WB	Wet Bulb
VP	Velocity Pressure
YTD	Year to Date
ZN	Zone

END OF SECTION 25 12 23

SECTION 25 13 00 - CONTROL AND MONITORING NETWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a complete microprocessor controlled BACnet compatible control and monitoring network for the various systems connected to the BAS communication network including, but not limited to:
 - 1. Air Handlers (CRAC Units)
 - 2. Variable Air Terminals / Fan Powered VAV Air Terminals
 - 3. Fan Coil Units
 - 4. Pumps
 - 5. Heat Exchangers
 - 6. Air Conditioners
 - 7. Heaters
- B. For renovation projects, utilize a JACE controller with appropriate drivers to facilitate communication between enterprise level and existing Siemens floor-level networks.
- C. The Control and Monitoring Network shall integrate to the following systems:
 - 1. Variable Frequency Drives
 - 2. Electrical Power
 - 3. BAS
- D. Related Sections
 - 1. 25 00 00 Integrated Automation
 - 2. 25 12 23 Client-Server Information Database Integration
 - 3. 25 14 00 Local Control Units

1.2 REFERENCES

- A. UL 916 Energy Management Systems

1.3 DEFINITIONS

- A. FLN Floor Level Network
- B. MS/TP Master Slave Token Ring-Passing

1.4 SYSTEM DESCRIPTION

- A. The Control and Monitoring Network shall utilize an open architecture capable of the following:
 - 1. Utilizing standard Ethernet communications and operating at a minimum speed of 10/100 Mb/sec.
 - 2. Communication via Foxprotocolat the Tier 1 level.
 - 3. BAS network shall support copper and optical fiber communication media at the Tier 1 level.

1.5 SUBMITTALS

- A. Submit BAS device schedule. Include:
 - 1. Device name and physical address
 - 2. Device I/O points
 - 3. Associated Building Level Controller

4. Device location
 5. Associated system
 6. Location served
 7. Make and model number of controller
 8. Shop Drawings:
 - a. Control drawings
 - b. Wiring details
 - c. Installation details
 - d. Bill of materials
 - e. Sequence of Operations
 - f. Panel layout for major control panels
 - g. Connection Approval Worksheet (DMS Document)
- B. Submit riser and protocol requirements for all devices on the FLN.
 - C. Submit grounding and shielding requirements.
 - D. Submit termination requirements.
 - E. Submit distance limitations if any.

1.6 QUALITY ASSURANCE

- A. Documented history of compatibility by design for a minimum of 2 years.
- B. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels and extend new field panels on a previously installed network.
- C. Prior to start-up, provide hardware representative for an on-site plugfest as described in Section 25 00 00.
- D. Conform to UL 916.
- E. Advanced and application specific controllers: Do not exceed 80% of manufacturer recommended device count on MSTP bus.
- F. Minimum 38,400 BAUD rate for MSTP network.

1.7 SYSTEM STARTUP

- A. Document system start up.
- B. Coordinate with other trades.

PART 2 - PRODUCTS

2.1 network ARCHITECTURE

- A. Complete communication architecture for BAS devices as well as other integrated vendor devices.
- B. Complete device programming capabilities via Operator Workstation.

2.2 CORESWITCHES

- A. Owner will provide all core switches.

2.3 ACCESS SWITCHES

- A. Owner will provide all access switches.
- B. No additional switches shall be added to Owner's network.
- C. All middleware devices shall be approved by owner prior to purchase and installation.

2.4 MANAGEMENT INTERFACE REQUIREMENTS

- A. Refer to Owner's IT standards on the requirements for interface and management.

2.5 CONTROLS FAULT-TOLERANCE

- A. Provide fault-tolerant controls (devices and network configuration) to prevent entire system shutdown when functionality of a single controller or device is lost.
- B. DDC Devices must have sufficient I/O capacity to perform and manage specific control sequences and include all points listed in point schedules.
- C. Analog control loops for major equipment (boilers, air handlers, etc.) shall have PID control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide system to monitor and/or control of BAS devices.
- B. Connect to 3rd party equipment per network diagram.
- C. Provide and coordinate all points for inclusion in database generation per section 25 1223.
- D. All panels and devices shall be configured to utilize static IP addresses. IP addresses shall be provided by Owner. This process is to be managed through the Owner's PM on the project. PM will provide Device Connection Application to request authority to connect new devices to Owner's network.
- E. All BACnet instance numbers for network controllers shall be provided by Owner. Instance numbers will utilize the vendor BACnet ID as the first digit(s).
- F. All systems utilizing BACnet are to be set up for a static BBMD, not dynamic.

3.2 NETWORK ARCHITECTURE

- A. Coordinate all network communication and low voltage power requirements with appropriate contractor including the installation of cabling, and overall communication system architecture, signal quality, attenuation, power level or special needs of the control system.
- B. Coordinate communications systems design and requirements (segmenting, broadcasting, multicasting, etc.) with Owner's Information Technology Services.
- C. Layer 2/3 devices shall be used to connect segments of the LAN or multiple LANs and to filter and forward packets among them.
- D. Network switches shall provide for wired services, performance criteria and capabilities to support:
 - 1. Real-time QOS (Quality of Service)
 - 2. Multimedia priority support
 - 3. Protocol Independent Multicast and Source-Specific Multicast

- 4. Voice Prioritization (SVP)
- E. Network switches shall assure security including:
 - 1. Lightweight Extensible Authentication Protocol (LEAP)
 - 2. Protected Extensible Authentication Protocol (PEAP)
 - 3. Remote Authentication Dial-In User Service (RADIUS)
 - 4. Virtual Private Networking (VPN)
 - 5. Internet Security Protocol (IPSec)
 - 6. Point-to-Point Tunneling Protocol (PPTP) (Core/switches)
- F. Follow manufacturer's installation, programming and setup practices.

END OF SECTION 25 13 00

SECTION 25 13 13 - CONTROL AND MONITORING SUPERVISORY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. System includes:

1. Building (or network) level control units for Integrated Automation systems
2. Incidental labor and material required, for a complete and operable system.

B. System Configuration & Definition

1. Changes made at the server shall be automatically recorded and downloaded to the appropriate Controller. Changes made at the Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
2. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back up must be done with the PC workstation off-line, the Controls contractor shall provide at least 2 operator workstations.

C. Related Sections:

1. 25 12 19 Integration Protocols

1.2 REFERENCES

- A. ANSI/ASHRAE Standard 135-2016 BACnet protocol.

1.3 SYSTEM DESCRIPTION

A. Microprocessor based, field programmable controllers to:

1. Integrate systems specified.
2. Accept commands from existing enterprise server the following:
 - a. Commands
 - b. Overrides
 - c. Schedules
 - d. Interlocks
 - e. Adjustments
3. Perform standalone facility wide control strategies and sequences.

1.4 SUBMITTALS

- A. Refer to section 25 00 00.

1.5 QUALITY ASSURANCE

- A. Comply with ISO 9000 (Model for Quality Assurance in Production, Installation, and Servicing).
- B. Documented history of compatibility by design for a minimum of 2 years. Future compatibility shall be supported for no less than 7 years.
- C. Comply with the ANSI/ASHRAE Standard 135-2016 BACnet protocol in one open, interoperable system.
- D. Refer to section 25 00 00 for additional requirements.

1.6 WARRANTY

- A. Upon completion of final test of installation and acceptance by Engineer and Owner, provide any service incidental to proper performance for a period of two years.

B. Include:

1. Software revisions or updates during the warranty period.
2. Two-year warranty for parts replacement.
3. Registration and warranty documents and warranty rights to the Owner.
4. Extended warranties, if necessary, to meet the warranty requirement.
5. Software and firmware updates which resolve known deficiencies.
6. 5-year software maintenance agreement.

C. Refer to Section 25 00 00 for additional requirements.

1.7 OWNER'S INSTRUCTIONS

A. Provide 8 hours training on Local Control Units.

PART 2 - PRODUCTS

2.1 SUPERVISORY CONTROLLERS

A. Controller hardware products shall be "Made in the USA" or come through the Tridium Richmond, Virginia shipping facility.

B. The network controllers shall be provided with no connectivity restrictions on which brand stations or tools can interact with the system. The station and tool "NiCS" would be as follows:

Property	Value
STATION COMPATIBILITY IN	ALL
STATION COMPATIBILITY OUT	ALL
TOOL COMPATIBILITY IN	ALL
TOOL COMPATIBILITY OUT	ALL

C. The Supervisory Controller connects to high speed Local Area Network (LAN), serves as communications hub for other DDC on slower speed LANs, and has sufficient processor capabilities and RAM to implement all types of custom software applications.

D. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.

1. Clocks in multiple DDC's shall be synchronized to automatically match designated central server.
2. Accuracy shall be within 1 second per day.
3. The general purpose DDC Controllers shall have the ability to perform all the following energy management routines:
 - a. Time-of-day scheduling
 - b. Calendar-based scheduling
 - c. Holiday scheduling
 - d. Temporary schedule overrides
 - e. Start-Stop Time Optimization
 - f. Automatic Daylight Savings Time Switch-over
 - g. Night setback control
 - h. Enthalpy switch-over (economizer)
 - i. Peak demand limiting
 - j. Temperature-compensated duty cycling

E. Maintain volatile memory and real time clocks for a period of at least 72 hours during power failure.

1. Batteries shall be maintenance free and have minimum life of 2 years.
2. Upon power restoration, the following occurs automatically:
 - a. Orderly startup of controlled equipment (user defined)
 - b. Continuation of control algorithms

- c. Database revision
 - d. Logging of power interruption and restoration times
 - e. Battery recharging
- 3. Provide local visual indication and system annunciation of low battery power for each battery.
- F. The general purpose DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
- G. Support firmware upgrades without the need to replace hardware.
- H. Communication Speed: Controllers shall communicate at a minimum of 100 – 200 Mbps using Ethernet implemented over EIA-802.3 using a CAT.5 cable at the Data Link Layer.
- I. Include a communications port to connect display device for operator access to information and operating system functions.
- J. The communication protocols utilized will be Niagara 4 Fox, or latest version of Fox protocol compatible with all existing devices. BACnet TCP/IP, Modbus TCP and SNMP shall be optional. Use of a proprietary communication protocol is not allowed.

PART 3 - EXECUTION

3.1 SUPERVISORY CONTROLLERS

- A. Provide Supervisory Controllers as needed to accommodate network architecture and cable design. Floor level network will be by floor only (not floor to floor).
- B. Provide communication cards, repeaters, connectors, jumpers, terminals, and other hardware for complete system.
- C. Provide all software for a complete system.
- D. Coordinate final controller locations prior to installation.

END OF SECTION 25 13 13

SECTION 25 14 00 - LOCAL CONTROL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. System includes Digital Controllers for Integrated Automation systems.

B. Related Sections:

1. 25 14 00 Local Control Units
2. 25 14 23 Field Equipment Panels

1.2 REFERENCES

A. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.

B. ANSI/ASHRAE Standard 135-2016 BACnet protocol.

1.3 DEFINITIONS

- | | |
|-----------------------|---|
| A. AI | Analog Input |
| B. AO | Analog Output |
| C. DI | Digital Input |
| D. DO | Digital Output |
| E. Dry Contact | Contact closure without an electrical output (switch) |
| F. I/O | Inputs and Outputs |
| G. Ma | Milliamps |
| H. MS/TP | Master/Slave Token Passing protocol used on the EIA-485 network. |
| I. NC | Normally Closed |
| J. NO | Normally Open |
| K. Ohm | Unit of electrical resistance |
| L. PID | Proportional Integral Derivative |
| M. Setpoint | The goal of any control loop. |
| N. Stand-Alone | To operate or control without the need for higher level communications. |
| O. TAB | Test Adjust and Balance |
| P. Terminal Equipment | HVAC equipment used for localized or zone control. |
| Q. VDC | Voltage Direct Current |

1.4 SYSTEM DESCRIPTION

A. Microprocessor based, field programmable controllers, include controllers dedicated to monitor and control of specific equipment such as:

1. Air Handling Units
2. Air Terminal Units

3. Fan Coil Units
 4. Unit Ventilators
 5. Pumps
 6. Fans
 7. Remote Dampers
 8. Other miscellaneous equipment
- B. Stand-alone controllers, performing specified control sequence independently of other controllers on the structured MS/TP network.
- C. Capable of performing control and monitor functions including:
1. Stand-alone PID control.
 2. Perform specific, standalone control sequences in contract documents.
 3. Accepting voltages, current, thermistors or resistive inputs.
 4. Accepting discrete inputs from isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or normally closed (NC) configuration.
 5. Have isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or
 6. Convert controller information into output signals to actuators and field control devices.
 7. Accepting voltages 0-5 VDC or 0-10 VDC, current (0-20ma or 4-20 mA), thermistors or resistive input (0-1000 ohm).
 8. Maintain setpoints, flow limits, and occupancy schedules, etc. indefinitely in each controller's non-volatile memory.
 9. Unless otherwise specified, control to within 5% of setpoint.

1.5 QUALITY ASSURANCE

- A. Comply with the ANSI/ASHRAE Standard 135-2012.
- B. Comply with UL 916.
- C. Comply with category UUKL of UL 864 for controlling smoke and fire/smoke dampers.
- D. Limit quantity of controllers to 85% of capacity of network or segment. Include any additional hardware required.
- E. Mount controllers for easy accessibility within enclosure and outside of airstream.
- F. At time of final observation, demonstrate the sequence of operation for each system to Owner.
- G. Provide services to assist Testing, Adjust and Balancing of systems.
- H. In the event of a loss of communication, all lower controller and components shall revert to occupied mode.
 1. Power failures shall cause the control module to go into an orderly shutdown with no loss of program memory.
 2. Upon resumption of power, the Control module shall automatically restart and report the time and date of the power failure and restoration.
 3. The restart program shall automatically restart affected field equipment.
- I. Include spare I/O's for each major piece of equipment (non-terminal) controlled per the following:
 1. 2 spare AI's
 2. 2 spare AO's
 3. 2 spare DI's
 4. 2 spare DO's

1.6 WARRANTY

- A. Include:

1. Software revisions or updates during the warranty period.
2. Two-year warranty for parts replacement.
3. Registration and warranty documents and warranty rights to the Owner.
4. Extended warranties, if necessary, to meet the warranty requirement.
5. Software and firmware updates which resolve known deficiencies.
6. 5-year software maintenance agreement.

1.7 OWNER'S INSTRUCTIONS

- A. Refer to Section 25 0000 for requirements.
- B. Provide 8 hours training on Local Control Units.
- C. Provide 4 hours training for TAB contractor prior to start of Test, Adjust and Balance.

PART 2 - PRODUCTS

2.1 FIELD EQUIPMENT CONTROLLERS

- A. Basis of Design –System Edge Controller (SEC) (Refer to Drawings for additional information.)
- B. Must include the following:
 1. Communicate on the local BAS cable system.
 2. Programs and parameters stored in nonvolatile memory.
 3. Access to parameters and program via laptop computer, handheld device or network.
 4. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
 5. The controllers shall be capable of peer-to-peer communications with other SEC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem, or connected via the Internet.
 6. The communication protocols utilized for peer-to-peer communications between SEC's will be Niagara 4 Fox, or latest version of Fox protocol compatible with all existing devices. BACnet TCP/IP, Modbus TCP and SNMP shall be optional. Use of a proprietary communication protocol for peer-to-peer communications between SEC's is not allowed.
 7. The SEC shall employ a device count capacity license model that supports expansion capabilities. Shall support up to 44 IO points (10 on board IO, 34 via expansion module)
 8. The SEC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - a. BACnet
 - b. Lon
 - c. MODBUS
 - d. SNMP
 9. The SEC shall be capable of executing application control programs to provide:
 - a. Calendar functions.
 - b. Scheduling.
 - c. Trending.
 - d. Alarm monitoring and routing.
 - e. Time synchronization.
 - f. Integration of LonWorks, BACnet, and MODBUS controller data.
 - g. Application specific and custom control algorithms.
 10. The SEC shall provide the following hardware features as a minimum:
 - a. Two 10/100 Mbps Ethernet ports. The SEC shall include two Ethernet ports that are capable and by default will route data between the two ports to allow for daisy chaining.
 - b. Isolated RS-485 port
 - c. 512 MB DDR SDRAM

- d. 2GB total eMMC flash storage
 - e. High Speed Field Bus Expansion
 - f. -20-60°C Ambient Operating Temperature
 - g. Integrated 24 VAC/DC Global Power Supply
 - h. Employ Encrypted Safe Boot Technology
 - i. 5 Universal inputs: Type 3 (10K) thermistors, 0-100K ohm, 0-10VDC, 0-20mA with external resistor, Dry Contact
 - j. 2 Analog outputs: 0-10VDC, 4mA max output current
 - k. 3 Digital outputs: Triac, 24VAC @.5 amp
 - l. Option 34 IO expansion module- Niagara IO-R-34
11. The SEC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
 12. The SEC shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 13. The SEC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - a. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - 1) Alarm.
 - 2) Return to normal.
 - 3) To default.
 - b. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text.
 - 2) Email of complete alarm message to multiple recipients.
 - 3) Pagers via paging services that initiate a page on receipt of email message.
 - 4) Graphics with flashing alarm object(s).
 - c. The following shall be recorded by the SEC for each alarm (at a minimum):
 - 1) Time and date.
 - 2) Equipment (air handler #, access way, etc.).
 - 3) Acknowledge time, date, and user who issued acknowledgement.
 14. Programming software and all controller "Setup Wizards" shall be embedded into the SEC.
 15. The SEC shall support the following security functions.
 - a. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - b. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - c. Require users to use strong credentials.
 - d. Data in Motion and Sensitive Data at Rest be encrypted.
 - e. LDAP and Kerberos integration of access management.
 - f. Secure Boot technology
 16. The SEC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - a. Metadata: Descriptive tags to define the structure of properties.
 - b. Tagging: Process to apply metadata to components
 - c. Tag Dictionary
 - d. Niagara Analytics
 17. The SEC shall employ Niagara template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.

18. SEC shall be based on Niagara compatible JACE hardware and Niagara 4, or higher, software platform.

a. The latest Niagara 4, or higher, revision shall be used.

19. Applications include but are not limited to the following:

- a. Air Handling Units
- b. Large Unit Ventilators
- c. Large Fan Systems
- d. Other system specific control

2.2 AIR TERMINAL CONTROLLERS

A. Must include the following:

- 1. Programs and parameters stored in nonvolatile memory.
- 2. Access to parameters and program via laptop computer, handheld device or network.
- 3. Integral actuator for air volume control (if available).
- 4. Prevent overlapping of heating and cooling setpoints.
- 5. Maintain airflow calibration without disrupting airflow.
- 6. Include Analog Output for reheat control where applicable.

B. Applications include:

- 1. Air terminal boxes
- 2. Terminal Reheat Coils
- 3. Other zone-specific control

C. Performance Requirements:

- 1. Min. Actuator Torque 35 in-lb
- 2. Min. Operating Temperatures 40 to 120 Deg F
- 3. Min. Operating Humidity 10 to 90% RH
- 4. Maintain Airflow +/- 5%
- 5. Maintain zone temperature +/- .5 Deg F.

D. TRIDIUM IP Based Air Terminal Controllers

- 1. Lynxspring JENEsys Edge 414 (Basis of Design)

2.3 UNITARY EQUIPMENT CONTROLLERS

A. Must include the following:

- 1. Communicate on the local BAS cable system.
- 2. Programs and parameters stored in nonvolatile memory.
- 3. Access to parameters and program via laptop computer, handheld device or network.

B. Applications include:

- 1. Fan Coil Units
- 2. Unit Conditioners
- 3. Heat Pumps
- 4. Simple Unit Ventilators
- 5. Small Fans
- 6. Floor Static Control stations
- 7. Other unit specific control

C. Performance Requirements:

- 1. Min. Operating Temperatures 40 to 120 Deg F
- 2. Min. Operating Humidity 10 to 90% RH
- 3. Maintain Airflow +/- 5%

- 4. Maintain zone temperature +/- .5 Deg FAD POWER SUPPLIES (transformers)

PART 3 - EXECUTION

3.1 FIELD EQUIPMENT CONTROLLERS

- A. Provide controllers to accomplish monitoring and control of systems.
- B. Provide additional miscellaneous equipment necessary for complete system control.
- C. Provide factory mounting in appropriate enclosures per Section 25 1423.
- D. To ensure stand-alone capability, provide a controller for each equipment (or group) such as Air Handling Unit, Heating Hot Water, Chilled Water, Exhaust Systems, etc.

3.2 AIR TERMINAL CONTROLLERS

- A. Provide Air Terminal Controllers to accomplish sequences for zone specific air terminal equipment including:
 - 1. Supply Air Terminals
 - 2. Return Air Terminals
 - 3. Exhaust Air Terminals
 - 4. Reheat Coils
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide coordination such as shipping, scheduling, and technical support for Air Terminal factory mounting and proper operation.
- D. To ensure stand-alone capability, provide a controller for each terminal or fan coil unit.
- E. Coordinate power requirements with Mechanical Specifications.

3.3 UNITARY EQUIPMENT CONTROLLERS

- A. Provide Unitary Equipment Controllers to accomplish sequences for zone specific air terminal equipment.
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide factory mounting in appropriate enclosures per Section 25 14 23.
- D. To ensure stand-alone capability, provide a controller as needed for miscellaneous equipment.

END OF SECTION 25 14 00

SECTION 25 14 23 - FIELD EQUIPMENT PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Control panel requirements for Integrated Automation Systems
- B. Related Sections
 - 1. 25 05 53 - Identification
 - 2. 25 14 00 - Local Control Units

1.2 REFERENCES

- A. NEMA 1 General Purpose - for use in dry indoor locations.
- B. NEMA 4 Watertight - for use in locations where subjected to direct water spray and outdoors (Use NEMA 3R in Wet Locations).

1.3 DEFINITIONS

- A. Rung – Logical decision resembling the rung of a ladder within a ladder logic diagram.
- B. Wiring Duct –Pathway for wire management inside of panels.
- C. Wiring Trough – Wiring enclosure used to manage wiring outside of panels.
- D. Refer to section 25 00 00 for additional definitions.

1.4 SYSTEM DESCRIPTION

- A. Field equipment panels include, but not limited to control panels for:
 - 1. Air Handler systems
 - 2. Chiller systems
 - 3. Boiler systems
 - 4. Exhaust Fan systems
 - 5. Pumping Systems
 - 6. Miscellaneous systems
 - 7. Monitoring systems
- B. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.

1.5 SUBMITTALS

- A. Submit control panel fabrication drawings including: Back-panel layout, panel face arrangement, panel name, and panel tag number (if applicable) prior to fabrication or device installation.
 - 1. Drawings shall show operator interface configuration on panel face and device locations on back-panel. Also include panel tagging schedule or identification detailing nameplate text and size.
 - 2. Include panel power schematic showing power sources and protection device capacity.
 - 3. List manufacturer supplied devices in bill of material table.
- B. Submit schematic and wiring interconnection drawings in ladder format. Include rung numbers. Number relays with rung number.
 - 1. Each relay function shall be fully described to right of relay right rung. Each relay contact location shall be referenced at coil location.
 - 2. Each contact shall have associated coil reference and shortened description of coil function. Each contact shall have relay pin-out identifiers.

3. Wire colors and designators shall be identified.
4. Terminal blocks shall be uniquely identified. Field and panel wiring shall be differentiated by solid line for panel and dashed line for field.
5. Each connection to field device or other remote panel shall be identified.

1.6 QUALITY ASSURANCE

- A. Include instrument/equipment tag numbers, when available, on submittal documents whenever specific component appears.
- B. Install panels according to manufacturer's instructions.
- C. Space wire-ways and terminal strips 3" apart.
- D. Locate terminal strips either horizontally in upper half of back panel or vertically. Do not locate terminal strips below 2'-0" or above 6'-6" above finished floor.
- E. Separate 24 VDC and 120 VAC terminal strips, wire, cable, and devices by 6" minimum space.
- F. Provide terminal strips for total controller I/O count plus 20% spare capacity with analog and discrete spare capacity calculated separately.
- G. Size raceway to maximum fill of 40% per NEC.
- H. Space controllers according to manufacturer's requirements with 3" minimum between controllers and other devices on back panel and 6" between controller front and door mounted devices. Ensure adequate space is allowed for device heat dissipation.
- I. Ensure interior temperature of enclosure to 80°F maximum.
- J. Do not place controller or control devices on enclosure sides.
- K. Provide 25% minimum spare capacity of panel space, spare controller chassis space, wiring duct space, and terminal blocks to allow for future expansion by adding I/O cards and associated cabling.
- L. Locate panels adjacent to equipment served with minimum of 3 ft clearance in front of door. Provide sufficient clearances to allow full door swing and full access to internal components. Remote mounted panels are acceptable where accessibility will be significantly improved.
- M. Mount top of panels between 5 and 6 ft above floor so that gauges and indicators are at eye level.
- N. Route and terminate wiring parallel and at right angles within panels.
- O. Terminate power within 4 inches of panel entrance.
- P. Refer to Section 25 00 00 for additional requirements.

PART 2 - PRODUCTS

2.1 ENCLOSURES

- A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.
- B. Construction:
 1. Minimum 14 gauge steel
 2. Hinged door
 3. Include inner panel
 4. ANSI 61 external powder paint finish
 5. Cylinder locks and master 4 master keys for all panels less than 8 foot above finished floor

6. Include print pockets on enclosure doors
7. Miscellaneous steel components, e.g. standoffs, shall be 12gauge minimum rolled steel.

2.2 WIRING DUCT

- A. Manufacturers: Panduit, Tyton, or approved alternate.
- B. Construction:
 1. Slotted plastic or vinyl (PVC)
 2. Grey or white
 3. Snap-on covers

2.3 WIRING TROUGH

- A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.
- B. Construction:
 1. Minimum 14 gauge steel
 2. Unpainted galvanized finish
 3. Flat cover

2.4 AC POWER SUPPLIES

- A. Transformers for use with digital controllers, actuators, etc.
 1. Input Power: 120 VAC to 480 VAC
 2. Output Power: 24 VAC
 3. Minimum capacity 40 VA

PART 3 - EXECUTION

3.1 ENCLOSURES

- A. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.
- B. Provide NEMA type 1 enclosures for dry indoor locations.
- C. Provide NEMA type 4 control panel enclosures in outdoor locations or indoor locations (including maintenance spaces) where water damage is possible.
- D. Label enclosures with respective unique ID numbers in accordance with Section 25 05 53.
- E. Mount local control panels at convenient locations adjacent to and independent of equipment served. Install control panels in locations as shown on drawings and with proper clearance.
- F. Mount cooling devices, receptacles, and incandescent lights (if applicable) on enclosure sides.
- G. Mount top of panels between 5 and 6 ft above floor. Mount panels at consistent height.
- H. Provide control panels where more than one control device requires field mounting.
- I. Instrument Mounting:
 1. Ensure connections can be easily made and ample room exists for servicing each item. Every component in and on enclosures shall be able to be removed individually without affecting other components and without the need to move other components.
 2. Install devices prior to terminating wire or tubing.
 3. Rigidly attach instruments with properly sized stainless-steel screws or bolts so they may be removed.

4. Do not install instruments on panel sides, except for cooling devices, receptacles, and lighting, devices.
5. Provide gaskets for instruments penetrating panel exterior and seal in accordance with NEMA standards. Entire enclosure shall meet NEMA standard after installation of required devices.

J. Knockouts:

1. Distortion of panels is not permitted as a result of machining cutouts or mounting instruments and devices.
2. Cutouts shall be smooth and without irregularity from desired shape.
3. Flame cutting or arc-cutting is not permitted.
4. Align knockouts, sub-panels, and drilling for mounting to keep devices grouped and in vertical and horizontal alignment.
5. Provide rubber grommets in cutouts for wiring or tubing to prevent chaffing or scarring of insulation or jacketing of wiring or tubing.

K. Mounting Fasteners:

1. Minimum size for panel fastening anchors shall be 9/16" for floor anchors and 3/8" bolt for wall anchors. Increase anchor sizes as required for heavy panels.

L. Floor Mounted Panels:

1. Unless otherwise specified, install floor mounted control panel(s) on four 4" concrete equipment pad(s) with grout as required.
2. Install two (2) anchors for each four (4) feet of equipment length or minimum of four (4) anchors. Decrease anchor spacing for heavy panels as required. Bolt equipment to pad using cap screws and washers.
3. Do necessary grouting after equipment is installed and leveled. Grouting material shall be Owner approved cement grout; mixed and placed in accordance with manufacturer's recommendations. Remove leveling shims and wedges after grout has hardened. Re-grout Shim and wedge areas after shims or wedges are removed.

M. Wall Mounted Panels:

1. Provide one anchor for every 4'-0" of outside perimeter for wall mounted panels; minimum anchors for wall mounted panels shall be 4. Decrease anchor spacing for heavy panels as required.
2. Provide clear space for dressing out wiring, cables and tubing entering panel. Provide 4"2 unrestricted clear space for each inch of conduit size or each square inch of wiring duct size, with 4" x 4" being minimum area, in alignment with entering conduit or wiring duct, for bringing wiring into panel and routing to other locations. This space shall be sufficiently accessible to enable pulling wiring, cables, or tubing into panel for termination with initially installed equipment in place.

N. Lifting Lugs:

1. Remove lifting lugs after panels are set and use short, full-thread, hex-head machine screws to fill lug holes.

O. Pneumatic Tubing

1. Do not splice tubing within panel. Use bulkhead bars for circuit extensions.
2. Mount tubing so that tubing run(s) do not interfere with removal of components.
3. Terminate interior pneumatic components to bulkhead bars. Terminate incoming tubing to these bulkheads.
4. Install tubing along vertical or horizontal runs to present neat appearance. Angled runs are not allowed.
5. Label pneumatic tubing.

3.2 WIRING DUCT

- A. Install wiring duct along vertical or horizontal runs to present neat appearance.
- B. Permanently fasten wire duct into sub-panels using 10/32 screws.
- C. Support lower sidewall on horizontal runs of plastic wiring duct with bracing to avoid sagging.
- D. Install wiring between devices and terminal blocks in wiring duct except for dressing out to make terminations.
- E. Wiring duct fill shall not exceed 40% of wiring duct volume.
- F. Provide labels on wiring duct designating AC and DC wiring.

3.3 WIRING TROUGH

- A. Provide wiring trough above or parallel to field control panels.
- B. Route wiring through wire trough to minimize wire tension and allow re-routing of wire when necessary.

3.4 AC POWER SUPPLIES

- A. Provide transformer with a means of disconnect.
- B. Locate transformer in panel to minimize 120V power wiring inside panel (upper left or upper right side of panel).

END OF SECTION 25 14 23

SECTION 25 15 00 - SOFTWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes software requirements for the following:

1. Operator Workstation
2. Network or Building level controllers
3. Application Specific or Terminal level controllers
4. Communication analyzer

B. Related Work

1. 25 13 00 Control and Monitoring Network
2. 25 14 00 Local Control Units

1.2 REFERENCES

- A. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.

1.3 DEFINITIONS

- A. Access - Process or effort to communicate to system
- B. AutoCAD - Computer Aided Design software
- C. Communication Analyzer - Software tool used to troubleshoot communication problems
- D. Firmware - Hardware imbedded with software
- E. Hardware - Physical components of a system
- F. License - Permit, rights and restrictions for legal use and access of software and applications
- G. Patch - Software upgrade typically to correct known problems
- H. Software - Program
- I. Stand Alone - Control without the need for communications

1.4 SYSTEM DESCRIPTION

- A. Provide all required system software to support an existing server/client architecture, designed around the open standards of web services.
- B. Software
1. Software shall be compatible and integrate with Building Management System.
 2. Includes project specific programming such that any of the following may be performed simultaneously on-line, and in any combination, via the browser interface:
- C. Licenses
1. Complete set of product licenses for systems and third-party software used in system development, including documentation for all applications, databases, browsers, communications software etc.
 2. Owner shall be the named license holder of all software.
- D. Alarms

1. Coordinate with Owner all alarm message requirements and guidelines.

E. Security Access

1. Access control via user defined passwords for system operation.
2. Minimum of 3 access levels.
3. Campus Access Security: Communications between any campus Web browser and the BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers 2 (SSL 2).
4. Allow authorized users complete access to the system via a web browser.
5. User security access from any web browser PC/PDA to the BAS controllers or server shall require both a Login Name and password.

F. Communication Analyzer for network troubleshooting.

1.5 SUBMITTALS

A. Software Manual including:

1. System overview
2. Describe operating procedures
3. Software command descriptions
4. Password management
5. Control program functions

B. Data sheet for each software program used.

C. Provide all product licenses including:

1. System software
2. Documentation for all third-party software

1.6 QUALITY ASSURANCE

A. Provide most current revision of software.

B. Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by this Contractor shall be provided at no additional charge during the 2-year warranty period.

C. Static IP addresses shall be provided by the Project Owner and not assigned by the Contractor.

D. All BACnet Network/Instance Numbers shall be provided by the Project Owner and not assigned by the contractor unless approved by the Project Owner.

E. JACE units shall be open license type and the license shall never expire.

F. Network controls shall include a lifetime license for free software updates/upgrades.

G. Software licensing shall have no restrictions on which brand of server software or programming tools that can interact with the system. Station and tool compatibility must be universal with connectivity restrictions.

H. When suitable, BACnet standard network communications shall be configured for COV reporting to minimize network traffic.

I. Obtain Project Owner approval before connecting new networks with existing networks.

J. Coordinate other system requirements with Project Owner.

1.7 WARRANTY

- A. Install software upgrades, patches, and protocol fixes. Contractor shall provide verification to Project Owner that all updates/upgrades have been installed and tested in accordance with site testing and deployment procedures.
 - 1. If the firmware version for a new project or firmware upgrade for an existing building BAS causes the need to upgrade or reconfigure/reprogram existing systems, controllers or software. Contractor shall notify the Project Owner prior to upgrade and provide additional work scope requirements in coordination with other Contractors, as required, at no cost to the Project Owner.
- B. During the warranty period, the Contractor shall maintain a backup of all software installed in the system. The backup shall be updated monthly or whenever the Contractor makes a change to the software. A reload of backup software into the system shall be performed by the Contractor immediately upon notification by the Project Owner. The reload shall be free of charge.

1.8 OWNER'S INSTRUCTIONS

- A. Provide 32 hours of off-site training by factory trained instructor for 4 people. Include travel and hotel accommodations.
- B. Provide an additional 24 hours of on-site training by factory trained instructor of owner specific subject, after 6 months of occupation and prior to end of warranty.
- C. Coordinate and schedule training with Owner.

PART 2 - PRODUCTS

2.1 PLATFORM (TRIDIUM NIAGARA N4)

- A. Provide access and control to Integrated Automation System.
- B. Allow standard web-browsers for access to Integrated Automation Systems.
- C. Include real time control of system interactions.
- D. Provide database information requests/transfers by system hardware or by operators.
- E. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.
- F. Allow for Daylight Savings Time.
- G. Synchronize with BAS network.
- H. Contain a HELP function key.
- I. Database management.
 - 1. Point values
 - 2. Controlled variables
 - 3. Setpoints
 - 4. Tuning parameters
 - 5. New hardware and software points.
 - 6. Online modifications
 - 7. Error detection, correction, re-transmission of database values, arithmetic or logical faults
- J. Alarm management.
 - 1. Perform enhanced alarm analysis
 - 2. Buffering alarms in order of importance
 - 3. Filtering to minimize operator interruptions

4. Messages
 5. Routing
 6. Parameter modification
- K. Trending management.
1. Creating
 2. Modifying
 3. Deleting
- L. Field controller loop tuning.
- M. Enable and Disable control loops.
- N. Integration Capabilities multiple building functions including:
1. Equipment supervision and control
 2. Alarm management
 3. Energy management
 4. Access control
 5. Information management
 6. Historical data collection and archiving
- O. Simulation software
1. Ability to view the logic execution in a step approach
 2. Ability to view the logic in real time for easy diagnosis of the logic execution
 3. Imbedded comment section
 4. Boolean Logic
 5. Ability to view the logic in a monitor mode
 6. Modular custom and standard applications

2.2 CONTROLLER CONFIGURATION TOOLS

- A. Software used to configure and commission controllers.
- B. Compatible with operating system.
- C. Capable of communication via Ethernet network.
- D. Communication Analyzer.

2.3 BUILDING LEVEL CONTROLLERS

- A. Appropriate functionality to accomplish monitoring and control of system.
- B. Provide security by allowing assignment of a minimum of 50 passwords for access and control priorities to each controller point individually.
- C. Capable of monitoring the status of all overrides and inform the operator that automatic control has been inhibited.
- D. Alarm or point change reports shall include the point's English language description and the time and date of occurrence.
- E. Contain self diagnostics that monitor panel operation.
- F. Store trend and history data until uploaded to hard disk storage archival volume as required ensuring no data is lost.
- G. Perform the following energy management routines
 1. Automatic Daylight Savings Time Switch-over
 2. Night setback control

3. Enthalpy switch-over (economizer)
4. Peak demand limiting
5. Temperature-compensated duty cycling
6. Runtime accumulation
7. Allow for comment lines for sequence of operation explanation

2.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER

- A. Stand alone control capability.
- B. Allow access to the controller's application parameters via standard Microsoft compatible laptop computer plugged in to the room temperature sensor.
- C. Includes a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
- D. Include time delays between successive start commands to heavy electrical loads (user selectable).
- E. Returns equipment to normal operation upon power restoration.
- F. Perform the following algorithms:
 1. Two-position control
 2. Proportional, integral, plus derivative control
 3. Automatic tuning of control loops
 4. Floating control

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide latest software compatible with automation system.
- B. Provide available upgrades, patches, etc. up to substantial completion date.
- C. Coordinate system requirements with owner.

3.2 CONTROLLER CONFIGURATION TOOLS

- A. Provide software for configuration of controllers.
- B. Provide network cards, cables and other accessories necessary for operation.
- C. Simulation software
 1. Provide programming for the system and adhere to the sequences of operation provided.
 2. Imbed into the control program sufficient comment statements to clearly describe each section of the program.
 3. Document all programming in the form of a logic flowchart.
 4. Provide actions for all possible situations.
 5. Programming shall be modular and structured.

3.3 BUILDING LEVEL CONTROLLERS

- A. Provide software as utilized for complete operating system.
 1. Include building level controller software for engineering and application modifications.
 2. Include software data/configuration files for each separate controller, programming code and documentation.
- B. Provide a software data/configuration files for each separate controller.

3.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER

- A. Provide software as utilized for complete operating system.
 - 1. Include software for engineering and application modifications.
 - 2. Include software data/configuration files for each separate controller, programming code and documentation.
- B. Provide a software data/configuration files for each separate controller.

END OF SECTION 25 15 00

SECTION 25 15 23 - GRAPHICS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes the graphic requirements for Integrated Automation System

B. Related Work

1. 25 15 00 Software

1.2 SYSTEM DESCRIPTION

A. Provide software and labor for graphical representation of all systems connected to the Integrated Automation System.

B. Show all hardware points, setpoints, integrated points as shown in drawings and as need to proper control and monitor systems.

C. Include floor plans showing locations of sensors, equipment, panels, etc. Point descriptions and units shall be as defined in documents.

D. Optimize graphical representations to maximize information such as descriptions, points, units, etc.

E. Graphics shall be compatible with manufactures software platform and Engineer's AutoCAD software and existing site map.

F. Coordinate additional graphics requirements with Owner.

G. Provide 2D color graphics. Graphics to have consistent use of colors, units, symbols, and descriptions. Include the following:

1. Text description
2. Calculated and shared points
3. Integrated points
4. Associated points, including dynamic input values, output values, set points, gains, time schedules, etc.
5. System schematic or picture
6. Alarm fields

H. Minimum Performance:

1. Display all points within 10 seconds.
2. Refresh all points every 15 seconds.

I. Include the following:

1. Integrated systems
 - a. Legend page
 - b. Communication risers
 - c. Communication status of systems
2. Provide system graphics such as:
 - a. AHU, FCU, CRAC and ATU
 - b. Exhaust
 - c. Chilled Water system
 - d. Heating Hot Water system
 - e. Utilities
 - f. Plumbing
 - g. Power Monitoring

3. Site Plan
 - a. Utilities
 - b. Lighting
 - c. Weather conditions
 - d. Allow penetration to floor plans graphics
4. Floor Plans
 - a. Coordinate with as-built drawings to include
 - 1) Room name and numbers
 - 2) Column numbers
 - b. Identify
 - 1) HVAC zones by AHU
 - 2) HVAC rooms served by single space sensor
 - 3) Fire Zones
 - c. Allow penetration to associated system graphic
5. Additional floor plan requirements include
 - a. Automated Temperature Controls system
 - b. Fire Alarm system
 - c. Security system
 - d. Lighting system
 - e. Plumbing system
 - f. Color coded temperature and/or pressure zones
 - g. Color coded alarms
 - h. Small key plan for partial floor plans
6. Dashboards
 - a. Facility weather
 - b. Facility cost per hour
 - c. Facility alarms
 - d. Facility utility usage
7. Dynamic Risers
 - a. System service and status
 - b. Hardware service and status
8. Summaries:
 - a. Alarms
 - b. Overrides
 - c. Transactions
 - d. AHUs
 - e. Terminal Units
 - f. Exhaust
- J. Match DMS Standard Graphics Templates; coordinate with Owner prior to bid and prior to installation of graphics.
- K. Provide organized hierarchy
 1. Provide penetration from main page down to instrument level using mouse point and click feature.
 2. Provide penetration from instrument level back up to main page level using mouse point and click feature.
 3. Provide links from sub-systems to main systems such as

- a. Air terminal shall have a link to associated AHU, lighting, etc.
 - b. AHU shall have a link to cooling, heating, exhaust, energy recovery, etc.
 - c. Rooms shall have a link to floor plan.
- 4. Provide links to the following:
 - a. Vendor control as-builts
 - b. Equipment schedules
 - c. Mechanical plans
 - d. Network layout
- L. Organize system data such that:
 - 1. Inputs and outputs points on graphics are relative to actual field locations.
 - 2. Locate control loop setpoints close to controlled loop variable.
 - 3. Locate commanded points close to feedback.
 - 4. Locate global information in upper left corner of the screen.

1.3 SUBMITTALS

- A. Provide submittals for each unique graphic.
- B. Sample proposed Graphics systems including:
 - 1. Air Handling system
 - 2. Air terminal unit
 - 3. Floor plan
 - 4. Hydronic System
 - 5. Energy Wheel
- C. Sample proposed Graphics status pages including:
 - 1. Area status pages
 - 2. Group status pages
 - 3. Overview pages

1.4 OWNER'S INSTRUCTIONS

- A. Provide an additional 8 hours of on-site training by factory trained instructor after 6 months of occupation and prior to end of warranty.
- B. Coordinate and schedule training with Owner.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 GENERAL

- A. Every graphic screen to show current outdoor air conditions, date and time information at bottom of the page.
- B. All control points shown on as-built control drawings will be indicated on equipment graphics.
- C. For all equipment graphics, provide free text space (chalk board) for operator to document notes.
- D. All analog inputs will have their corresponding setpoints displayed on the equipment graphic.
- E. When the input values are outside their respective setpoints their indicator cells will turn red to show the user that the reading is in alarm mode.
- F. The user will be allowed to override all setpoints and settings.

G. Link database graphic objects with associated product specification data sheet.

H. Coordinate with DMS and Match Standard Graphic Templates.

3.2 LEGEND PAGE

A. Include color coding intent of the graphics and instructions to help the operator with various viewing commands.

B. Include links to home screen, previous screen and site map in the top left corner.

3.3 DASHBOARD

A. Provide overview of the building energy consumption and building pressurization.

B. A picture of the building will appear in the left-hand corner of the screen. The picture will not act as an active link. Under the building picture, provide links to floor plans, building systems and performance graphics as below:

1. Floor plans
2. Air Systems
3. Water Systems
4. Miscellaneous Systems
5. Key Performance Indicators
6. Measurement and Verification

C. Provide an alarm bell as an indicator and an active link. Bell will have one of two colors – green or red. Green color will inform the user that all building systems are operating normally, while red color will notify the user that there are systems within the building which are in alarm mode. The alarm bell red color activation will be adjustable per user preference to trigger only if high priority alarms exist in the building. Provide a direct link to alarm management screen.

D. Provide building pressurization indicator to show the building pressure with respect to outdoor. The bar indicator will be divided into green and red area, with green representing positive building pressure and red as negative pressure. The numerical indicator cell below the bar will display current building pressure as reported by the building differential pressure sensor. If more than one DP sensor serves the building, the cell will display the worst case differential pressure.

E. Show energy consumption gauges and indicator to display current energy consumption for each measured utility. The gauges scale and resolution will be adjusted to correspond to peak design conditions. The indicator arrows will show the same value as displayed in a cell below the gauge.

F. Top left-hand corner of the screen will have two links to previous screen and site map.

3.4 FLOOR PLANS

A. When a link to a particular floor is selected, the screen will show an overall floor plan view divided into sections, where necessary, to view room numbers and sensors. The floor plan will accurately represent the as-built layout of rooms in the building.

1. If partial floor plan sections should require, they shall be based on the zoning relative to the system serving the area being viewed where possible or the floor plan to be divided in equal parts.
2. Each section to actively inform user of any alarm conditions within the section by changing from green to red background color.

B. Each section shall have a link to take the user to a more detailed floor plan screen. In the bottom left hand corner of the screen are links to other floors arranged in a tree. The links to indicate alarm conditions present on each floor.

- C. The floor plan section screen to show layout in more detail with room numbers and sensors displaying room environmental conditions.
 - 1. Each sensor acts as a link to the corresponding room. Room background color to be green under normal operation and red when any of the analog or binary inputs are outside their alarm limits.
 - 2. The bottom left hand corner of the screen to feature links to different floors described previously as well as a picture of the sectioned view of the overall floor plan.
 - 3. Each section acts as an indicator and a link. When any room is in alarm mode in, that section turns red, otherwise it remains green. The user can move between section screens by selecting the appropriate link. Room thermostat graphic shall be provided with link to the associated system.

3.5 AIR SYSTEMS

AIR HANDLING UNITS

A. AHU screen will show equipment tag and overview of the system.

- 1. Following additional information will be included as applicable:
 - a. Cooling and economizer mode setpoints
 - b. Mode of Operation including dehumidification mode, economizer mode
 - c. Economizer run time (reset per day)
 - d. Average ATU damper position served by AHU
 - e. ATU driving AHU's Static Pressure Reset Setpoint
 - f. Total airflow CFM derived by adding airflows associated with all ATUs served by AHU
- 2. Damper statuses will be indicated by indicator cell and dynamically by making the damper blades move close when damper is closed and open when damper is open.
- 3. Fan status will be shown by dynamically spinning the fan wheel when the fan is ON, when fan is OFF the fan wheel will not spin. When fan is in alarm, the fan wheel color will be red.
- 4. Fan operating kW will be indicated next to fan icon.
- 5. When AHU is equipped with fan array, the number of fans will be shown next to the fan icon. An alarm point shall be added to indicate alarm condition when fans are commanded ON but indicate an OFF condition.
- 6. VFD box above the fan will provide the user with active links to variable frequency drive integrated points.
- 7. Fan VFD command cell will display the speed of the drive in 0-100%. If the VFDs are allowed to exceed 60Hz during normal operation, 100% will correspond to the maximum speed the VFD is allowed to go to.
- 8. Cooling and heating coil valve command indicator cells will display the % open amount of valve full span. Chilled water returning from the cooling coil will have its temperature displayed in the indicator cell.
- 9. Filter status will be indicated in the cell and shall flash red when in an alarm state.
- 10. Low temperature alarm, high static alarm and smoke alarm indicator cells will have a green background and display "Normal" when in normal mode. During alarm mode, the cell background color will change to red and display will read "Alarm".
- 11. UV lights status indicator cell will indicate "On" or "Off" according to the status of the lights.

B. AIR TERMINAL UNITS

- 1. Air terminal unit graphic will indicate equipment tag along with room number in parentheses.
- 2. Supply airflow sensor will have the airflow and min/max airflow setpoints listed.
- 3. Zone temperature will be listed with associated heating and cooling setpoints. If the temperature deviates outside those setpoints, the point will go into alarm mode.
- 4. Show a setpoint list block that will act as a link to all settings not displayed on the screen.
- 5. Provide links to associated as-built reference information at the bottom of the page.

C. EXHAUST SYSTEM

1. Exhaust fan screen title will show the equipment tag.
2. Following additional information will be included as applicable:
 - a. Average ATU position served by EF system.
 - b. ATU driving EF's Static Pressure Reset Setpoint.
 - c. Total airflow CFM derived by adding airflows associated with all ATUs served by EF.
3. Fan status will be shown by dynamically spinning the fan wheel when the fan is ON, when fan is OFF the fan wheel will not spin. When fan is in alarm, the fan wheel color will be red.
4. Indicator cell displaying fans lead-lag listing will be shown below each fan, as the fan rotation occurs, the indicator cells will display updated lead lag status in each cell.
5. Fan operating kW will be indicated next to fan icon.
6. Where bypass dampers are present, damper status will be indicated by indicator cell and dynamically by making the damper blades move close when damper is closed and open when damper is open.
7. Where fan is provided with a VFD, command cell will display the speed of the drive in 0-100%. If the VFD is allowed to exceed 60HZ during normal operation, 100% will correspond to the maximum speed the VFD is allowed to go to.
8. Low static alarm indicator cells will have a green background and display "Normal" when in normal mode, during alarm mode the cell background color will change to red and display will read "Alarm".

3.6 WATER SYSTEMS

A. CHILLED WATER SYSTEM

1. Chilled water system screen title will show the system name.
2. Chiller water system graphic will include all relevant components such as chillers, primary/secondary pumps, cooling towers etc.
 - a. Picture of each equipment to closely resemble actual piece of equipment in the field.
 - b. Chiller picture or tag shall be provided with an active link to take the user to a more detailed interface showing internal chiller control points.
3. Provide indicator cells to display status and position of relevant valves in the system such as isolation valves, bypass valves etc.
4. Where applicable, provide dynamic representation of equipment statuses such as chillers, towers, pumps etc. to indicate whether a particular piece of equipment is ON or OFF.
 - a. Pump status will be shown by dynamically spinning the impeller wheel when the pump is ON, when pump is OFF the impeller wheel will not spin. When pump is in alarm mode, the impeller wheel color will turn red.
 - b. Pump operating kW will be indicated next to the pump icon.
 - c. Where pump is provided with a VFD, VFD box above the pump will provide the user with active links to variable frequency drive.
 - d. Indicator cell displaying pumps lead-lag listing will be shown below each pump, as the pump rotation occurs, the indicator cells will display updated lead lag status in each cell.

B. HEATING HOT WATER SYSTEM

1. Heating hot water system screen title will show the system name.
2. Heating hot water system graphic will include all relevant components such as boilers, primary/secondary pumps etc.
3. Picture of each equipment to closely resemble actual piece of equipment in the field.
4. Provide indicator cells to display status and position of relevant valves in the system such as isolation valves.

5. Where applicable, provide dynamic representation of equipment statuses such as boilers, heat exchangers, pumps etc. to indicate whether a particular piece of equipment is ON or OFF.
 - a. Pump status will be shown by dynamically spinning the impeller wheel when the pump is ON, when pump is OFF the impeller wheel will not spin. When pump is in alarm mode the impeller wheel color will be red.
 - b. Pump operating kW will be indicated next to the pump icon.
 - c. Where pump is provided with a VFD, VFD box above the pump will provide the user with active links to variable frequency drive.
 - d. Indicator cell displaying pumps lead-lag listing will be shown below each pump, as the pump rotation occurs, the indicator cells will display updated lead lag status in each cell.

3.7 MISCELLANEOUS SYSTEMS

A. VARIABLE FREQUENCY DRIVE

1. Upon activation of a VFD link on any of the equipment screens the user will be directed to the VFD display screen. The name of the equipment will be displayed in the title block of the screen. If the piece of equipment has backup VFD, the name will appear in the title block.
2. The picture of the VFD will show the actual piece of equipment installed in field.
3. All available analog and binary inputs will be shown with appropriate names and units. When VFD is offline all the indicator cells will turn black.
4. Fan or pump status will be derived from the output power reading.

3.8 KEY PERFORMANCE INDICATORS

- A. Key Performance Indicators (KPI) will be configured and trended at Building Automation System at 15 min intervals.
- B. Provide the following data points for each of the KPIs shown below, Current Value, Previous Month Value, Previous Year Value (Current Month), and Benchmark Data.
- C. The KPI Graphics shall include the following as applicable to the project:

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Key Performance Indicators				
KPI	UNITS	VALUE	TIME INTERVAL (MONTHS)	TREND PERIOD (YRS)
TOTAL BUILDING ENERGY AND WATER				
MEASURED ENERGY USE INTENSITY (EUI)	KBTU/GSF	TOTAL	12	5
MEASURED WATER USE INTENSITY (WUI)	KGAL/GSF	TOTAL	12	5
PRIMARY UTILITY METRICS				
ELECTRICITY TOTALIZED	KWH	TOTAL	1	5
ELECTRICITY PEAK	KW	PEAK	1	5
NATURAL GAS TOTALIZED	THERMS	TOTAL	1	5
NATURAL GAS PEAK	BTU/HR	PEAK	1	5
DISTRICT HEATING TOTALIZED	MMBTU	TOTAL	1	5
DISTRICT HEATING PEAK	BTU/HR	PEAK	1	5
DOMESTIC COLD WATER TOTALIZED	KGAL	TOTAL	1	5
PRIMARY END USE METERS				
HVAC COOLING	MMBTU	TOTAL	1	5
HVAC STEAM	MMBTU	TOTAL	1	5
HVAC HEATING HOT WATER	MMBTU	TOTAL	1	5
HVAC PUMPS	KWH	TOTAL	1	5
DCW PUMPS	KWH	TOTAL	1	5
PROCESS COOLING	MMBTU	TOTAL	1	5
PROCESS HEATING	MMBTU	TOTAL	1	5
PROCESS ELECTRICITY	KWH	TOTAL	1	5
PRIMARY EQUIPMENT/SYSTEM METRICS				
COOLING PLANT	KW/TON		15 Minutes	5
BOILER/STEAM METER	MMBTU/HR		1 hour	5
BOILER	% EFF		1 hour	5
AIR HANDLING UNITS	KW/CFM		15 Minutes	5
RETURN FANS	KW/CFM		15 Minutes	5
EXHAUST FANS	KW/CFM		15 Minutes	5
AIR CHANGE RATES	ACH		1 hour	5
ECONOMIZER MODE OPERATING HOURS	HOURS		1	5
AVERAGE FACE VELOCITY OF HOOD AIR FLOW	FPM		1	5
AVERAGE SASH POSITION	INCHES		1	5

3.9 MEASUREMENT AND VERIFICATION

- A. Provide building performance graphics reports, as applicable to the project, for the following utilities. Reports should include 5 years of historical data. X-axis to be time in months, Y-axis to be utility consumption totalized for per month.
- B. Mechanical
 1. Chilled water consumption (kTons)
 2. Steam Consumption (#/Hr)
 3. Steam Condensate Return (Gal)
- C. Electrical

1. Electrical Consumption Building (kW-Hr)
 2. Electrical Consumption Mechanical Equipment (kW-Hr)
- D. Plumbing
1. Domestic Water Usage (Gal)
 2. Irrigation Water Usage (Gal)
 3. Process Water Usage (Gal)
 4. Non-Potable Water Usage (Gal)
 5. Nature Gas Consumption (CuFt)

END OF SECTION 25 15 23

SECTION 25 35 13 - ACTUATORS AND OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes control valve actuators, damper actuators, and positioners for systems as shown in Contract Documents and where provide by equipment manufacturer.
- B. Related Sections
 - 1. 25 05 13 Conductors and Cables
 - 2. 25 05 28 Pathways
 - 3. 25 35 19 Control Valves
 - 4. 25 35 23 Control Dampers

1.2 REFERENCES

- A. ISO 9001 Quality Management
- B. UL 873 Temperature-Indicating and -Regulating Equipment

1.3 DEFINITIONS

- A. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control valve, and balancing valve.

1.4 SYSTEM DESCRIPTION

- A. Actuators, operators and positioners for control valves and control dampers, etc.

1.5 SUBMITTALS

- A. Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.
- B. Identify actuator torque capacities, control signal, power requirements.
- C. Include other options such as linkage kits, weather shields, manual cranks, etc.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall be ISO9001 certified.
- B. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.
- C. Obtain adequate system information necessary for sizing.
- D. Refer to section 25 05 13 for power connections and other cable requirements.
- E. Refer to section 25 05 28 for pathway requirements.

PART 2 - PRODUCTS

2.1 ANALOG ELECTRONIC ACTUATORS

- A. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or approved equal.
- B. Modulating actuator input signals shall be, 0-5VDC, 2-10VDC, or 0-10VDC. Floating or pulsing signals are not allowed.

- C. Provide spring return feature for fail open or closed positions as required by control sequence or control drawings.
- D. Provide actuator with a conduit fitting.
- E. Non-spring return actuators and spring return actuators with more than 60lbs torque, shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
- F. Provide local service switch for large valves powered by 120VAC.
- G. Spring return not required for terminal equipment.
- H. Provide analog feedback as required by control sequence or control drawings.

2.2 DISCRETE TWO-POSITION ELECTRIC ACTUATORS

- A. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or approved equal.
- B. Provide spring return feature for fail open or closed positions as required by control sequence or control drawings.
- C. Non-spring return actuators and spring return actuators with more than 60lbs torque, shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
- D. Provide local service switch for large valves powered independent of control signal or powered by 120VAC.
- E. Provide discrete feedback as required by control sequence or control drawings.

PART 3 - EXECUTION

3.1 ANALOG ELECTRONIC ACTUATORS

- A. Provide actuator for dampers and valves with sufficient capacity to operate under all conditions.
- B. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
- C. Each actuator shall be full-modulating as required or specified and shall be provided with spring-return for fail open or fail closed position for, heating or cooling protection on power interruption as indicated and/or as required.
- D. Fail steam valves serving pressure rated heat exchangers or converters closed unless otherwise shown.
- E. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
- F. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.
- G. Coordinate the factory installation of control valve actuators and operators where possible.
- H. Mount actuators and operators outside the airstreams.

3.2 DISCRETE TWO POSITION ELECTRIC ACTUATORS

- A. Provide actuators for dampers and valves with sufficient capacity to operate under all conditions.
- B. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
- C. Each actuator shall be two-position as specified and shall be provided with spring-return for fail open or fail closed position for heating or cooling isolation or protection on power interruption as indicated and/or as required.
- D. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
- E. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.

END OF SECTION 25 35 13

SECTION 253515 - SWITCHES AND RELAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Systems include switches and relays for the control of Heating, Ventilation, and Air Conditioning systems.
- B. Related Sections:
 - 1. 25 05 53 Identification

1.2 REFERENCES

- A. UL 20 – General Use Snap Switches.

1.3 SYSTEM DESCRIPTION

- A. Include all components not specifically indicated or specified, but necessary to make the system function within the intent of the specification and in accordance with control sequences located on contract documents.
- B. Unless otherwise specified, functionality of interlocks and safeties shall be operational in hand, auto, or bypass (for VFD's).

1.4 QUALITY ASSURANCE

- A. Electrical devices, switches, and relays shall be UL listed and of type meeting current and voltage characteristics of project.
- B. Ratings of normally open and normally closed contacts shall be adequate for applied load (minimum 5 amps at 240 Volts) unless otherwise specified.
- C. Mount adjustable or resettable instruments for easy access without the need for a ladder, flashlight, etc.
- D. Install per manufactures recommendations.

PART 2 - PRODUCTS

2.1 LOW LIMIT TEMPERATURE SWITCHES

- A. Manufacturers: Siemens, Johnson Controls/Penn or equal
- B. Electric 2-position type with temperature sensing element and manual reset.
- C. Capable of opening circuit if any one-foot length of sensing element is subject to temperature below setting.
- D. Include auxiliary contact for alarm condition reporting to the building automation system.
- E. Minimum Requirements:
 - 1. Set Point Range 35 Deg F to 45 Deg F.
 - 2. Switch differential .12 Deg F
 - 3. Contact Type SPST-NC
 - 4. Ratings:
 - a. 16 amps @ 120VAC,
 - b. 9.2amps @ 208VAC
 - c. 8 amps @ 240 VAC
 - d. 125VA @ 24 277VAC (Pilot Duty)

2.2 DRY PRESSURE SWITCHES

- A. Manufacturers: Cleveland, Allen Bradley, Ashcroft, Dwyer, Honeywell, Johnson Controls/Penn, Siemens Building Technologies, Invensys, SOR, or United Electric. Or approved equal.
- B. Field adjustable set point, differential pressure type.
- C. Manual Reset.
- D. Minimum Requirements:
 - 1. Set Point Range 1.25" w.c to 12.0"w.c.
 - 2. Switch differential .06"min to 0.8"max
 - 3. Contact Type 2 SPST-NC
 - 4. Ratings:
 - a. 15amps @ 125, 250 or 277 VAC
 - b. .5VA@ 24 VAC
 - c. ¼ HP @ 125 VAC
 - d. ½ HP @ 250 VAC
- E. UL approved for application.
- F. Include auxiliary contact for alarm condition reporting to the control system.

2.3 CONTROL RELAYS

- A. Non-enclosed relays
 - 1. Manufacturers: IDEC, Potter Brumfield, Square D, or Allen Bradley.
 - 2. Equal to IDEC type RH2B-U, miniature 8 blade pilot relay with DPDT silver cadmium oxide contacts rated at 10A, 30 VDC, or 120 VAC. Coil shall match control circuit characteristics.
 - 3. Rectangular base socket mount with blade type plug-in terminals and polycarbonate dust cover.
 - 4. Provide DIN rail mountable (Snap type) mounting sockets equal to IDEC SH2B-05.
 - 5. Include manual override
- B. Enclosed Relay (Relay-in-a-Box):
 - 1. Manufacturers: Veris Industries, Kele & Associates, Functional devices, Inc. or approved equal.
 - 2. 1 or 2 SPDT relays in NEMA 1 or better enclosure. Coil shall be selected for control circuit characteristics.
 - 3. Contacts rated at 10A, 28 VDC or 120 VAC. Conduit nipple is 1/2" NPT. Maximum coil current burden 50 milliamps.
 - 4. LED status indication.
 - 5. Include Hand-Off-Auto (HOA) switch

2.4 CURRENT SWITCHES

- A. Manufacturers: Veris Industries, N-K Technologies, Absolute Process Instruments, Kele & Associates, R-K Electronics or approved equal.
- B. Induction type sensors clamped over single- phase conductor of AC electrical power and shall be solid-state sensors with adjustable threshold, visual indication and normally open contacts. Each current switch shall be selected for proper operating range of current.

2.5 POSITION SWITCHES (END SWITCHES)

- A. Manufacturers: Allen Bradley, Johnson Controls/Penn, Honeywell, Ruskin, Greystone Energy Systems, NAMCO, Kele & Associates, Omron or Westlock

- B. SPDT contacts rated for application
- C. Provide damper brackets and connecting rods for connecting position switch actuation levers to damper blades or jackshafts.
- D. Mercury type position switches are not allowed

2.6 THERMAL DISPERSION FLOW SWITCHES:

- A. Manufacturers: Fluid Components, Inc., Delta M, Dwyer or Magnetrol.
- B. Units shall use thermal dispersion sensors to detect flow from heated reference elements whenever flow is above threshold setpoint. Setpoint shall be adjustable between 20 and 80% flow. Select units for proper installation orientation.
 - 1. Maximum Response Time: 1 minute
 - 2. Maximum Temperature: 200°F
 - 3. Repeatability: $\pm 1\%$
 - 4. Pressure Rating: 300 psi for chilled water
150 psi for other applications

2.7 LEVEL SWITCHES:

- A. Manufacturers: Drexelbrook, Magnetrol, Endress and Hauser or Dwyer.
- B. Radio Frequency (RF) type continuous level probe with multiple adjustable setpoints and SPDT snap action contacts to meet intended use. Probe shall have probe shielding to reject build up of conductive, sticky or viscous material. Probe length shall match vessel dimensions to measure within 6" of bottom.
- C. Provide probe brace every 4 ft if probe length exceeds 6 ft, and not installed in stilling well.
 - 1. Supply Voltage: 120 VAC/60 Hz
 - 2. Fail Safe: Low Level output on instrument failure
 - 3. Ambient Temperature Limits: -40 to 160°F
 - 4. Minimum Enclosure Rating: NEMA 4
 - 5. Transmitter Mounting: Remote
 - 6. Performance:
 - a. Accuracy: $\pm 2\%$ nominal
 - b. Linearity: $\pm 1\%$ nominal
 - c. Repeatability: $\pm 1\%$ nominal
 - d. Response Time: 20 milliseconds
 - e. Ambient Temperature Effect: 2% per 100°F max.
 - f. Voltage Variation Effect: $\pm 0.2\%$ maximum per 10 V change

PART 3 - EXECUTION

3.1 LOW LIMIT TEMPERATURE SWITCHES

- A. Provide low limit temperature switches where indicated on drawings or as required to accomplish sequences.
- B. Unless otherwise indicated, install sensing element on upstream face of cooling coil where cooling coil is provided, or at downstream side of heating coils where no cooling coil is provided.
- C. Size element or add additional elements to cover no less than one lineal foot per square foot of coil surface areas.
- D. Unless otherwise indicated, adjust temperature switch setpoint to 38°F.
- E. Distribute sensing element across entire area of medium being sensed.

- F. Install controls at accessible location with suitable mounting brackets and element duct collars where required.

3.2 DRY PRESSURE SWITCHES

- A. Provide pressure switches where indicated on drawings or as required to accomplish sequences.
- B. Unless otherwise indicated, adjust high static pressure switch to .5" w.c less than equipment of duct static ratings.

3.3 WET PRESSURE SWITCHES

- A. Provide pressure switches where indicated on drawings or as required to accomplish sequences.
- B. Select switches for accuracy, ranges (20 to 80% of operating range) and dead-band to match process conditions, electrical requirements and to implement intended functions.

3.4 CONTROL RELAYS

- A. Provide control relays where indicated on drawings or as required to accomplish sequences.
- B. Provide DIN mounted relays in control panels.
- C. Provide RIB type relays for field control devices and equipment such as chillers, AHUs, pumps, VFD's, etc.
 - 1. Mount relay for easy accessibility.
 - 2. Mount relay for easy visual accessibility.

3.5 CURRENT SWITCH

- A. Provide current switches where indicated on drawings or as required to accomplish sequences.
- B. Locate in starter or VFD or in an appropriate adjacent enclosure.

3.6 POSITION SWITCHES (END SWITCHES)

- A. Provide end switches where indicated on drawings or as required to accomplish sequences.

3.7 THERMAL DISPERSION FLOW SWITCHES:

- A. Provide dispersion flow switches where indicated on drawings or as required to accomplish sequences.

3.8 LEVEL SWITCHES:

- A. Provide level switches where indicated on drawings or as required to accomplish sequences.

END OF SECTION 25 35 15

SECTION 25 35 16 - SENSORS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Instrumentation for the following Sensors and Transmitters for HVAC
- B. Products Supplied but Not Installed Under This Section
 - 1. Sensor wells
- C. Related Sections:
 - 1. 25 00 00 Integrated Automation

1.2 REFERENCES

- A. DIN-IEC -751 Standard for platinum sensor.
- B. Refer to section 25 00 00 for additional references.

1.3 SYSTEM DESCRIPTION

- A. Provide supplementary or miscellaneous items, products, and labor incidental to or necessary for a complete and operable installation.
- B. Wiring shall be done in accordance with all local and national codes.
- C. Coordinate installation of instrumentation, including but not limited to:
 - 1. Power requirements
 - 2. Panel locations
 - 3. Commissioning
 - 4. Test and Balance
 - 5. Equipment start-up
 - 6. User access

1.4 SUBMITTALS

- A. Refer to section 25 00 00.

1.5 QUALITY ASSURANCE

- A. Coordinate timely delivery of materials.
- B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.
- C. Install control devices in appropriate enclosure and in an accessible location.
- D. Provide shielding per manufactures recommendation.
- E. Provide junction box or enclosure to protect wiring and allow conduit connection for all sensors.
- F. Refer to Section 25 00 00 for additional requirements.

1.6 WARRANTY

- A. Refer to section 25 00 00.

PART 2 - PRODUCTS

2.1 AVERAGING TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance

1. Accuracy: $\pm 1.0\%$ at 32°F (Class B)
2. Operating Range: -50 to 170°F
0 to 99% RH
3. Conformance: DIN-IEC 751

2.2 SINGLE POINT TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance

1. Accuracy: $\pm 0.1\%$ at 32°F (Class B)
2. Operating Range: -50 to 170°F
0 to 99% RH
3. Conformance: DIN-IEC 751

B. Thermistors type, with the following minimum performance

1. 5 yr guarantee that device will maintain its accuracy within tolerance of $\pm 0.36^\circ\text{F}$ between 32°F and 150°F, and 0.5°F between -20°F and 212°F.
2. Accuracy: $\pm 0.1\%$ at 32°F (Class B)
3. Operating Range: -50 to 170°F
0 to 99% RH

2.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Thermister or RTD type, with the following minimum performance

1. Accuracy: ± 1.0 Deg F at 70°F (Class B)
2. Operating Range: -50 to 170°F
0 to 99% RH

2.4 RTD Temperature SENSOR/TRANSMITTERS:

A. Manufacturers: Rosemount, Burns, Minco Products, Weed or Pyromation or Equal.

B. Transmitters shall provide 2 wires, 4-20 mA current output signal proportional to specified temperature span of transmitter and compatible with DDC equipment.

1. These shall be 1000 platinum RTD type temperature instruments for process immersion or air duct mounting
2. Operating Temperature: -20 to +180°F
3. Power Supply Voltage: 3 to 35 VDC unregulated
4. Accuracy or Output Error: 0.1% of span of sensor and transmitter combination
5. Temperature Coefficient: 0.00385 O/O°C
6. Thermowells: By same manufacturer as Sensor/Transmitter or approved alternate.

C. Provide local temperature indicator with 3 LCD digital readout.

2.5 SENSOR WELLS

A. Compatible with sensor and application.

B. Include thermal compound.

2.6 SPACE TEMPERATURE SENSORS

A. Adjustable setpoint, with programmable minimum/maximum setpoints(default to disable).

B. Pushbutton override for temporary occupancy default to disable.

- C. Compatible with the intended service (VAV, VAV Reheat, Dual-duct, unoccupied setback, etc.), and associated controlled devices (DDC air terminal controller, damper, valve, etc.).
- D. RTD type, with the following minimum performance:
 - 1. Accuracy: $\pm 0.1\%$ at 32°F (Class B)
 - 2. Temperature Operating Range: -50 to 500°F
 - 3. Humidity Operating Range: 0 to 99% RH
- E. Thermistors will be acceptable in lieu of RTD if device will maintain its accuracy within tolerance of $\pm 0.36^\circ\text{F}$ between 32°F and 150°F, and 0.5°F between -20°F and 212°F.

2.7 SPACE HUMIDITY SENSORS/TRANSMITTERS

- A. Manufactures: Viasala, General Eastern, or Automation Components or Equal.
- B. Space humidity sensors shall be wall mount type to match room thermostats and/or temperature sensors.
- C. Sensing element shall be resistive bulk polymer, or thin film capacitive type. Sensor/transmitter shall have the following minimum performance:
 - 1. Accuracy: $\pm 2\%$ RH at 25°C over range of 20-95% RH including hysteresis, linearity and repeatability
 - 2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F
 - 3. Sensitivity: 0.1% RH
 - 4. Repeatability: 0.5% RH
 - 5. Hysteresis: Less than 1%
 - 6. Long Term Stability: Less than 1% RH drift per year
 - 7. Adjustment: $\pm 20\%$ RH zero, non-interactive
 $\pm 10\%$ RH span, non-interactive
 - 8. Operating Range: 0-99% RH, non-condensing, sensor
-95% RH, non-condensing, electronics
 - 9. Output: 0-10VDC 0-100% linear, proportional
 - 10. Power: 12-36 VDC or 24VAC

2.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

- A. Manufactures: Viasala, General Eastern, or Automation Components or Equal.
- B. Probe type, temperature compensated, resistive bulk polymer or thin film capacitive type.
- C. Sensor/transmitter shall have the following minimum performance.
 - 1. Accuracy: $\pm 2\%$ RH at 25°C over 20-95% RH including hysteresis linearity and repeatability
 - 2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F.
 - 3. Sensitivity: 0.1% RH
 - 4. Repeatability: 0.5% RH
 - 5. Hysteresis: Less than 1%
 - 6. Long Term Stability: Less than 1% drift per year
 - 7. Adjustment: $\pm 20\%$ RH zero, non-interactive
 $\pm 10\%$ RH span, non-interactive
 - 8. Operating Range: 0-99% RH, non-condensing, sensor
0-95% RH, non-condensing, electronics
 - 9. Output: 0-10VDC 0-100% linear, proportional
 - 10. Power: 12-36 VDC or 24VAC

2.9 VIBRATION SENSOR

- A. Performance Requirements:
 - 1. Power 12VDC – 36VDC loop power
 - 2. Output 4-20mA

- 3. Frequency Range 2-1000 HZ
- 4. Accuracy +/- 5%

B. Enclosure shall be NEMA rated for application.

PART 3 - EXECUTION

3.1 AVERAGING TEMPERATURE SENSORS

- A. Provide flexible averaging element for air ducts where prone to temperature stratification or where ducts are larger than 9 square feet.
- B. Provide rigid averaging probe for air ducts smaller than 9 square feet.
- C. Provide multiple averaging type sensors as required for sufficient duct or coil coverage. For coils, at minimum provide appropriate number of sensors as necessary for 1 linear foot of sensing for every 1 sq. ft of coil.

3.2 SINGLE POINT TEMPERATURE SENSORS

- A. Provide single point duct mounted probes where ducts are too small for averaging elements.
- B. Mount in center of air flow or where most accurate reading will result.
- C. Install as far from fan as possible, but within mechanical space.

3.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

- A. Provide single point duct mounted sensors at air terminal coils or fan coil units.

3.4 SPACE TEMPERATURE SENSORS

- A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
- B. Coordinate mounting height prior to installation. Unless otherwise noted, mount sensors at 48" above finished floor.
- C. Recess mounting box unless otherwise indicated or required by the building construction materials.
- D. Unless otherwise noted provide at minimum, 1/2" conduit from room sensors to corresponding controller.
- E. Mounted space thermostats/sensors, located on exterior walls, on thermally insulated subbase.
- F. Relocate space thermostats/sensors if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.

3.5 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

- A. Provide sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions. At minimum, provide at discharge of fan coil units and terminal reheat.

3.6 SPACE HUMIDITY SENSORS/TRANSMITTERS

- A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
- B. Mount sensors at 48" above finished floor.

- C. Recess mounting box unless otherwise indicated or required by the building construction materials.

3.7 SENSOR WELLS

- A. Furnish wells for installation.
- B. Coordinate with Division 23 Specifications for location placement.
 - 1. Wells mounted in pipe 3" and larger may be installed in horizontal or vertical lines if element is always in the flow, (for condensate and other gravity return lines, install in bottom of pipe).
 - 2. Wells mounted in pipe 2-1/2" and smaller shall be installed at elbow tee fittings with well pointed upstream. Minimum of 2" pipe size for elbow tee installation.

3.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

- A. Provide duct humidity sensors and transmitters where indicated, and as required to perform specified control sequences, and as directed to meet job site conditions.

3.9 VIBRATION SENSOR

- A. Provide vibration transmitter for well pumps, and motors and equipment where shown.
- B. Coordinate installation/mounting requirements with motor and equipment manufacture.

END OF SECTION 25 35 16

SECTION 25 35 18 - LIQUID PRESSURE AND FLOW MEASUREMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Systems include instrumentation for the following water systems pressure and flow measurement for Integration and Automation.
- B. Products furnished but not installed under this section:
 - 1. Pressure transmitters
 - 2. Heating hot water flow meter.
- C. Related Sections:
 - 1. 25 00 00 Integrated Automation
 - 2. 25 12 19 Integration Protocols

1.2 SUBMITTALS

- A. Refer to section 25 00 00.

1.3 QUALITY ASSURANCE

- A. Coordinate timely delivery of materials.
- B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.

1.4 WARRANTY

- A. Refer to section 25 00 00.

PART 2 - PRODUCTS

2.1 DIFFERENTIAL PRESSURE TRANSMITTER

- A. Manufacturers: Ashcroft, BAPI, Setra, Veris, or approved equal.
- B. Pressure sensor and integral transmitter. Select instrument for intended usage (differential pressure, gauge pressure, level, etc.), range, maximum pressure/temperature. Enclosure to be NEMA 4.
- C. Include LCD display.
- D. Differential pressure transmitters shall have 3-valve manifold for servicing.
- E. Performance:
 - 1. Power 12 - 30 VDC or 24VAC
 - 2. Output 0-5 VDC, 2-10 VDC or 0-10VDC
 - 3. Accuracy (PSIG) + 1 percent of full scale
 - 4. Stability + 0.25 percent per year
 - 5. Hysteresis + 0.05 percent of calibrated span
- F. Operating Range -140 Deg F to 130 Deg F
- G. Over Pressure: 2 times maximum operating pressure whichever is greater.
- H. Accuracy: $\pm 1\%$ of full scale

- I. Zero adjust pushbutton.

2.2 PRESSURE TRANSMITTERS

- A. Manufacturers: Setra, Ashcroft, Dwyer or approved equal
- B. Include pressure sensor and integral transmitter. Transmitters shall use capacitance sensing element.
- C. Performance:
 - 1. Power 12 - 30 VDC or 24VAC
 - 2. Output 0-5 VDC, 2-10 VDC or 0-10VDC
 - 3. Accuracy (PSIG) + 0.5 percent of calibrated span
 - 4. Stability + 0.25 percent per year

2.3 WATER FLOW TRANSMITTER

- A. Manufacturers: Onicon, Badger, Neptune or approved equal.
- B. Type: Electromagnetic insertion.
- C. Include flow meter and transmitter.
- D. Include certificate of calibration.
- E. Direction of flow indication (for bi-direction flow meters).
- F. Performance:
 - 1. Output 0-5 VDC, 2-10 VDC or 0-10VDC
 - 2. Accuracy +1 percent of rate from 2-20ft/s

2.4 BTU SUB-METER

- A. Manufacturer: Onicon (System 10), or approved equal.
- B. Include flow meter and remote transmitter with NIST Traceable Calibration with Certifications.
- C. Include BACnet communications card to integrate to building automation systems. Provide with Local Readout. Coordinate with Owner for final Location.
- D. Minimum Performance:
 - 1. Output 0-5 VDC, 2-10 VDC or 0-10VDC
 - 2. Temperature Accuracy + .15 percent from 32-200 Deg F.
 - 3. Water Flow Accuracy + 1.0 percent of reading.

PART 3 - EXECUTION

3.1 DIFFERENTIAL PRESSURE TRANSMITTER

- A. Provide differential pressure transmitter for building [chilled water/hot water] differential pressure.
- B. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device. Transmitter range shall be selected for mid-range values while operating under normal operating range.
- C. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines. Test ports shall be included for 3rd party verification.

- D. Differential pressure transmitter shall include a separate pressure gage scaled to indicate normal operating range of device. This pressure gage shall be installed in parallel with sensing lines.
- E. The transmitters shall be installed in an accessible location whenever possible.

3.2 PRESSURE TRANSMITTER

- A. Furnish differential pressure transmitters as shown in construction documents or as required to implement sequences.
 - 1. Span flow transmitter for 130% of design pressure.
- B. Transmitter shall be mounted in accessible location and in mechanical rooms shall be installed 4' to 5' above floor level. Include isolation valve for servicing at transmitter location.

3.3 WATER FLOW TRANSMITTER

- A. Furnish Flow Transmitter for Water Systems.
 - 1. Span flow meter for 130% of design flow.
- B. Remote Transmitter shall be mounted in accessible location and in mechanical rooms shall be installed 4' to 5' above floor level.

3.4 BTU SUB-METER

- A. Furnish BTU Sub-Meter for Water Systems.
 - 1. Span flow meter for 130% of design flow.
- B. Display shall be mounted in accessible location and in mechanical rooms shall be installed 4' to 5' above floor level.

END OF SECTION 25 35 18

SECTION 25 35 19 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Control valves for HVAC systems as shown in Contract Documents, except where provide by equipment manufacturer.

B. Products Supplied, But Not Installed Under This Section:

1. Actuated Control Valves for Integrated Automation and HVAC applications.

C. Related Sections:

1. 25 05 53 Identification
2. 25 35 13 Actuators and Operators

1.2 REFERENCES

A. UL-873 Temperature-Indicating and Regulating Equipment

B. ANSI American National Standards Institute

1.3 DEFINITIONS

A. HVAC – Heating Ventilation and Air Conditioning.

B. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control valve, and balancing valve.

1.4 SYSTEM DESCRIPTION

A. Control valves for HVAC systems.

B. Control valves types shall be from the same manufacture.

1.5 SUBMITTALS

A. Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke. Product data sheets shall include charts, graphics or similar items used in making selections.

B. Valve Schedule:

1. Indicate size, location and model of each control valve, CV, flow, type, actuation, etc.
2. Indicate unique tag numbers for each device, equipment item or system served.
3. Include sizes, shut-off head required, actuator air pressure or force required to meet shut-off head, torque requirements for rotary valves, actual flow requirements based on equipment shop drawings, and calculation of actual pressure drops.

C. Include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.

D. Include charts, graphics or similar items used in making selections.

1.6 QUALITY ASSURANCE

A. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.

- B. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Obtain adequate system information necessary for valve sizing.
- D. Water Valves:
 - 1. Pressure independent control valves shall be factory calibrated and tested.
- E. Tag control valves appropriately. Refer to 25 05 53.
- F. Valve body ratings indicated in Part 2 are minimum required. Valves selected shall be designed to withstand maximum pressure and temperature encountered in the systems, for proper control and without cavitation.
- G. Calculations for sizing modulating valves shall be based on actual characteristics of equipment and system being installed. Valve calculations shall include information such as pump head or available pressure; branch piping circuit losses including all pipe, fittings, valves, and coils; flow rates; and pressure losses of other in-line devices.
- H. Obtain adequate system information necessary for sizing.

PART 2 - PRODUCTS

2.1 WATER CONTROL VALVES (3" OR SMALLER):

- A. Valves shall be pressure independent. Size for full flow + 20%.
- B. Actuator stem shall be removable / replaceable without removing valve from line.
- C. Control flow from 0 to 100%.
- D. Include pressure / temperature ports.
- E. Minimum Characteristics:
 - 1. Valve Body: Brass
 - 2. Max Operating Temperature: 212°F
 - 3. Close off Pressure: 90 PSI
 - 4. Accuracy +/- 5%
 - 5. Rated Pressure: 150 PSI

2.2 WATER CONTROL VALVES (LARGER THAN 3"):

- A. Valves shall be pressure independent. Size for full flow + 20%.
- B. Control flow from 0 to 100%.
- C. Include pressure / temperature ports.
- D. Minimum Characteristics:
 - 1. Valve Body: Iron, Bronze, or Steel
 - 2. Max Operating Temperature: 240°F
 - 3. Close off Pressure: 90 PSI
 - 4. Rated Pressure: 150 PSI
 - 5. Accuracy +/- 5%

2.3 TWO POSITION CONTROL VALVES

- A. Meet ANSI Class 150 rating design.
- B. Provide bubble-tight shut off with pressures in either direction to 275 psi suitable for 150 psi steam.

- C. External disc position indication.
- D. Valve neck extensions with sufficient length to allow for insulation.
- E. Provide threaded lug type valves for equipment isolation, permitting removal of downstream piping without removing valve. Dead end pressure rating of lug type valves shall be 275 psi.
- F. Characteristics:
 - 1. Valve Body: Carbon or Cast steel, Cast Iron
 - 2. Valve Type: Butterfly
 - 3. Max Operating Temperature: 250°F (minimum)
 - 4. Min Rated Pressure: 150 PSI
 - 5. Shaft: Stainless steel
 - 6. Disc: Stainless steel
 - 7. Seat: Reinforced PTFE
 - 8. Packing: Graphite

PART 3 - EXECUTION

3.1 WATER CONTROL VALVES (3" OR SMALLER):

- A. Furnish pressure independent control valves for terminal units.
- B. Factory mount actuator.
- C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.

3.2 WATER CONTROL VALVES (LARGER THAN 3"):

- A. Furnish pressure independent control valves for larger equipment.
- B. Factory mount actuator where possible
- C. Shut-off against maximum system temperatures and pressure encountered.
- D. Select valve components to withstand maximum pressure and temperature encountered in system.

3.3 TWO POSITION CONTROL VALVES (2" and Larger)

- A. Furnish two position control valves for equipment isolation.
- B. Factory mount actuator.
- C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.
- D. Size valve to full pipe size for shut off applications.

END OF SECTION 25 35 19

SECTION 25 55 00 - INTEGRATED AUTOMATION CONTROL OF HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Equipment monitoring of HVAC equipment throughout the facility including but not limited to:
 - 1. Computer Room Air Conditioners
 - 2. VFD's
 - 3. Chillers
 - 4. Boilers
 - 5. Other HVAC Equipment
- B. Related Sections:
 - 1. 25 13 00 Control and Monitoring Network
 - 2. 25 12 19 Integration Protocols

1.2 DEFINITIONS

- A. HOA Hand Off Auto (usually referring to equipment switch)
- B. VFD Variable Frequency Drive

1.3 SYSTEM DESCRIPTION

- A. Include all components not specifically indicated or specified, but necessary to make the system function within the intent of the specification.
- B. Coordinate installation of instrumentation, including but not limited to:
 - 1. Power requirements
 - 2. Panel locations
 - 3. Commissioning
 - 4. User access
- C. Coordinate protocol requirements for integration to each piece of equipment. Refer to section 25 12 19 for protocol requirements.
- D. Refer to Division 23 specifications for additional equipment information.

1.4 SUBMITTALS

- A. Submit point-list and protocol information required for integration.
- B. Submit products not specified but required for integration of systems.

1.5 QUALITY ASSURANCE

- A. Install equipment according to manufacturer's recommendations.
- B. Include auxiliary containers, immersion solutions/product, etc. to minimize effects of routine operations, such as product inventory, product replacement, periodic door openings, compressor cycles, etc.
- C. Safeties shall operate regardless of equipment HOA position or mode of operation, unless otherwise noted.

1.6 WARRANTY

- A. Refer to section 25 00 00.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide Integrator/Driver to ensure seamless communications with HVAC equipment.
- B. Integrate to HVAC equipment including VFD's, Computer Room Air Conditioners, Chillers, Boilers, etc.
- C. Coordinate network requirements with sections 25 13 00.
- D. Coordinate VFD monitor requirements with Division 23 specifications.
- E. Coordinate Computer Room Air Conditioning monitor requirements with Division 23 specifications.
- F. Coordinate Chillers and Boiler requirements with Division 23 design specification sections.

3.2 INTEGRATED HVAC EQUIPMENT POINTS

- A. Include the following list of points for monitoring and control from the building automation system. Refer to drawings for additional requirements.
 - 1. Computer Room Air Conditioners
 - a. Unit Status
 - b. Global Alarm
 - c. Space Temperature Setpoint
 - d. Space Humidity Setpoint
 - e. Space Temperature
 - f. Space Humidity
 - g. Supply Air Temperature
 - h. Fan Status
 - i. Cooling Coil Control Valve Position
 - j. Compressor Run Time
 - 2. Variable Frequency Drives
 - a. Percent Speed Feedback
 - b. Alarm
 - c. Run time
 - d. Power Consumption
 - e. Power Consumption Totalized
 - f. Setpoint
 - g. Drive Speed
 - h. Frequency
 - i. Current
 - j. Percent Current
 - k. Power
 - l. Last Fault Number
 - m. OK/Faulted Status
 - n. Stop/Run Status
 - o. Hand/ Off/ Auto Status
 - p. VFD Start/Stop
 - 3. Chillers
 - a. Chiller System Status (on/off)
 - b. Chiller System Start/Stop
 - c. Chilled Water Entering Temperature
 - d. Chilled Water Flow (Flow Switch Interlock)

- e. Chilled Water Leaving Temperature
- f. Condenser Water Entering Temperature
- g. Condenser Water Flow (Flow Switch Interlock)
- h. Condenser Water Leaving Temperature
- i. Chiller Amps
- j. Chiller Percent RLA
- k. Chiller Voltage
- l. Manual Reset Alarm
- m. Auto Reset Alarm
- n. Chilled Water Pump Start/Stop
- o. Communication Status
- p. Demand-Limit Set-Point
- q. Chilled Water Set-Point
- r. Oil Tank Temperature
- s. Oil Tank Pressure
- t. Oil Differential Pressure
- u. Discharge Oil Pressure
- v. Inlet Guide Vane Degrees
- w. Inlet Guide Vane Percent
- x. Compressor Phase-A Current
- y. Compressor Phase-B Current
- z. Compressor Phase-C Current
- aa. Compressor Winding #1 Temperature
- bb. Compressor Winding #2 Temperature
- cc. Compressor Winding #3 Temperature
- dd. Compressor Discharge Refrigerant Temperature
- ee. Evaporator Refrigerant Temperature
- ff. Evaporator Refrigerant Pressure
- gg. Condenser Refrigerant Temperature
- hh. Condenser Refrigerant Pressure
- ii. Saturated Condenser Temperature
- jj. Saturated Evaporator Temperature
- kk. Purge Status
- ll. Purge Suction Temperature
- mm. Purge Water Set-Point Source
- nn. Purge Liquid Temperature
- oo. Purge Operation (Code)
- pp. Purge Total Pump-Out Time (Minutes)
- qq. Purge Total Run Time (Hours)
- rr. Purge 24-Hour Pump-Out (Hours)
- ss. Purge Maximum Pump-Out (Hours)
- tt. 30-Day Purge Pump-Out Average (Minutes)
- uu. Chiller Average Run Time (Days)
- vv. Bearing #1 Temperature
- ww. Bearing #2 Temperature
- xx. Compressor Starts (Number of Starts)
- yy. Compressor Run Time (Hours)

4. Boilers

- a. Heating Hot Water Flow Status
- b. Heating Hot Water Supply Setpoint
- c. Boiler Alarm Descriptor
- d. Boiler Active Setpoint
- e. Boiler Enable/Disable
- f. Boiler Status
- g. Communications Status
- h. Entering Heating Hot Water Temperature
- i. Leaving Heating Hot Water Temperature

5. Other HVAC Equipment

- a. Refer to Drawings for Control Schematics, Sequences, etc.

END OF SECTION 25 55 00