VI. TECHNICAL SPECIFICATIONS

230000 HVAC General
230501 HVAC Codes and Standards
230502 HVAC Related Work
230513 HVAC Motors
230515 HVAC Identification
230519 HVAC Meters and Gauges
230523 HVAC Valves
230529 HVAC Support Anchors and Seals
230548 Vibration Isolation
230593 Testing and Balancing of HVAC Systems
230713 Exterior Ductwork Insulation
230717 Equipment and Piping Insulation
230810 HVAC Commissioning
230930 Refrigerant Monitoring System
232113 Chilled Water System
232116 Hydronic Piping Specialties
232400 Testing, Cleaning, and Sterilization of Piping Systems
233100 Metal Ductwork
233300 Ductwork Accessories
233400 Fans
233700 Grilles Registers and Diffusers
234000 Variable Frequency Drives
234100 Air Filtration Equipment
237315 Custom Air Handling Units

250000 Building Automation General Requirements
250553 Building Automation Naming and Identification
251000 Building Automation Network Equipment
251300 Building Automation Reporting
253000 Building Automation Instrumentation

260000 Electrical General
260501 Electrical Codes and Standards
260502 Electrical Related Work
260526 Grounding and Bonding
260531 Wires and Cables
260533 Raceways
260534 Boxes and Fittings
260553 Electrical Identification
262726 General Wiring Devices
262816 Heavy Duty Safety Switches
264100 Lightning Protection

280000 Electronic Safety and Security General
280501 Electronic Safety and Security Codes and Standards
280502 Electronic Safety and Security Related Work
283100 Fire Alarm System

PART 1 - GENERAL

A. The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the mechanical work as herein called for and shown on the drawings.

1.2 Related Documents:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to work of this section.
B. This is a Basic Mechanical Requirements Section. Provisions of this section apply to work of all Division 23 sections.
C. Review all other contract documents to be aware of conditions affecting work herein.
D. Definitions:

1. Provide: Furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for subsequent requirements.
3. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be construed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.
B. Verify all field dimensions and locations of equipment to ensure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.
C. Coordinate work in this division with all other trades in proper sequence to ensure that the total work is completed within contract time schedule and with a minimum cutting and patching.
D. Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on mechanical drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

E. Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings, and passageways. Cut no structural members without written approval.

F. Carefully examine any existing conditions, piping, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

G. Because of the small scale of the drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate piping, ductwork, equipment, and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or piping cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

A. The Contractor shall guarantee labor, materials, and equipment for a period of one (1) year from Substantial Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

B. Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

A. When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1. Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and the following.

a. Submittals shall be properly organized in accordance with the approved submittal control log.

b. Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

c. Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

d. Submittals shall have been reviewed and approved by the Builder. Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

e. Submittals that include a series of fixtures or devices (such as plumbing fixtures or valves) shall be organized by the fixture number or valve type

and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

f. The electrical design shown on the drawings supports the mechanical equipment basis of design specifications at the time of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this change will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

B. If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

C. Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

D. Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations, and details to scale (not smaller than 1/4" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications, and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports, and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance (O&M) data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final "Approved" or "Approved as Noted" copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required and as described herein. Submit manuals at the Substantial Completion inspection.

PART 2 - PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description,

characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

A. Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

B. Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings, and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated, or painted.

C. The label of the approving agency, such as UL, IBR, ASME, ARI, AMCA, by which a standard has been established for the particular item shall be in full view.

D. The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

E. A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

F. Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

G. Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material, and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

H. Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.3 Requests for Substitution:

A. Where a particular system, product, or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product, or material specified.

B. Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances:

1. Required product cannot be supplied in time for compliance with Contract time requirements.
2. Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted, or insured, or has other recognized disability as certified by Contractor.
3. Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation, and other necessary services and similar considerations.

C. All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

1. Principal of operation.
2. Materials of construction or finishes.
3. Thickness of gauge of materials.
4. Weight of item.
5. Deleted features or items.
6. Added features or items.
7. Changes in other work caused by the substitution.
8. Performance curves.
9. If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

PART 3 - EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

A. The Contractor shall be responsible for full coordination of the mechanical systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for piping, ductwork, or other equipment passing through slabs or walls.

B. Any additional steel supports required for the installation of any mechanical equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

C. It shall be the Contractor's responsibility to see that all equipment such as valves, dampers, filters, and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

D. All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

E. The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

F. Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

3.3 Start of work will be construed as acceptance of suitability of work of others.

3.4 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be

done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.5 Phasing: Provide all required temporary valves, piping, ductwork, equipment, and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.6 Cutting and Patching: Notify Builder to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.7 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts, and washers. Level equipment.

3.8 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 23. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.9 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials, and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.10 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.11 Climate Control: Operate heating and cooling systems as required after initial startup to maintain temperature and humidity conditions to avoid freeze damage and warping or sagging of ceilings and carpet.

3.12 Record Drawings:

A. During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

B. Upon completion of the work, record drawings shall be prepared as described in the General Conditions and Supplementary Conditions.

3.13 Acceptance:

A. Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

B. Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

C. Operation and Maintenance Manuals: Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

1. Detailed operating instructions and instructions for making minor adjustments.
2. Complete wiring and control diagrams.

3. Routine maintenance operations.
4. Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
5. Copies of approved submittals.
6. Copies of all manufacturer's warranties.
7. Copies of test reports and verification submittals.

D. Record Drawings: Submit record drawings.
E. Test and Balance Report: Submit four electronic certified copies. The Report shall be submitted for review prior to the Substantial Completion Inspection.
F. Acceptance will be made on the basis of tests and inspections of job. A representative of firm that performed test and balance work shall be in attendance to assist. Contractor shall furnish necessary mechanics to operate system, make any necessary adjustments and assist with final inspection.
G. Control Diagrams: Frame under glass and mount on equipment room wall.

PROJECT NAME
PROJECT NUMBER

ARCHITECT: Company Name

ENGINEER: Mitchell Gulledge Engineering

CONTRACTOR: Contractor Name

SUBCONTRACTOR: Sub Name

SUPPLIER: Supply Company

MANUFACTURER: Manufacturer

DATE: mm/dd/yyyy

SAMPLE

Any standard heading is acceptable.

SECTION: 23 XX XX/Section Name

1. Product 1: Manufacturer, Model

2. Product 2: Manufacturer, Model

3. Product 3: Manufacturer, Model

4. Product 4: Manufacturer, Model

5. Product 5: Manufacturer, Model

List each product individually. Include manufacturer name and model.

Include GC or CM Approval stamp indicating review and acceptance by responsible contractor.

END OF SECTION

PART 1 - GENERAL

1.1 The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the mechanical work as herein called for and shown on the drawings.

1.2 This is a Basic Mechanical Requirements section. Provisions of this section apply to work of all Division 23 sections.

PART 2 - CODES

2.1 All work under Division 23 shall be constructed in accordance with the codes listed herein. The design has been based on the requirements of these codes; and while it is not the responsibility of the Contractor to verify that all work called for complies with these codes, he shall be responsible for calling to the Architect/Engineer's attention any drawings or specifications that are not in conformance with these or other codes prior to ordering equipment or installing work.

2.2 Comply with regulations and codes of utility suppliers.

2.3 Where no specific method or form of construction is called for in the contract documents, the Contractor shall comply with code requirements when carrying out such work.

2.4 Where code conflict exists, generally the most restrictive requirement applies. Comply with current code edition, unless noted.

2.5 Additional codes or standards applying to a specific part of the work may be included in that section.

2.6 The following codes and standards shall govern all work:

A. Florida Building Code – Sixth Edition (2017)
B. Florida Building Code – Sixth Edition (2017) – Existing Building
C. Florida Building Code – Sixth Edition (2017) – Energy Conservation
D. Florida Building Code – Sixth Edition (2017) – Mechanical
E. Florida Building Code – Sixth Edition (2017) – Plumbing
F. Florida Building Code – Sixth Edition (2017) – Fuel Gas
G. Florida Building Code – Sixth Edition (2017) – Accessibility
H. National Electric Code (NFPA 70 – 2014)
I. Fire Alarm and Signaling Code (NFPA 72 – 2013)
J. Standard for Air Conditioning and Ventilating Systems (NFPA 90A – 2012)
K. University of Florida construction standards
L. Florida Fire Prevention Code Sixth Edition

1. Fire Code (NFPA 1 – 2017)
2. Life Safety Code (NFPA 101 – 2017)

PART 3 - STANDARDS

All mechanical materials, installation, and systems shall meet the requirements of the following standards, including the latest addenda and amendments, to the extent referenced:

3.1 Underwriters' Laboratories (UL)
3.2 American National Standards Institution (ANSI)
3.3 American Society of Testing Materials (ASTM)
3.4 National Fire Protection Association (NFPA)
3.5 National Electrical Manufacturers Association (NEMA)
3.6 Air Conditioning and Refrigeration Institute (ARI)
3.7 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

3.8 American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
3.9 Air Movement and Control Association (AMCA)
3.10 Standards of the Hydronic Institute (IBR)

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

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

1.2 This is a Basic Mechanical Requirements section. Provisions of this section apply to work of all Division 23 sections.

1.3 Coordinate with the General Contractor for all cutting and patching. Contractors performing Division 23 work shall inform the General Contractor of all cutting and patching required prior to bidding and shall coordinate installation.

PART 2 - DIVISION 3 - CONCRETE

2.1 Refer to owner construction standards, for:

A. Rough grouting in and around mechanical work.
B. Patching concrete cut to accommodate mechanical work.

2.2 The following is part of Division 23 work, complying with the requirements of Division 3.

A. Curbs, foundations, and pads for mechanical equipment.
B. Basins, sumps, and vaults of mechanical work.

PART 3 - DIVISION 4 - MASONRY

3.1 Refer to owner construction standards, for:

A. Installation of wall louvers.
B. Installation of access doors in walls.

PART 4 - DIVISION 5 - METALS

4.1 Refer to owner construction standards, for:

A. Framing openings for mechanical equipment.

4.2 The following is part of Division 23 work:

A. Supports for mechanical work.

PART 5 - DIVISION 6 - WOOD AND PLASTIC

5.1 Refer to owner construction standards, for:

A. Framing openings for mechanical equipment.

PART 6 - DIVISION 7 - THERMAL AND MOISTURE PROTECTION

6.1 Refer to owner construction standards, for:

A. Installation of all roof curbs and roof supports for mechanical work.
B. Caulking and waterproofing of all wall and roof mounted mechanical work.
C. Providing all roof curbs and all vent flashing for metal roofs.

6.2 The following is part of Division 23 work, complying with the requirements of owner construction standards, for:

A. Fire barrier penetration seals.

PART 7 - DIVISION 8 - DOORS AND WINDOWS

7.1 Refer to owner construction standards, for:

A. Providing all undercuts

PART 8 - DIVISION 9 - FINISHES

8.1 Refer to owner construction standards, for:

A. Painting exposed ductwork, piping, and equipment.
B. Painting structural metal and concrete for mechanical work.
C. Painting door grilles and access panels.
D. Painting color-coded mechanical work indicated for continuous painting.
E. Installation of access doors in gypsum drywall.

8.2 Colors shall be selected by the Architect for all painting of exposed mechanical work in occupied spaces, unless specified herein. Do not paint insulated or jacketed surfaces.

8.3 Perform the following as part of Division 23 work:

A. Touch up painting of factory finishes.
B. Painting of all hangers.

PART 9 - DIVISION 26 - ELECTRICAL

9.1 Mechanical contractor shall coordinate the exact electrical requirements of all mechanical equipment being provided with the electrical contractor. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The electrical design shown on the drawings supports the mechanical equipment basis of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this design will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

9.2 Mechanical contractor shall provide all HVAC control wiring including the Energy Management Control system sensors, alarms, and input/output signals and all relays, interlocks, warning lights, and control devices, complying with the requirements of Division 26. The intent is for the mechanical contractor to be responsible for the entire HVAC control system, including point-to-point wiring.

9.3 Electrical contractor shall provide disconnect switches, starters, and contactors for mechanical equipment unless specifically noted as being furnished as part of mechanical equipment.

9.4 Electrical contractor shall provide all power wiring, raceway, and devices, and make final electrical connections to all mechanical equipment, switches, starters, contactors, controllers, and similar equipment.

9.5 All duct-mounted smoke detectors shall be furnished and wired by the electrical contractor and installed by the mechanical contractor.

PART 10 - DIVISION 33 - SITE WORK

10.1 Specific requirements for excavation and backfill for underground piping are contained in Section 23 05 90. Refer to owner construction standards, for all site related work.

10.2 The following is part of Division 23 work: All site chilled water piping.

END OF SECTION

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. This Section includes basic requirements for motors. It includes motors that are factory-installed as part of equipment and appliances as well as field-installed motors.

1.3 Quality Assurance:

A. Comply with NFPA 70, "National Electrical Code", and with NEMA MG1 31.40.4.2, "Motors and Generators".
B. Provide NRTL listed motors. (The term "listed" shall be as defined in "National Electrical Code," Article 100, and "NRTL" (Nationally Recognized Testing Laboratory) shall be as defined in OSHA Regulation 1910.7.
C. Acceptable manufacturers: Baldor Gold.

PART 2 - PRODUCTS

2.1 Motors, General:

A. Provide open drip proof motors with sufficient capacity to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity. Temperature rise shall be based on 40˚C ambient except as otherwise indicated.
B. Motors 1/2 HP and larger shall be polyphase. Motors smaller than 1/2 HP shall be single-phase. Motor frequency ratings shall be 60 Hz, with voltage ratings as determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

1. 120 V Circuit: 115 V - motor rating.
2. 208 V Circuit: 200 V - motor rating.
3. 240 V Circuit: 230 V - motor rating.
4. 480 V Circuit: 460 V - motor rating.

2.2 Polyphase Motors:

A. Provide NEMA Design B squirrel-cage induction-type motors with double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading of the application. All polyphase motors shall be of the high efficiency type, with nominal efficiency equal to or greater than that stated in NEMA MG 1, Table 12-6B for that type and rating of motor.
B. Multi-speed motors shall have a separate winding for each speed.
C. Variable speed motors for use with solid-state drives shall be energy efficient, squirrel-cage induction, Design B units with ratings, characteristics, and features coordinated with and approved by drive manufacturer.
D. Internal thermal overload protection for motors, where indicated, shall automatically open control circuit arranged for external connection. Protection operates when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.
E. Rugged duty motors shall be totally enclosed with 1.25 minimum service factor. Provide motors with regreasable bearings and equipped with capped relief vents.

Insulate windings with nonhygroscopic material. External finish shall be chemical resistant paint over corrosion resistant primer. Provide integral condensate drains.

F. Coordinate motors with reduced inrush starting with indicated reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

G. For all motors used for exterior applications, provide TEFC type motors.

2.3 Single-Phase Motors:

A. Single-phase motors shall be of one of the following types as selected to suit the starting torque and other requirements of the specific motor application.

1. Permanent Split Capacitor.
2. Split-Phase Start, Capacitor-Run.
3. Capacitor-Start, Capacitor-Run.

B. Shaded-pole motors may be used only for motors smaller than 1/20 HP.

C. Internal thermal overload protection for motors, where indicated, shall automatically open the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.

D. Bearings for belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single-phase motors.

PART 3 - EXECUTION

3.1 Installation:

A. For field installed motors, install motors in accordance with manufacturer's published instructions and the following:

B. Direct Connected Motors: Mount securely in accurate alignment.

C. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.

D. Provide TEFC motors for outside installations.

3.2 Commissioning:

A. Check operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part. Report unusual conditions, and correct deficiencies of field-installed units.

END OF SECTION

PART 1 - GENERAL

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

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to or requiring identification devices specified herein.

1.3 Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Refer to Division-26 sections for identification requirements of electrical work; not work of this section. Refer to other Division-23 sections for identification requirements for controls; not work of this section.

1.5 Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.2 Painted Identification Materials:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel.

D. Plastic Pipe Markers.

E. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers.

F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

G. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.3 Valve Tags:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Provide 1-1/2" diameter tags, except as otherwise indicated.

B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Provide 1-1/2" square black tags with white lettering, except as otherwise indicated.

2.4 Engraved Plastic-Laminate Signs:

A. General: Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style a minimum of

3/4" tall and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 3/32" for larger units.

C. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.5 Stamped Nameplates: Provide equipment manufacturer's standard stamped nameplates for motors, AHUs, pumps, etc.

PART 3 - EXECUTION

3.1 Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 Ductwork Identification:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures, and at 50' spacings along exposed runs.

C. Access Doors: Provide stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate and procedural information.

3.3 Piping System Identification:

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

B. Plastic pipe markers.

C. Stenciled markers, black or white for best contrast.

D. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces and exterior non-concealed locations.

E. Near each valve and control device.

F. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

G. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.

H. At access doors, manholes and similar access points which permit view of concealed piping.

I. Near major equipment items and other points of origination and termination.

J. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.

K. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

L. The following piping shall be color-coded where exposed in mechanical and electrical rooms by completely painting the piping with the indicated color. Use standard colors where exposed in finished spaces. Use standard identification methods in concealed areas.

3.4 Valve Identification: Provide coded valve tag on every valve, cock, and control device in each piping system; exclude check valves, 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. Coordinate code with operating instructions.

3.5 Valve Charts: Provide framed, glass covered valve charts in each mechanical room. Identify coded valve number, valve function, and valve location for each valve.

3.6 Mechanical Equipment Identification: Install engraved plastic laminate sign on a vertical surface on or near each major item of mechanical equipment and each operational device. Label shall indicate type of system and area served. Provide signs for the following general categories of equipment and operational devices:

A. Main control and operating valves, including safety devices.
B. Meters, gauges, thermometers, and similar units.
C. Fuel-burning units including boilers, furnaces, and heaters.
D. Pumps, chillers, and similar equipment.
E. Heat exchangers.
F. Fans, blowers, primary balancing dampers.
G. HVAC air handlers and fan coil units.
H. Tanks and pressure vessels.
I. Air conditioning indoor and outdoor units.

3.7 Stamped Nameplates: Equipment manufacturers to provide standard stamped nameplates on all major equipment items such as motors, pumps, AHUs, etc. Where motors are hidden from view (within equipment casing, or otherwise not easily accessible, etc.), the equipment supplier shall furnish a duplicate motor data nameplate to be affixed to the equipment casing in an easily visible location, unless data is already included on the equipment nameplate.

A. Adjusting and Cleaning:

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

END OF SECTION

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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 meters and gauges required by this Section is indicated on drawings and/or specified in other Division 23 sections. Types of meters and gauges specified in this Section include the following:

1. Glass Thermometers.
2. Thermometer Wells.
3. Pressure Gauges.
4. Pressure Gauge Cocks.
5. Calibrated Balancing Valves.
6. Gauge Connector Plugs.
7. Venturi - Type Flow Meters.

1.3 Quality Assurance:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of meters and gauges, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

B. Comply with ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

1.4 Submittals:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

PART 2 - PRODUCTS

2.1 Thermometers:

A. Glass Thermometers: Provide a die cast aluminum case finished in baked epoxy enamel, with glass front, spring secured, and nine inches long. The adjustable joint shall also be die cast aluminum with 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device. Provide a mercury filled tube and capillary with magnifying lens and 1% scale range accuracy. Scale shall be satin faced, nonreflective aluminum, with permanently etched markings. Stem shall be copperplated steel or brass, for separable socket. Ranges shall be as follows:

1. Chilled Water: 0°F-120°F with 1°F scale divisions.

2.2 Thermometer Wells:

A. Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide extension, length equal to insulation thickness, for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

2.3 Temperature or Pressure Gauge Connector Plugs:

A. General: Provide temperature gauge connector plugs rated for 500 psi and 200˚F (93˚C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Acceptable manufacturers include Peterson Equipment Co.

2.4 Pressure Gauges:

A. Provide pressure gauges for general use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection. Cases shall be drawn steel or brass, with glass lens, 4-1/2" diameter. Provide a brass connector with 1/4" male NPT. Provide a protective siphon when used for stream service. Scales shall be white coated aluminum with permanently etched markings. Accuracy shall be 1%. Ranges shall be as follows:

1. Case: Drawn steel or brass, glass lens, four and 4-1/2" diameter.
2. Connector: Brass with 1/4" male NPT. Provide protective siphon when used for steam service.
3. Scale: White coated aluminum, with permanently etched markings.
4. Range: Conform to the following:

a. Chilled Water: 0 - 100 psi.

B. Acceptable manufacturers include Trerice (H.O. Co.), Weiss Instruments, Inc., Weksler Instruments Corp.

2.5 Pressure Gauge Cocks:

A. Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4" female NPT on each end, and "T" handle brass plug.

2.6 Calibrated Balancing Valves:

A. Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Each readout valve shall have an integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicate degree of closure of precision machined orifice. Construct balancing valve with internal EPT o-ring seal to prevent leakage around rotating element. Provide balance valves with pre-formed polyurethane insulation suitable for use on both heating and cooling systems. Acceptable manufacturers include Bell & Gossett, Taco, and Trush products.

2.7 Flow Venturis:

A. Flow Venturi: Brass or steel flow venturi equipped with quick connect valves to facilitate connecting of differential pressure meter to flow meter. Provide calibrated nameplate with flow meter detailing its flow range of differential head pressures. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide one portable differential pressure meter and associated connecting hoses fully compatible with supplied venturis. Acceptable manufacturers include Rinco Engineering Co. (Berkley, California), Presco Industries, Barco, and Gerand Engineering Co.

PART 3 - EXECUTION

3.1 Inspection:

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Installer.

3.2 Installation:

A. Install temperature gauges, pressure gauges, and flow meters in accessible location and positioned so as to be easily read by an observer standing on the floor.
B. Install gauge connector plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.
C. Install pressure gauge cocks in piping tees with snubber. Install siphon for steam pressure gauges.
D. Install venturi with grooved piping connections to allow for simple disassembly, cleaning, and orientation of ports.

3.3 Adjusting and Cleaning:

A. Adjust faces of meters and gauges to proper angle for best visibility.
B. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.
C. Provide two full sets of capacity curves for all flow venturis provided on the job. Capacity curves should be bound in a letter size three-ring binder.

END OF SECTION

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PART 1 - GENERAL

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

1.2 This section is a Division-23 Basic Materials and Methods section, and is part of each Division-23 section making reference to or requiring valves specified herein.

1.3 Extent of valves required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Quality Assurance:

A. Valve Dimensions: For face-to-face and end-to-end dimensions of flanged or welding-end valve bodies, comply with ANSI B16.10.

B. Valve Types: Provide valves of same type by same manufacturer.

1.5 Approval Submittals: When required by other Division-23 sections, submit product data, catalog cuts, specifications, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valves with Division-23 section using the valves, not as a separate submittal. For each valve, identify systems where the valve is intended for use.

A. Ball Valves: Type BA.

B. Butterfly Valves: Type BF.

1.6 O&M Data Submittals:

A. Submit maintenance data and a copy of approval submittals.

PART 2 - PRODUCTS

2.1 General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with specifications and installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide valves of one of the producers listed for each valve type. The model numbers are listed for contractor's convenience only. In the case of a model number discrepancy, the written description shall govern.

2.3 Ball Valves:

A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

B. Construction: Ball valves shall be rated for 150 psi saturated steam and 600 psi non-shock cold water. Pressure containing parts shall be constructed of ASTM B-584 alloy 844, or ASTM B-124 alloy 377. Valves shall be furnished with blow-out proof bottom loaded stem constructed of ASTM B-371 alloy 694 or other approved low zinc material. Provide TFE packing, TFE thrust washer, and reinforced teflon seats. Valves 1" and smaller shall be full port design. Valves 1-1/4" and larger shall be conventional port design. Stem extensions shall be furnished for use in insulated piping where insulation exceeds 1/2" thickness.

C. Comply with the following standards:

1. MSS SP-72. Ball Valves with Flanged or Butt Welding Ends for General Service.
2. MSS SP-110. Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

D. Types of ball (BA) valves:

1. Threaded Ends 2" and Smaller (BA1): Bronze two-piece full port body with adjustable stem packing. Nibco T-585-70. Stockham S216-BR-R-T. Milwaukee BA125. Apollo 77-100.
2. Soldered Ends 2" and Smaller (BA2): Bronze three-piece full port body with adjustable stem packing and stainless steel ball and trim. Nibco S-595-Y-66. Milwaukee BA350. Apollo 82-200.
3. Threaded Ends 1" and Smaller (BA3): Bronze two-piece full port body, UL listed (UL 842) for use with flammable liquids and LP gas. Nibco T-585-70-UL.
4. Threaded Ends 2" and Smaller (BA4): 175 WWP, bronze two-piece body. Nibco KT-585-70-UL and KT-580-70-UL.
5. Threaded Ends 2" and Smaller (BA5): 400 WWP, bronze two-piece body. Nibco KT-580.
6. Threaded Ends 2-1/2" and Smaller (BA6): 300 WWP, bronze three-piece body, gear operator with handwheel, indicator flag, accepts tamper switch. Nibco T-505-4 and G-505-4.
7. Flanged Ends 2-1/2" and Larger (BA7): Class 150, carbon steel full bore two-piece body with adjustable stem packing. Nibco F515-CS series. Apollo 88-240.

2.4 Butterfly Valves:

A. General: Comply with MSS SP-67, Butterfly Valves. Provide butterfly valves designed for tight shut-off. Where used for terminal or equipment removal or repair, select lug type valves. Select wafer type valves for other applications. Provide gear operators on all butterfly valves 6" and larger.

B. Types of butterfly (BF) valves:

1. Wafer Type 3" and Larger (BF1): 200 CWP, cast-iron body, lever-operated, cadmium-plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-512. Nibco WD 2110-3. Crane 42-FXB-TL. Milwaukee MW222E-8416.
2. Lug Type 3" and Larger (BF2): 200 CWP, cast-iron body, lever-operated, cadmium-plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-712. Nibco LD 2110-3. Crane 44-FXB-TL. Milwaukee ML132B-8416.
3. Wafer Type 3" and Larger (BF3): 150/200 CWP, cast-iron body, gear-operated, cadmium-plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-522 and LG-521. Nibco WD 2110-5. Crane 42-FXB-G. Milwaukee MW 122B-8115.
4. Lug Type 3" and Larger (BF4): 150/200 CWP, cast-iron body, gear-operated, cadmium-plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-722 and LG-721. Nibco LD 2110-5. Crane 44-FXB-G. Milwaukee ML 132B-8115.
5. Wafer Type 4" and Larger (BF5): 175 WWP, cast-iron body, gear-operated, nickel-plated ductile iron disc, Type 410 stainless steel stem, EPT seat, UL listed. Stockham LG-52U. Nibco WD 3510-8.
6. Lug Type 4" and Larger (BF6): 175 WWP, cast-iron body, gear-operated, nickel-plated ductile iron or aluminum bronze disc, Type 410 stainless steel stem, EPT seat, UL listed. Stockham LG-72U. Nibco LD 3510-8.

2.5 Valve Features:

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.
B. Valve features specified or required shall comply with the following:

1. Bypass: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving. Provide for gate valves 8" and larger.
2. Drain: Comply with MSS SP-45, and provide threaded pipe plugs complying with applicable Division-23 pipe or tube section. Provide for gate valves 8" and larger.
3. Flanged: Provide valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
4. Threaded: Provide valve ends complying with ANSI B2.1.
5. Solder-Joint: Provide valve ends complying with ANSI B16.18.
6. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry unless otherwise specified.
7. Non-Metallic Disc: Provide non-metallic material selected for service indicated in accordance with manufacturer's published literature.
8. Renewable Seat: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.
9. Extended Stem: Increase stem length by 2" minimum, to accommodate insulation applied over valve.
10. Mechanical Actuator: Provide factory-fabricated gears, gear enclosure, external chain attachment and chain designed to provide mechanical advantage in operating valve for all valves 4" and larger that are mounted more than 7'-0" above the floor, or are otherwise difficult to operate regardless of height.

PART 3 - EXECUTION

3.1 Installation:

A. General: Install valves where required for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward below horizontal plane.
B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
C. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator.
D. Mechanical Actuators: Install mechanical actuators as recommended by valve manufacturer.

3.2 Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:

A. Tube Size 2" and Smaller: Threaded valves.
B. Pipe Size 2" and Smaller: Threaded valves.
C. Pipe Size 2-1/2" and Larger: Flanged valves.

3.3 Non-Metallic Disc: Limit selection and installation of valves with non-metallic disc to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

3.4 Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

END OF SECTION

PART 1 - GENERAL

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

1.2 This section is a Division-23 Basic Materials and Methods section, and is a part of each Division-23 section making reference to or requiring supports, anchors, and seals specified herein.

1.3 Extent of supports, anchors, and seals required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports, anchors, and seals.

1.5 MSS Standard Compliance:

A. Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58.
B. Select and apply pipe hangers and supports, complying with MSS SP-69.
C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
D. Terminology used in this section is defined in MSS SP-90.

1.6 UL Compliance: Provide products which are Underwriters Laboratories listed.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide supports and hangers by Grinnel, Michigan Hanger Company, B-Line Systems, or approved equal.

2.2 Horizontal-Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

A. Adjustable Steel Clevises: MSS Type 1.
B. Steel Double Bolt Pipe Clamps: MSS Type 3.
C. Adjustable Steel Band Hangers: MSS Type 7.
D. Steel Pipe Clamps: MSS Type 4.
E. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

2.3 Vertical-Piping Clamps: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

A. Two-Bolt Riser Clamps: MSS Type 8.
B. Four-Bolt Riser Clamps: MSS Type 42.

2.4 Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building

attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

A. Steel Turnbuckles: MSS Type 13.
B. Malleable Iron Sockets: MSS Type 16.

2.5 Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

A. Center Beam Clamps: MSS Type 21.
B. C-Clamps: MSS Type 23.
C. Malleable Beam Clamps: MSS Type 30.
D. Side Beam Brackets: MSS Type 34.
E. Concrete Inserts: MSS Type 18.

2.6 Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

A. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
B. Protection Saddles: MSS Type 39; use with rollers, fill interior voids with segments of insulation matching adjoining insulation.

2.7 Miscellaneous Materials:

A. Metal Framing: Provide products complying with NEMA STD ML 1.
B. Steel Plates, Shapes, and Bars: Provide products complying with ANSI/ASTM A 36.
C. Cement Grout: Portland cement (ANSI/ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes or continuous channel struts selected for loads required; weld steel in accordance with AWS standards.

PART 3 - EXECUTION

3.1 Preparation:

A. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.
B. Prior to installation of hangers, supports, anchors, and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, and installers of other work requiring coordination with work of this section for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.2 Installation of Building Attachments:

A. In areas of work requiring attachments to existing concrete, use self-drilling rod inserts, Phillips Drill Co., "Red-Head", or equal.

3.3 Installation of Hangers and Supports:

A. General: Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69 or as listed herein, whichever is most limiting. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

Horizontal steel pipe and copper tube 1-1/2" diameter and smaller: support on 6 foot centers.

1. Horizontal steel pipe and copper tube over 1-1/2" diameter: support on 10 foot centers.
2. Vertical steel pipe and copper tube: support at each floor.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
C. Paint all black steel hangers with black enamel. Galvanized steel and copper clad hangers do not require paint.
D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
E. Provision for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

F. Insulated Piping: Comply with the following installation requirements.

1. Shields: Where low-compressive-strength insulation or vapor barriers are indicated, install coated protective shields.
2. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

3.4 Installation of Anchors:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
C. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and elbows. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

D. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

E. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Prime and paint with black enamel.

END OF SECTION

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 work required by this Section is indicated on drawings and/or specified in other Division 23 sections. Types of vibration isolation specified in this Section include equipment support isolators and equipment bases.

1.3 Quality Assurance:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration isolation, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.
B. Comply with ASME B31 Series - Code for pressure piping.
C. All metallic components installed outdoors shall be hot dipped galvanized after fabrication.
D. All equipment provided under this division shall operate under all conditions of load, free of objectionable sound and vibration. Sound and vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner.

1.4 Submittals:

A. Product Data: Submit manufacturer's technical product data, including dimensions, supported loads, static deflections, isolator size, and type for each item of supported equipment for each of the following required types:

1. Equipment support isolators. Type EM.

1.5 O&M Data Submittals:

A. Submit maintenance data and a copy of approval submittals.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. All vibration isolation materials and systems shall be supplied by a single, approved manufacturer. Acceptable suppliers are VMC Amber/Booth Co., Vibro-Acoustics Inc., Kinetics Noise Control, Inc., Metraflex, Inc., Mason Industries, Inc. (MI), Wheatley.

2.2 Equipment Support Isolators:

A. Spring Isolators, Free-Standing (EM1): Provide vibration isolation spring between top and bottom loading plates, and with pad-type isolator bonded to the bottom loading plate. Spring diameter shall not be less than eighty percent of the compressed height of the spring at the design load. Springs shall have a minimum additional travel to solid equal to fifty percent of the actual deflection. Springs shall have a horizontal to vertical stiffness ratio of approximately one. The spring element shall be set in the neoprene cup to ensure centering of spring on plate and have a steel washer to distribute the load evenly over the neoprene. All mounts shall have leveling bolts. Include holes in bottom plate for bolting to substrate.

1. If isolators are to be travel limited, all mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum

clearance of 1/4 inch shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.

B. Floor Neoprene (EM3): Neoprene isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.

C. Double Neoprene Pad (EM4): Neoprene pad isolators shall be formed by two layers of 5/16 inch thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. Neoprene shall be forty to fifty durometer. The pads shall be sized so that they will be loaded between forty and fifty psi.

PART 3 - EXECUTION

3.1 Application:

A. Unless otherwise shown or specified, all floor-mounted major equipment items shall be set on four inch high housekeeping type concrete pads. All equipment having moving parts shall be vibration isolated from the building structure. Electrical connections to vibration isolated equipment shall be flexible.

B. Vibration isolation devices shall be installed for all piping, sheet metal ducts, and plenums as recommended by the manufacturer at the vibration products, and in accordance with recognized industry standards.

3.2 Installation:

A. Location of all vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation. Installation of vibration isolation equipment shall be in accordance with the manufacturer's written instructions.

B. Sealed resilient penetration sleeves shall maintain an airtight seal around the penetrating element and shall prevent rigid contact of the penetrating element and the building structure.

C. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment. Hanger rods for vibration isolated support shall be connected to structural beams or joists, not from the floor slab between beams and joist. Provide intermediate support members as necessary.

D. Vibration isolation hanger elements shall be positioned so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting the building structure or any object.

E. No pipes or equipment shall be supported from other pipes or equipment. Resiliently isolated pipes shall not contact any rigid building structure or equipment.

F. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

G. Unless otherwise indicated, there is to be a minimum operating clearance of 1-1/2" between inertia bases or structural steel frames and the concrete housekeeping pad or floor beneath the equipment.

H. Metal ductwork equipment connections: Ducts shall be connected to fan intakes and discharged by means of a flexible connection per Division 23 Ductwork Accessories specification section so that all equipment is fully isolated.

END OF SECTION

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PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials Sections apply to work of this section.

1.3 Description of Work:

A. Extent of testing, adjusting, and balancing work (TAB) is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

B. Pretesting: Where required by the drawings or other Division 23 sections, pretest existing HVAC systems as directed and report findings prior to start of demolition work or any other modifications to the existing systems. Results of pretesting shall be reported to the Engineer in a timely manner. Comply with standards for final TAB reports described herein.

C. Coordination: Coordinate with the General Contractor and Mechanical Contractor responsible for the HVAC system installation as required to complete the TAB work.

1.4 The intent of this specification is to balance HVAC systems within the tolerances listed, maintaining the pressure relationships indicated, with a minimum of noise.

A. Airflow Tolerances:

1. Air Handling: The supply air, return air, and outdoor air quantities shall be balanced within +/-5% of design values.

B. Temperature Tolerances:

1. Air Handling Temperatures: The controlled temperatures at AHUs shall be verified to be under control within +/-1°F of design values.
2. Hot Water Temperatures: The heating hot water controlled temperatures from boilers and heat exchangers and other similar devices shall be under control within +/-5°F.
3. Chilled Water Temperatures: The chilled water controlled temperature from
4. Room Temperatures: Balance systems and controls within +/-2°F of indicated settings.

C. Hydronic Flow: Balance hydronic flow rates to within 10% of design values.

1.5 Quality Assurance: The TAB Contractor shall be certified as follows:

A. Tester: A firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, who is not the Installer of the systems to be tested and is otherwise independent of the project. Comply with NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" as applicable to this work.

B. Tester: A firm certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project. AABC-certified firms are independent by definition. Comply with AABC's Manual MN-1 "AABC National Standards", as applicable to this work.

C. Industry Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to

measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

1.6 Job Conditions:

A. Do not proceed with testing, adjusting, and balancing work until HVAC work (including Controls) has been completed and is operable. Ensure that there is no residual work still to be completed.
B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt, and discarded building materials.
C. Do not proceed until architectural work that would affect balancing (walls, ceiling, windows, doors) have been installed.
D. Testing may proceed system by system, but each HVAC system must be complete as describe herein.
E. The mechanical contractor shall make any changes in pulleys, belts, and dampers, and/or add dampers as required for correct balancing.

1.7 Approval Submittals:

A. Submit the name of the proposed test and balance company for the Engineer's approval within thirty (30) days after awarding of contract.

1.8 Test Reports and Verification Submittals:

A. Submit an electronic copy of the dated test and balance report upon completion of TAB work. The report shall include a list of instruments used for the work. The report shall be signed by the supervisor who performed the TAB work.

PART 2 - PRODUCTS

2.1 Patching Materials: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork, and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

2.2 Test Instruments: Utilize test instruments and equipment of the type, precision, and capacity as recommended in the referenced standard. All instruments shall be in good condition and shall have been calibrated within the previous six (6) months (or more recently if required by standard).

PART 3 - EXECUTION

3.1 General:

A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned, and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.
B. Test, adjust, and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as modified or detailed herein.
C. Test, adjust, and balance systems during summer season for air conditioning systems and during winter season for heating systems, 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. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit. The Contractor shall

return for a change of seasons test at no additional cost to the Owner and submit the revised TAB report.

D. Punch List: Prepare a deficiency (punch)list for the Contractor with a copy of the Engineer that lists all items that are incorrectly installed or are functioning improperly. Provide a retest after all items are corrected.

E. Prepare TAB report of test results, including instrumentation calibration reports, in format recommended by applicable standards, modified as required to include all data listed herein.

F. Patch holes in insulation, ductwork, and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

G. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

H. Include in the TAB report recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

I. Include an extended warranty of ninety (90) days after completion of test and balance work, during which time the Engineer, at his discretion, may request a recheck, or resetting of any component as listed in test report. The TAB company shall provide technicians and instruments and make any tests required by the Engineer during this time period.

3.2 Controls:

A. Check all HVAC controls for proper location, calibration, and sequence of operation.

B. Check operation of all controllers and controlled devices to verify proper action and direction. Check the operation of all interlocks.

C. Check all motorized damper motors for leakage when in closed position. If leakage is more that 5%, mechanical contractor shall reset damper linkages.

D. Check all control valves for complete closure and correct action under all operating conditions.

3.3 Air Balancing:

A. Leakage tests on ductwork must have been completed before air balancing.

B. Set dampers, volume controls, and fan speeds to obtain specified air delivery with minimum noise level. Rebalance as required to accomplish this. Simulate fully loaded filters during test.

C. Set grille deflections as noted on plans. Modify deflections if required to eliminate drafts or objectionable air movement.

D. Record air terminal velocity after completion of balance work.

E. Record final grille and register deflection settings if different from that specified on contract drawings.

F. Record all fan speeds.

3.4 Water Balancing:

A. Verify proper operation of all hydronic system devices to ensure the proper flowrate, flow direction, and pressure are maintained.

B. Set balancing cocks and flow control devices to obtain specified water flow rates to all terminal units, coils, chillers, boilers, and heat exchangers.

C. Impeller Trim: Record the initial suction and discharge pressure and flow rate of each pump with all cocks fully open. The Engineer will compare this data with the "balanced system" data and will determine if pump impellers should be trimmed for the piping

system as installed. Impeller trimming, if required, will be accomplished by change order. Additional TAB work to accomplish impeller trimming shall be performed at no additional cost to the Owner.

D. Variable Speed Pumps: Verify proper operation of variable speed pumps and the associated distribution system at 50% and 100% flow.

3.5 Data Collection:

A. In addition to the data required for any specified performance tests, measure and record the temperatures, pressures, flow rates, and nameplate data for all components listed herein.

B. It is the intent of this section to record data on balanced systems, under normal operating or design conditions.

C. Temperatures:

1. Outside dry and wet bulb temperatures.
2. Dry bulb temperature in each room and at least one wet bulb temperature in each zone.
3. Refrigerant liquid and suction temperatures.
4. Inlet and outlet temperature of each heat exchange device - both fluids.

D. Pressures:

1. Suction and discharge static pressure of each fan.
2. Suction and discharge pressure of each pump.
3. Each refrigerant suction and discharge pressure.
4. Water pressure drop through each heat exchanger.

E. Flow rates:

1. Flow rate through each fan and pump
2. Flow rate through each coil or heat exchange device.

F. Nameplate Data:

1. Complete nameplate data for all equipment.
2. Motor data to include horsepower, phase, voltage, RPM, full load nameplate current, fuse rating in disconnect switch, number or manufacturer's size designation, and ampere rating of overcurrent and low voltage protection devices in starters.

3.6 All test openings in ductwork shall be resealed in an approved manner.

END OF SECTION

PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Approval Submittals:

A. Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1. Rigid duct insulation
2. Flexible duct insulation

1.4 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Knauf, Owens-Corning, Johns Manville, Certainteed.

2.2 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, coverings, sealers, mastic, and adhesive) with a flame spread rating of 25 or less, and a smoke-developed rating of 50 or less as tested by ANSI/ASTM 84.

2.3 Rigid Fiberglass Insulation Board: ASTM C612, Class 1 (non-load bearing). Boards shall be 3 pcf density with UL rated aluminum foil vapor barrier (FSK).

2.4 Flexible Fiberglass Insulation: ASTM C553, Type I, Class B-3 (temperature less than 350°F). Duct wrap shall be 1 pcf density with UL rated aluminum foil vapor barrier (FSK).

2.5 General Purpose Mastic: Benjamin Foster 35-00 Series, Insulcoustic VIAC Mastic, Childers CP-10, or approved equal. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.6 Vapor Barrier Sealant: Benjamin Foster 30-35, Insulcoustic IC-501, 3M EC-1378, Childers CP-30, or approved equal. Provide "Low Odor" type. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.7 Adhesive: Benjamin Foster 85-20, Insulcoustic IC-205, 3M EC-35, Childers CP-82, Childers CP-89, or approved equal. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.8 Fiber-Glas Mesh: 10x10 Mesh. Foster Mastafab or equal.

PART 3 - EXECUTION

3.1 Insulate all supply, return, and outdoor air ductwork exposed in mechanical rooms, chiller plants, mezzanines, fan lofts or in any open spaces with 1-1/2" thick rigid fiberglass insulation with vapor barrier.

3.2 Installation of Rigid Insulation:

A. Clean and dry ductwork prior to insulating. Butt insulation firmly together to ensure complete and tight fit over surfaces to be covered. Install insulation materials with smooth and even surfaces. Maintain integrity of aluminum vapor barrier wherever

possible. Extend insulation without interruption through walls, floors, and similar ductwork penetrations except where otherwise indicated.

B. Adhere insulation to duct with 50 percent coverage using approved insulation adhesive applied in 6" wide swaths with 6" spaces between swaths. Additionally, secure insulation with perforated pins and Tuff-Bond or by self-sticking pins with a 3/8" self-tapping screw. Space on 12" centers and 3" from all edges. Ducts up through 24" wide only require one row of pins. Ducts over 24" wide shall have pins spaced as described herein.

C. Apply open mesh glass fabric embedded in vapor barrier mastic. Then apply a second coat of general purpose mastic with aluminum grey color. This finish shall be complete over all rigid insulation.

3.3 Insulate all supply, return and outdoor air ductwork concealed above ceilings, in chases, or elsewhere, and the backs of all ceiling supply outlets with 2" thick fiberglass blanket insulation with vapor barrier.

3.4 Installation of Flexible Insulation:

A. Insulate round elbows and fittings with wrap such that thickness is equal to adjoining duct covering. Clean and dry ductwork prior to insulating.

B. Adhere insulation to duct with 50 percent coverage using approved insulation adhesive applied in 6" wide swaths with 6" spaces between swaths. Additionally, secure insulation with perforated pins and Tuff-Bond or by self-sticking pins with a 3/8" self-tapping screw. Space on 12" centers and 3" from all edges. Ducts up through 24" wide only require one row of pins. Ducts over 24" wide shall have pins spaced as described herein.

C. Lap all joints 2" and seal joints with 4" wide strips of open mesh glass fabric embedded in two coats of general purpose mastic.

D. Seal all punctures and breaks in aluminum vapor barrier with open mesh glass fabric and vapor barrier sealant.

END OF SECTION

PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.3 Approval Submittals:

A. Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1. Cellular glass pipe insulation
2. Flexible unicellular piping insulation

1.4 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Armstrong, Johns Manville, Knauf, Owens Corning, Pittsburgh Corning, U.S. Rubber, or approved equal. All products shall be asbestos-free.

2.2 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesive) with a flame-spread rating of 25 or less, and a smoke-developed rating of 50 or less, as tested by ANSI/ASTM E84.

2.3 Pipe Insulation Materials:

A. Cellular Glass Pipe Insulation: ASTM C552, Type II, Class 1. (Uncovered.)
B. Flexible Unicellular Pipe Insulation: ASTM C534, Type I. (Tubular, suitable for use to 200°F.)
C. Staples, Bands, Wires, and Cement: As recommended by the insulation manufacturer for applications indicated.
D. Adhesives, Sealers, Protective Finishes: Products recommended by the insulation manufacturer for the application indicated.
E. Bedding Compound for CHW Systems: Provide products to completely cover the piping or equipment being insulated. Products shall be low odor type. Foster 30-45 or Foster 95-50.
F. Jackets: ASTM C921, Type I (vapor barrier) for piping below ambient temperature, Type II (vapor permeable) for piping above ambient temperature. Type I may be used for all piping at Installer's option.

PART 3 - EXECUTION

3.1 General:

A. Install 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 insulation and protect it to prevent puncture and other damage. Label all insulation "ASBESTOS FREE".
D. Do not apply insulation to surfaces while they are hot or wet.

E. Do not install insulation until systems have been checked and found free of leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

F. Do not install insulation on pipe systems until acceptance tests have been completed except for flexible unicellular insulation. Do not install insulation until the building is "dried-in".

3.2 Cellular Glass Pipe Insulation:

A. Insulate the following piping systems:

1. Chilled water: smaller than 6" pipe – 1-1/2" thick,

B. Indoor Exposed, Mechanical Rooms, Manholes, and Outdoor Locations: Cut insulation in sections at fittings and carefully fit to the pipe and fittings. No stovepipe or single miter insulation is allowed. Apply cellular glass bedding compound to the pipe surface to achieve 100% coverage. Apply vapor barrier mastic to all edges of the cellular insulation and between joints in the insulation. Wire the cellular glass in place with stainless steel wire 9" on center. Provide hanger or pipe support shields of 16 gauge (minimum) galvanized steel over or embedded in the insulation which extend halfway up the pipe insulation cover and at least 4" on each side of the hanger. Insulate anchors adequately to prevent moisture condensation problems. Finish cellular glass by applying a heavy coat of weather barrier sealant reinforced with white glass fabric to the exterior of the cellular glass. Provide removable end caps for strainers. Flexible rubberized asphalt products are not acceptable.

3.3 Flexible Unicellular Pipe Insulation:

A. Insulate the following piping systems:

1. Condensate drains from air conditioning units: 1/2" thick.
2. Refrigerant piping: 3/4" thick.

B. Apply insulation in accordance with the manufacturer's recommendations and instructions. Mitre cut insulation to fit pipe fittings. Use approved cement to seal all joints and ends in the insulation.

END OF SECTION

PART 1 - GENERAL

1.1 Related Documents:

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

1.2 Summary:

A. Section includes commissioning process requirements all mechanical equipment shown on the drawings.

1.3 Definitions:

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
B. CxA: Commissioning Authority.
C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 Informational Submittals:

A. Certificates of readiness.
B. Certificates of completion of installation, prestart, and startup activities.

1.5 Contractor's Responsibilities:

A. Perform commissioning tests at the direction of the CxA.
B. Attend controls coordination meeting.
C. Attend testing, adjusting, and balancing review and coordination meeting.
D. Provide information requested by the CxA for final commissioning documentation.
E. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA's Responsibilities:

A. Provide Project-specific checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
B. Direct commissioning testing.
C. Verify testing, adjusting, and balancing of Work are complete.

1.7 Commissioning Documentation:

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Corrective action documents.
2. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 Testing Preparation:

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the outlined in the scope of work documents.

B. Certify that HVAC&R instrumentation and control systems have been calibrated and that they are operating according to the scope of work documents, and that pretest set points have been recorded.
C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
E. Inspect and verify the position of each device and interlock identified on checklists.
F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 General Testing Requirements:

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of unit controllers and sensors.
D. Tests will be performed using design conditions whenever possible.
E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
F. The CxA may direct that set points be altered when simulating conditions is not practical.
G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
H. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.3 HVAC&R Systems, Subsystems, and Equipment Testing Procedures:

A. HVAC&R Instrumentation and Control System Testing: Field testing plans will be completed by CxA to test Sequence and Operations for HVAC Controls. Assist the CxA with preparation of testing plans.
B. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air distribution systems, including HVAC&R terminal equipment and equipment.

END OF SECTION

PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.4 Coordination:

A. Refer to Division-23 section "Testing, Adjusting, and Balancing" control checkout.

B. Refer to Division-23 section "Building Automation System" for controls.

C. Refer to Division-26 sections for power supply wiring from power source to power connection to devices. Division-26 work will include required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.5 Codes and Standards:

A. System shall conform to ANSI/BSR ASHRAE Standard 15-2004 Safety Code for Mechanical Refrigeration.

1.6 Approval Submittals:

A. Product Data: Submit manufacturer's technical data, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions. Submit assembly-type drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

1. Refrigerant Monitoring System

1.7 O&M Data Submittals: Submit maintenance data and parts list, accessory, and control. Include these data, a copy of approved submittals, and wiring diagrams in O&M Manual.

PART 2 - PRODUCTS

2.1 Refrigerant Detection Systems:

A. Manufacturers: Bacharach or approved equal.

2.2 Infrared type refrigerant detection and alarm systems detecting refrigerant in listings at adjustable detection points to provide both visual and audible alarms. System shall use internal pump, and required filters, for extracting samples from remote locations.

2.3 Sensor shall be compound specific and calibrated for refrigerant used in chillers. System shall be automatically zero at set intervals by sensing air from and uncontaminated air source. Auto zero cycle may be manually or remotely initiated.

2.4 Latched alarms shall be capable of being reset locally by remote contact closure. System malfunction alarm shall be non-latching contact annunciated locally and remotely.

2.5 System shall require no more than annual recalibration and monthly confirmation of clean air source for auto-zero.

2.6 Provide local alarm and control panel to accept these inputs and provide outputs for warning alarm and critical alarm, which shall energize emergency ventilation system. Both alarms shall have DPDT relays and shall energize local horn-strobe alarm and also provide for connection to Owners control system.

2.7 Refrigerant leak detection system to have the following minimum performance.

A.	Power:	120 VAC/60 Hz
B.	Operating Temperature:	60°F to 105°F (15°C to 40°C)
C.	Operating Humidity:	10% to 90% RH
D.	Contact Ratings:	5 amp 120 VAC
E.	Contact(s): different	2 sets DPDT independently configured for concentrations.
F.	Performance:	
	1. Minimum measurable:	1 ppm as tested per UL2075
	2. Response time:	5 to 120 seconds
	3. Accuracy:	Error < ± 2% full scale
G.	Display:	3 digit LED or LCD displaying refrigerant gas concentration
H.	Display Range:	0-100 ppm
I.	Quantity of Required Monitor Points:	See drawings
J.	Monitoring Distance:	500 ft. from measuring point to monitor
K.	Output:	4-20 mA/24VDC. Provide BACnet interface

Refrigerant	Warning Alarm Point	Critical Alarm Point
R123	15 ppm	30 ppm
R134a	200 ppm	300 ppm

2.8 Provide refrigerant leak detection alarm system as shown in Drawings. Alarm system shall meet ASHRAE 15, 2004 requirements. Horn/strobe assemblies located outdoors shall be weatherproof. Horn/strobe assemblies located indoors shall be by Federal Signal Corporation or be fully compatible with the existing devices slated for reuse.

PART 3 - EXECUTION

3.1 General: Except as otherwise indicated or specified, install in accordance with manufacturer's installation instructions and recognized industry practices to ensure that unit serve their intended function.

3.2 Coordinate work with work of all other trades.

3.3 Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer. 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 Testing: After installation has been completed, test each system to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected. Provide startup report from certified start up technician and letter certifying that the entire system has been tested for proper operation.

3.5 Cleaning: Clean factory-finished surfaces. Remove all tar and soil. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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. This Section includes piping systems for chilled water. Piping materials and equipment specified in this Section include pipes, fittings, specialties, and valves.

1.3 Definitions:

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

1.4 Submittals:

A. Product Data: Submit manufacturer's technical product data for:

1. Valves
2. Meters and Gauges

1.5 Shop Drawings:

A. Submit scaled layout drawings of piping systems in mechanical rooms including, but not necessarily limited to pipe sizes, location, offsets, connections, elevations, and hydronic specialties. Indicate interface and spatial relationship between piping and equipment. Coordinate with all other trades work and existing conditions. Field verify final location of pipe prior to submittal of layout drawings and fabrication.

1.6 Maintenance Data: For hydronic specialties and special duty valves, for inclusion in operating and maintenance manuals.

1.7 Quality Control Submittals:

1. Welders' certificates certifying that welders comply with the quality requirements specified in Quality Assurance below.
2. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.
3. Submit reports specified in Part 3 of this Section.

1.8 Quality Assurance:

A. Qualifications for Welding Processes and Operators: ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification".

B. ASME Compliance: Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 Pipe and Tubing Materials:

2.2 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.3 Basic Identification: Provide identification complying with Division-23 Basic Mechanical Materials and Methods section "Mechanical Identification."

2.4 Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

A. Pipe Size 2" and Smaller: Black steel pipe; Schedule 40; Class 125 cast-iron fittings with threaded joints.

2.5 Pipe Size 2½" and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings with welded joints.

2.6 Basic Piping Specialties: Provide piping specialties complying with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties."

2.7 Basic Supports and Anchors: Provide supports and anchors complying with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors."

2.8 Basic Valves: Provide valves complying with Division-23 Basic Materials and Methods section “Valves” and the following list:

A. Standard Service Sectional Valves: Type BF2, BF4.
B. Standard Service Shutoff Valves: Type BA1, BF2, BF4.
C. Standard Service Drain Valves: Type BA1.

2.9 Basic Meters and Gauges: Provide meters and gauges complying with Division-23 Basic Mechanical Materials and Methods section "Meters and Gauges", in accordance with the following listing:

A. Temperature gauges and fittings.
B. Pressure gauges and fittings.
C. Flow measuring meters.

2.10 Access Doors: Provide access doors to service all valves and other devices as required in accordance with Division-23 Basic Materials and Methods Section “Access Doors”.

PART 3 - EXECUTION

3.1 General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Hydronic Piping:

A. General: Install hydronic piping in accordance with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".
B. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush. Do not use bushings.
C. Install piping with 1/32" per foot (¼%) upward slope in direction of flow, or as indicated on the drawings. The intent is to install piping sloped to drains at low points in the system for a drainable system.
D. Connect branch-feed piping to mains at horizontal center line of mains, connect run-out piping to branches at horizontal center line of branches.
E. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
F. Install piping specialties in accordance with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".
G. Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

H. Install valves in accordance with Division-23 Basic Mechanical Materials and Methods section "Valves".

3.3 Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.

3.4 Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet and outlet of each hydronic terminal, and elsewhere as indicated.

3.5 Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.

3.6 Install meters and gauges in accordance with Division-23 Basic Materials and Methods section "Meters and Gauges".

3.7 Equipment Connections:

3.8 General: Connect hydronic piping system to mechanical equipment as indicated on the drawings, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return and a drain valve on the drain connection.

3.9 Connections between dissimilar metals shall be made with dielectric devices.

3.10 Hydronic Terminals: Install hydronic terminals with shutoff valves, unions and related devices as shown on the drawings. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing cocks for ease of maintenance. Where indicated, install automatic temperature control valve with unions on return line between coil and shutoff valve.

3.11 Provide sufficient swing joints, expansion loops and devices necessary for a flexible piping system. Install drain valves at all low points of each system to enable complete drainage, and air vents at all high points in the piping system to enable complete air venting.

3.12 Pipe drains from strainers, etc., to spill over an open sight drain, floor drain or other acceptable discharge point, and terminate with a plain end (unthreaded pipe) 6" above the drain. Rigidly support all drains.

3.13 Locate and coordinate installation of access doors for all valves and devices in accordance with Division-23 Basic Mechanical Materials and Methods section “Access Doors”.

3.14 Testing, Cleaning, Flushing, and Inspecting: Test, clean, flush, and inspect hydronic piping systems in accordance with requirements of Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning, and Sterilization of Piping Systems."

3.15 New piping shall be flushed, cleaned and pre-treated as recommended by Chemtreat the current University of Florida water treatment vendor. Contractor shall purchase the necessary chemicals from Chemtreat, and flushing, cleaning, and pre-treatment shall be witnessed by the Chemtreat representative. Submit test report.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Documents:

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

1.2 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, including drip pans, sleeves, and seals and basic piping installation instructions.

1.3 Quality Assurance:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

1.4 Submittals:

A. Product Data: Submit product data on escutcheons, dielectric unions and fittings, mechanical sleeve seals, roof drains, and strainers.
B. Quality Control Submittals: Submit welders' certificates.

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.

PART 2 - PRODUCTS

2.1 Joining Materials:

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code.
B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code.
C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.
D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21).

2.2 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. Acceptable manufacturers include Chicago Specialty Manufacturing Co., Sanitary-Dash Manufacturing Company, and Grinnell Co.
B. Unions: Malleable-iron, Class 150 for low pressure service and Class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Waterway Fittings: Acceptable manufacturers include Epco Sales, Inc., and Victaulic Company of America.
D. Dielectric Unions: Provide dielectric unions which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion. Acceptable manufacturers include Eclipse, Inc., Perfection Corp., and Watts Regulator Company.
E. Y-Type Strainers: Provide strainers full line size of connecting piping. 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 or Flanged Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded or 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. Acceptable manufacturers include Armstrong Machine Works, Hoffman Specialty ITT (Fluid handling Div.), Metraflex Corp., R-P & C Valve (Div. White Consolidated Industries Inc.), Spirax Sarco, Victaulic Co., of America, and Watts Regulator Co.

F. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snap-lock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" and smaller, 20 gauge; 4" to 6", 16 gauge; over 6", 14 gauge.
2. Steel Sleeves: Schedule 40 galvanized welded steel pipe, ASTM A53, Grade A.

G. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:

1. 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. Acceptable manufacturers include Thunder Line Corp.

H. Fire Barrier Penetration Seals:

1. Cracks, Voids, or Holes up to 4" Diameter: Use putty or caulking, one-piece intumescent elastomer, noncorrosive to metal, compatible with synthetic cable jackets, and capable of expanding ten times when exposed to flame or heat, UL listed.
2. Openings 4" or Greater: Use sealing system capable of passing three-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350°F UL listed.
3. Acceptable manufacturers include Electro Products Div./3M, and Nelson (Unit of General Signal).

I. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

J. Manual Air Vent: Bronze body and non-ferrous internal parts, 150 psig working pressure, 225˚F operating temperature; manually operated with screwdriver or thumb screw and having 1/8" discharge connection and a 1/2" inlet connection. Acceptable manufacturers include Armstrong, Bell & Gossett, Hoffman Specialty, and Spirax Sarco.

K. Automatic Air Vent: Bronze body and non-ferrous internal parts with built in shutoff valve and vacuum breaker. All internal components shall be replaceable. 150 psig working pressure, 225˚F operating temperature; manually operated with screwdriver or thumb screw and having 1/2" discharge connection and a 3/4" inlet connection. Acceptable manufacturer: Honeywell Industrial air vent EA79A1004.

PART 3 - EXECUTION

3.1 Preparation:

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

3.2 Installations:

A. So far as practical, install piping as indicated. Install piping free of sags or bends, tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with one-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing valves.

B. 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. Hose bibbs will not be used. If low points are created and are not on plans or shop drawings, a drain shall be installed and noted on as-built drawings.

C. 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.

D. Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

E. Fire Barrier Penetration Seals: Provide seals for any opening through fire rated walls, floors, or ceilings used as a passage for mechanical components such as piping or ductwork. Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

F. Escutcheons shall be used where piping enters or exits finished walls, cabinets and in the interior of cabinets, and elsewhere as noted in the specs and drawings.

G. Install manual air vents at all high points of the piping systems and as indicated on the drawings.

3.3 Fittings and Specialties:

A. Remake leaking joints using new materials.

B. 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.
C. Install flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
D. Install dielectric unions to connect piping materials of dissimilar metals in all piping systems.
E. Pipe Sleeves: Install steel-pipe sleeves except as otherwise indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 1/4" above level floor finish, and 3/4" above concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.
F. Drip Pans: Locate drip pans under piping passing over or within three feet horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

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.
2. Pipe Larger than 2":

a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31. The use of backing rings is acceptable.
b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
c. 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.

B. Nonferrous 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. 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.

3.5 Testing:

A. See individual specification sections in which piping specialties are installed for testing procedures for piping systems.

END OF SECTION

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PART 1 - GENERAL

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

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section and is part of each Division-23 section making reference to or requiring the testing and other procedures specified herein.

1.3 Notify the Architect/Engineer when system tests are ready to be witnessed at least 24 hours prior to the test.

1.4 All materials, test equipment, and devices required for cleaning, testing, sterilizing or purging shall be provided by the Contractor.

PART 2 - PRODUCTS

2.1 None.

PART 3 - EXECUTION

3.1 Pressure Tests:

A. General: Provide temporary equipment for testing, including pump and gauges. Test piping systems before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with indicated medium and pressurize for indicated pressure and time.

B. Required test period is 2 hours.

C. No piping, fixtures, or equipment shall be concealed or covered until they have been tested. The contractor shall apply each test and ensure that it is satisfactory for the period specified before calling the Architect/Engineer to observe the test. Test shall be repeated upon request to the satisfaction of those making the inspection.

D. Observe each test section for leakage at the end of the test period. Test fails if leakage is observed or if pressure drop exceeds 5% of the test pressure.

E. Check of systems during application of test pressures should include visual check for water leakage and soap bubble or similar check for air and nitrogen leakage.

F. During heating and cooling cycles, linear expansion shall be checked at all elbows and expansion joints for proper clearance.

G. Repair piping systems sections which fail required piping test. Disassemble and re-install using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

3.2 Pressure Test Requirements:

A. Chilled Water: Perform hydrostatic test at 150% of the normal operating pressure, but not less than 150 psig.

3.3 Cleaning and Sterilization:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water or blowdown with air before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

B. Flush and drain all water systems at least three times. Reverse flush systems from smallest piping to largest piping. Replace startup strainers with operating strainers.

C. Cleaning: After completion of all work and operational check out of the HVAC installations and prior to acceptance of the project by the Owner, the following shall be

accomplished. The completed piping systems shall be thoroughly flushed (reversed flushing) and chemically cleaned as needed to remove all dirt, debris, and any foreign matter that may have been trapped in the piping systems during construction. After flushing of systems is complete, the Contractor shall clean all main strainers and all strainers at air handlers.

D. A second cleaning of all strainers will be required if requested by the Engineer. Contractor shall furnish and install all valves and piping stub outs in the piping systems as needed to accommodate this flushing operation. Install the valves and stub outs at a location and in a manner that will allow them to remain in place for future flushing operations. The flushing and strainer cleaning operations shall be witnessed and approved by the Engineer and Owner's representative.

END OF SECTION

PART 1 - GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
1.2 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.
1.3 Extent of HVAC metal ductwork is indicated on drawings and in schedules, and by requirements of this section.
1.4 Refer to other Division-23 sections for exterior insulation of metal ductwork.
1.5 Refer to other Division-23 sections for ductwork accessories.
1.6 Codes and Standards:

A. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" Latest Edition for fabrication and installation of metal ductwork, unless otherwise noted.
B. NFPA 90A Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.7 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data and installation instructions for the following.

1. Factory-fabricated ductwork
2. Sealants

B. Shop Drawings: Submit scaled layout drawings of HVAC metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

PART 2 - PRODUCTS

2.1 Ductwork Materials:

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.
B. Galvanized Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653, lockforming quality; with G 90 zinc coating in accordance with ASTM A653; and mill phosphatized for exposed locations. Stamp gauge and manufacturer's identification on each sheet. Break sheets so that identification is exposed.

2.2 Miscellaneous Ductwork Materials:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
B. Duct Sealant: Provide UL listed low VOC non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded

and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant shall be NFPA 90A and 90B compliant.

C. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim, and angles for support of ductwork.

D. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.

2.3 Fabrication:

A. Shop fabricate ductwork in 4, 8, 10, or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards", except provide sealant at all joints. Duct downstream of terminal units and supply duct from air conditioning units and all return and exhaust duct shall be minimum 2" pressure class unless otherwise noted.

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1-1/2 times associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.

2.4 Factory-Fabricated Low Pressure Ductwork (Maximum 2" W.G.):

A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.

B. Gauge: 28-gauge minimum for round ducts and fittings, 4" through 8" diameter. 26-gauge minimum 9" through 14", 24-gauge minimum 15" through 26".

C. Elbows: One-piece construction for 90° and 45° elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

D. Divided Flow Fittings: 90° tees, constructed with saddle tap spot welded and bonded to duct fitting body.

E. Acceptable Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork by Semco Mfg., Inc. or United Sheet Metal Div., United McGill Corp, or approved equal.

PART 3 - EXECUTION

3.1 General: Examine areas and conditions under which HVAC metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Metal Ductwork:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of

performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within c" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

B. Supports: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work. Install self-drilling screw anchors in

C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements. Seal joints in round or oval ductwork with hard cast or shrink bands, and sheet metal screws, or by welding.

D. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally. Avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. In finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction or above suspended ceilings, unless specifically noted as "Exposed". Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

E. Electrical Equipment Spaces: Do not route ductwork through transformer vaults or other electrical equipment spaces and enclosures.

F. Penetrations: Where ducts pass through 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 gauge as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate.

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards. Fan discharge outlet ducts shall be installed correctly with regard to "system effect" per AMCA Publication 201.

3.3 Leakage Tests: After each duct system is completed, test for duct leakage in accordance with Sections 3 and 5 of the SMACNA HVAC Air Duct Leakage Test Manual. Test pressure shall be equal to pressure class of duct, less 0.5" static pressure. Repair leaks and repeat tests until total leakage is less than 5% of system design air flow for low pressure systems and less than 1% for systems rated over 3".

3.4 Equipment Connections: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.5 Clean ductwork internally free of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration. Keep ducts closed with poly during construction to prevent contamination by construction dust and debris.

3.6 Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

3.7 System Adjustment: Adjust the system to provide functional operation to the extent possible, and leave ready for Testing and Balancing work. It is not the intent of this section to provide final testing and balancing, but to leave the system operational with a minimum of noise.

END OF SECTION

PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

1.4 Refer to other Division-23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.5 Codes and Standards:

A. SMACNA Compliance: Comply with applicable portions of both SMACNA "HVAC Duct Construction Standards, Metal and Flexible" and "Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems".

B. UL Compliance: Construct, test, and label fire dampers in accordance with the latest UL Standard 555 "Fire Dampers and Ceiling Dampers".

C. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.6 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions as follows:

1. Low pressure manual dampers
2. Fire dampers
3. Duct access doors
4. Flexible connections

B. O&M Data Submittals: Submit manufacturer's maintenance data including parts lists for fire dampers. Include this data, product data, and a copy of approval submittals in O&M manual.

PART 2 - PRODUCTS

2.1 Dampers:

A. Low Pressure Manual Dampers: Provide 20 gauge dampers of single-blade type (12" maximum blade width) or provide 16 gauge dampers of multi-blade type. Damper blades to be gang-operated from a single shaft with acetal bearings on each end. Provide indexed locking quadrant. Parallel or opposed blade style is acceptable. Provide 2" standoff on locking quadrant for externally insulated duct.

B. Control Dampers: Provide AMCA Standard 500-D certified dampers with parallel blades for 2-position control or opposed blades for modulating control. Construct blades of 16 gauge steel. Provide heavy-duty molded self-lubricating nylon bearings and 1/2" diameter steel axles spaced on 9" centers. Provide TPE blade seals. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16 gauge channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up. Actuators (motors) are provided by control contractor.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide dampers by Air Balance, American Warming & Ventilating, Arrow Louver and Damper, Greenheck, or Ruskin Mfg. Co.

2.2 Fire Dampers:

A. Fire Dampers: Provide curtain type fire dampers, UL classified and labeled per UL 555, of types and sizes indicated. Construct casings and blades of galvanized steel. Damper shall not restrict duct free area when open. Dampers shall be rated for dynamic closure under flow and pressure. Provide sleeves and mounting angles. Provide fusible link rated at 160 to 165°F unless otherwise indicated. Provide damper with positive lock in closed position. All dampers shall be spring activated. Basis of design:

1. 1-1/2 HR: Greenheck DFD - Style B for rectangular, Style CR for round, Style CO for oval.
2. 1-1/2 HR: Greenheck DFD-110 for transfer grilles in narrow partitions.
3. 3 HR: Greenheck DFD350 - Style B for rectangular, Style CR for round, Style CO for oval.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide fire dampers by Air Balance, Inc., American Warning & Ventilating, Arrow Louver and Damper, Greenheck or Ruskin Mfg. Co.

2.3 Turning Vanes: Provide manufactured or fabricated single wall turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.4 Duct Access Doors:

A. General: Provide duct access doors of size indicated, or as required for duty indicated.

B. Construction: Construct of same or greater gauge as ductwork served. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by Air Balance, Inc., Duro Dyne Corp., Ruskin Mfg. Co., or Ventfabrics, Inc.

2.5 Flexible Connections:

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following: Duro Dyne Corp., Flexaust (The) Co., or Ventfabrics, Inc.

PART 3 - EXECUTION

3.1 Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Ductwork Accessories:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install balancing dampers at all main ducts adjacent to units in return air, outside air and where indicated.
C. Install control dampers in the outside air duct and return air duct for each air handler. Damper Motor provided by control contractor.
D. Install turning vanes in square or rectangular 90° elbows in supply, return, and exhaust air systems, and elsewhere as indicated.
E. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
F. Install flexible connections in ductwork such that the clear length of the connector is approximately two inches. Provide thrust restraints as required. Flexible material shall not be so slack as to take a definite concave or convex shape during fan operation.
G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
H. Install fire dampers within fire walls and floors at locations shown on the mechanical drawings. Install in strict accordance with the manufacturer's printed instructions, NFPA 90A, and UL 555. Basis of design installation is detailed on the drawings. Provide out of wall dampers where indicated on the drawings.
I. Install ceiling fire dampers to protect openings in rated ceilings at locations shown on the mechanical drawings. Install in strict accordance with the manufacturer's printed instructions, NFPA 90A, and UL 555. Provide diffuser radiation shields where required. Basis of design installation is detailed on the drawings.

3.3 Fire Dampers: Notify Engineer at least 24 hours in advance of ceiling installation or chase closure so that complete fire damper installation can be observed. A copy of the manufacturer’s printed installation instructions shall be available at the site.

3.4 Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

3.5 Adjusting and Cleaning:

A. Adjusting: Adjust ductwork accessories for proper settings. Install fusible links in fire dampers and adjust for proper action.
B. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing". However, the system shall be left functional with all dampers open or throttled.
C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
D. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

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PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of fan work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.4 Coordination:

A. Refer to Division-7 sections for installation of prefabricated roof curbs; not work of this section. Furnishing prefabricated roof curbs is part of this section's work.
B. Refer to Division-23 section "Testing, Adjusting, and Balancing" for balancing of fans.
C. Refer to Division-23 section "Building Automation System" for controls.
D. Refer to Division-26 sections for power supply wiring from power source to power connection on fans. Division-26 work will include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.5 Codes and Standards:

A. AMCA Compliance: Provide fans which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Ratings Seal.
B. UL Compliance: Provide fans which are listed by UL and have UL label affixed.

1.6 Approval Submittals:

A. Product Data: Submit manufacturer's technical data for fans, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions. Submit assembly-type drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

1. Fans

1.7 O&M Data Submittals: Submit maintenance data and parts list for each type of fan, accessory, and control. Include these data, a copy of approved submittals, and wiring diagrams in O&M Manual.

PART 2 - PRODUCTS

2.1 General: Except as otherwise indicated, provide standard prefabricated fans of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation. Provide accessories as listed in the schedule on the drawings and as described herein. Motors shall be high efficiency per Division-23 section "Motors".

2.2 Acceptable Manufacturers: Subject to compliance with requirements provide fans manufactured by Acme, Greenheck, Loren Cook or approved equal unless otherwise noted herein.

2.3 Centrifugal Roof Exhausters:

A. Housing: Provide heavy gauge aluminum hood, housing, and base with a galvanized steel frame.
B. Fan Wheels: Provide aluminum air foil type, statically and dynamically balanced.
C. Drive: Provide direct or belt drive as scheduled with pre-lubricated, ball bearing, continuous duty type motors. Provide vibration isolation equipment for the entire drive.

D. Round Hood Fans: Where indicated provide fans with motors mounted in a separate compartment out of the air stream.

2.4 In-Line Centrifugal Fans:

A. Housing: Provide round aluminum or square weather tight housing constructed of steel and painted inside and out with an epoxy finish. Provide venturi type inlet.
B. Fan Wheels: Provide aluminum air foil type, backward curved, statically and dynamically balanced.
C. Drive: Provide direct or belt drive as scheduled with pre-lubricated, ball bearing, continuous duty type motors. Provide vibration isolation equipment for the entire drive.
D. Isolation and Support: Provide spring type vibration isolators and fan support brackets.

2.5 Fan Accessories and Features: Where indicated on the schedule or drawings provide accessories and features listed herein.

1. Belt drive: Belt drives shall include cast iron, variable pitch sheaves, heavy duty belts, and 1750 rpm motors. The drive shall be adjustable to plus or minus 20% of scheduled flow. Provide fixed sheaves after balancing is complete.
2. Direct drive: Direct drives shall have multispeed motors or speed controllers to achieve scheduled flow.
3. Curbs: Furnish 12-inch high, roofed over type, prefabricated aluminum curbs with treated wood nailer and 1-1/2" fire resistant fiberglass insulation sized to match the fans. For deck slopes of 1/4" per foot and more, fabricate curbs to form level top edge.
4. Bird Screens: Provide bird screens of 1/2" mesh aluminum or galvanized steel hardware cloth.
5. Backdraft Dampers: Provide where indicated aluminum louvered dampers with felt-edged blades and nylon bearings.
6. Disconnect Switches: Provide factory installed local disconnecting means.
7. Thermal Overloads: Provide internal thermal overloads.
8. Speed Controller: Provide where indicated solid state speed controller for remote mounting.
9. Motorized Dampers: Provide where indicated aluminum louvered dampers with felt-edged blades and nylon bearings with 120-volt motors wired to operate with the fan. Provide limit switch to prevent fan starting until damper is at least half open.

PART 3 - EXECUTION

3.1 General: Except as otherwise indicated or specified, install fans in accordance with manufacturer's installation instructions and recognized industry practices to ensure that fans serve their intended function.
3.2 Coordinate fan work with work of roofing, walls, and ceilings as necessary for proper interfacing. Framing of openings, caulking, and curb installation is not work of this section.
3.3 Ductwork: Refer to Division-23 section "Ductwork". Connect ducts to fans in accordance with manufacturer's installation instructions. Provide flexible connections in ductwork at fans.
3.4 Roof curb adapters: Furnish roof curb adapter to installer for Installation.
3.5 Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer. Verify that electrical wiring installation is in accordance with

manufacturer's submittal and installation requirements of Division-26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.6 Remove shipping bolts and temporary supports within fans. Adjust dampers for free operation.

3.7 Testing: After installation of fans has been completed, test each fan to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.8 Cleaning: Clean factory-finished surfaces. Remove all tar and soil. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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PART 1 - GENERAL

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

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

1.4 Refer to other Division-23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets and for balancing of air outlets and inlets; not work of this section.

1.5 Codes and Standards:

A. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual". Provide air outlets and inlets bearing ADC Certified Rating Seal.

B. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets indicating construction, finish, and mounting details.

B. Performance Data: For each type of air outlet and inlet furnished, provide aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections and data as required.

1.7 O&M Data Submittals: Submit cleaning instructions for finishes and spare parts lists. Include this data and a copy of approval submittals in O&M manual.

PART 2 - PRODUCTS

2.1 General:

A. Except as otherwise indicated, provide manufacturer's standard grilles, registers, and ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Manufacturers not listed in the following specification will not be considered for approval unless accepted by addendum prior to bid.

C. Performance: Provide grilles, registers, and ceiling diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device equal to the basis of design.

D. Ceiling and Wall Compatibility: Provide grilles, registers, and diffusers with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into ceiling module or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems and walls which will contain each type of ceiling diffuser, grille, or register.

E. Appearance: All grilles and registers shall be aluminum construction and all diffusers shall be aluminum construction, unless otherwise noted, with uniform matching appearance for each type of outlet. Ceiling mounted grilles and registers shall be set to be sight tight from the predominant exposure.

F. Finish: All ceiling mounted grilles, registers, and diffusers shall be finished with baked white enamel. Wall and door mounted grilles and registers shall be finished with white enamel.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products by Titus, Price, or Metal Aire.

2.3 Sidewall Supply Registers (SR): Provide supply registers with two sets of individually adjustable airfoil registers, spaced at 3/4", with the front set parallel to the long dimension. Provide opposed blade damper, screwdriver operated from the face. Provide mounting frame. Titus 272-FL or Metalaire 4004.

2.4 Drum Louvers (DL): Provide long throw diffusers. Titus DL or Metaliare RL.

PART 3 - EXECUTION

3.1 Coordinate installation with ceiling and light fixture installation. Locate ceiling outlets as indicated on architectural Reflected Ceiling Plans. Unless otherwise indicated, locate ceiling outlets in the center of acoustical ceiling modules with sides parallel to the grid.

3.2 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.

3.3 Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

3.4 Set air volumes to values shown on the drawings so that the system is functional. Leave ready for test and balance contractor.

3.5 Furnish to Owner three operating keys for each type of outlet and inlet that require them; obtain receipt.

END OF SECTION

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 air handler variable frequency drives work required by this Section is indicated on drawings and schedules, and by requirements of this Section.
B. Refer to Division 26 sections for power supply wiring from power source to power connection on variable frequency drives; not work of this Section.

1.3 Quality Assurance:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of variable frequency drives for the HVAC industry with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.

1.4 UL Compliance: Provide variable frequency drives and components which are listed and labeled by Underwriters' Laboratories.

1.5 Submittals:

A. Product Data: Submit manufacturer's drive specifications and installation and start-up instructions.
B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
C. Maintenance Data: Submit maintenance data and parts lists.

1.6 Product Delivery, Storage, and Handling:

A. Handle variable frequency drives and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged drives or components; replace with new.
B. Store drives and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
C. Comply with manufacturer's installation instructions for unloading drives and moving them to final location.

1.7 Warranty:

A. All units shall be warranted for a period of 18 months from date of shipment. Any warranty expense during that time shall be born entirely by the manufacturer, including any travel costs or living expenses necessary to repair in warranty equipment.

PART 2 - PRODUCTS

2.1 Variable Frequency Drive:

A. General:

1. The variable torque AC drive shall consist of an adjustable frequency controller capable of driving a standard AC induction motor.
2. The variable frequency controller shall convert 460 volts ±10% three phase 60 HZ utility power to an adjustable frequency output for speed control from 10% to 200% of base speed. The adjustable frequency control shall be designed

exclusively for variable speed applications. The drive must be modifiable to accept all standard input voltages.

B. Basic Design:

1. The variable frequency drive (VFD) shall produce adjustable frequency and voltage output. To eliminate the need for isolation transformers and/or line suppression equipment, input line filters will be an integral part of the input section of the drive.
2. To minimize motor noise generation, the drive output will be six-step. Drives employing a pulse width modulation output wave form shall not be acceptable.
3. The variable frequency drive shall comply with the FCC rules and regulations part 15 subpart J regarding radio frequency interference.
4. Line noise created shall be no greater than three percent (3%) harmonic distortion and no more than a 16,400 volt-microsecond commutation notch area, in accordance with IEEE standard 519-1981 for special applications.
5. Ambient conditions - 0-40ºF) to 95% non-condensing, elevation to 1000 meters (3300 feet) without derating.

C. Control Panel:

1. The operator's control panel shall include the following:

   a. Manual Bypass
   b. Hand/Off/Auto Switch
   c. Local/Remote Switch
   d. Manual Speed Control
   e. Meter Function Selector

2. The control panel shall include a back lit LCD meter that will display % speed, % load, or output voltage. The desired display is selected by a push button.
3. The control logic for the drive shall contain the following customer adjustment potentiometers:

   a. Minimum Speed Adjustment
   b. Maximum Speed Adjustment
   c. Gain and Offset Adjustments for Signal Follower
   d. Current Limit

4. The VFD shall include the following drive status indicator lights on the control panel:

   a. Power On
   b. Ready
   c. Overvoltage
   d. Overcurrent
   e. Running at commanded speed
   f. Run
   g. Fault
   h. Reverse
   i. Phase Loss
   j. Over Temperature
   k. Ground Fault
   l. External Fault

5. In addition, the drive shall contain customer settable DIP switches to control the following functions:
    a. Acceleration Time: Adjustable from approximately 3 to 280 seconds
    b. Deceleration Time: Separately adjustable from approximately from 3 to 280 seconds
    c. Fault Counter Reset: To limit fault reset attempts to seven, the fault counter reset is turned on
    d. Variable Overload: To protect motor from excess current at low speeds
    e. Individual Selectable Resettable Fault Control: Automatic functioning of the fault counter reset can be allowed or denied for ground fault, and phase loss fault.
    f. High Starting Torque: 125% torque can be selected for starting
    g. Follower Selection
    h. Deceleration Control or Coast to Rest
    i. Reverse Rotation
    j. Output Frequency: 50 or 60 Hz
    k. Output Voltages: 200/208, 230, 380, 415, 460, and 575 VAC
6. The following troubleshooting lights shall be supplied:
    a. Bus Power
    b. Commutation Drive
    c. Conduction Drive
    d. Commutation Power Supply
    e. Run Command

D. Features:
1. In addition to the start/stop and variable speed features in the drive, the following features shall be supplied as standard:
    a. 4-20mA or 0-10VDC follower capability
    b. Floating input (accepts ground signal, 1K ohm impedance to drive ground)
    c. Current limit protection
    d. Independently adjustable acceleration and deceleration
    e. Automatic restart
    f. Over voltage protection
    g. Over temperature protection
    h. Ground fault protection
    i. 96% efficiency

E. All steel enclosure, NEMA-3R.
F. Hinged, locking door.

2.2 Quality Assurance:

A. To improve quality and eliminate premature failures, all VFDs shall be pretested at an elevated ambient temperature.

2.3 Manufacturers:

A. Subject to compliance with requirements, manufacturers offering variable frequency drives which be incorporated in the work include the following:
1. ABB, Toshiba, Yazkawa

PART 3 - EXECUTION

3.1 Inspection:

A. Examine areas and conditions under which variable frequency drives are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Drives:

A. General: Install variable frequency drives where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that system complies with requirements and services intended purposes.

B. Access: Provide access space around drives for service as indicated, but in no case less that recommended by manufacturer.

3.3 Start-Up and Cleaning:

A. The manufacturer shall provide start-up assistance in the form of a factory trained service technician. When factory authorized start-up is performed, the warranty shall be extended to 36 months from date of shipment.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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 air cleaning work required by this Section is indicated on drawings and schedules, and by requirements of this Section. Types of air cleaning equipment specified in this Section include air filters (replaceable and automatic roll), filter holding systems (front, rear and side access), and filter gauges.
B. Field installed control wiring shall be work of this Section. Refer to Division 26 for power wiring; not work of this Section.

1.3 Quality Assurance:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cleaning equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.
B. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B, and NEC pertaining to installation of air filters and associated electric wiring and equipment.
C. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.

1.4 Submittals:

A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.
B. Wiring Diagrams: Submit wiring diagrams for power, interlock, and control wiring. Differentiate between factory-installed and field-installed wiring.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. Manufacturers offering air cleaning equipment which may be incorporated in the work include American Air Filter Co., (An Allis-Chalmers Co.), Cambridge Filter Corp., Continental Filter Corp., Farr Co., and Flanders Filters, Inc.

2.2 Air Filters:

A. Ring Panel Filters (Moisture Resistant): Provide polyester antimicrobial self-sealing, ring and link 2-ply filter with unitized construction and fully sealed perimeter and at points on the face such that the inner wire frame supports the filter through the full range of rated velocity and filter loading. Initial filter resistance shall be less than 0.30" w.g. at 500 fpm and 70% efficient for particles greater than 5 um. Filters shall require no fasteners or clips.
B. Replaceable (Throwaway) Panel Filters: Provide factory-fabricated, viscous-coated, flat panel type replaceable air filters with holding frames; with 2" thick UL Class 2 throwaway media material. Construct media of interlaced glass fibers, spray with nonflammable adhesive, frame in throwaway fiberboard casings, and sandwich between perforated metal grills. Construct ductwork-holding frames of 20-gauge galvanized steel, capable of holding media and media frame in place, and gasketed to

prevent unfiltered air by-passing between media frames and holding members. Provide filters with rated face velocity of 500 fpm, initial resistance of not greater than 0.30" w.g., final rated resistance of 0.50" w.g., and average arrestance of 80%. Basis of design: American Air Filter 5700.

C. Extended Surface Filters: Provide high efficiency factory-fabricated, dry, supported, extended surface filters with holding frames; where shown, in sizes indicated. Equip with UL Class 1 water resistant fibrous media material formed into 12" deep V-shaped pleats and held by self-supporting wire frames. Construct ductwork-holding frames of 18-gauge galvanized steel, capable of holding media and media frame in place, and gasketed to prevent unfiltered air by-passing between media frames and holding members. Provide filters with rated face velocity of 500 fpm, initial resistance of not greater than 0.50" w.g. / 0.60" w.g., final rated resistance of 1.2" w.g. Basis of design: American Air Filter Varicel.

2.3 Filter Holding Systems:

A. Front and Rear Access Filter Frames: Provide filter bank framing system, constructed of aluminum framing members having minimum thickness of 0.09". Design system for either upstream (front) or downstream (rear) filter servicing. Cut to size and pre-punch members for easy assembly into modules of size and capacity as scheduled or noted on drawings. Provide permanently gasketed framing members to prevent bypass of unfiltered air. If vertical support members are required to prevent deflection of horizontal members, install so as not to interfere with either installation or operation of filters. Incorporate separate track for prefilters, removable from front, or removable from back after removal of after-filters. Provide factory-installed positive sealing device for each row of filters, to insure seal between gasketed filter elements. Provide hardware necessary for field assembly.

B. Side Servicing Housings: Provide factory-assembled side servicing housings with flanges for insertion into ductwork system as indicated. Construct of 16-gauge galvanized steel. Provide integral pre-filter tracks to accommodate 2" throw-away or cleanable filters. Provide access doors with continuous gasketing on perimeter and positive locking devices. Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass. Arrange so filter cartridges can be loaded from either access door.

2.4 Filter Gauges:

A. Provide manometer-type filter gauge for each filter bank, with logarithmic curve tube gauge, and integral leveling gauge, graduated to read from 0-3" w.g.

PART 3 - EXECUTION

3.1 Installation:

A. Install air filters and holding devices in accordance with air filter manufacturer's written instructions and with recognized industry practices. Install filters in proper position to prevent passage of unfiltered air. Locate each filter unit accurately in position indicated. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate. Coordinate as necessary to interface installation of filters properly with other work.

B. Install and provide wiring for electrical devices furnished by manufacturer but not specified to be factory-mounted. 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.

C. Install air filter gauge pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gauges if any, for proper readings

3.2 Field Quality Control:

A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

3.3 Extra Stock:

A. Provide one complete extra set of filters for each air handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed, and the extra set has been received.

END OF SECTION

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PART 1 - GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.
1.3 Refer to other Division-23 sections for other devices installed piping system, supports, Testing, Adjusting, and Balancing, Building Automation System.
1.4 Refer to Division-23 section "Vibration Isolation" for vibration isolation.
1.5 Extent of work required by this section as indicated on drawings and schedules, and by requirements of this section.
1.6 Refer to Division 26 sections for power supply wiring from power source to power connection; not work of this Section. All fan power cabling shall be installed in raceway.
1.7 Codes and Standards:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of custom air handling units for the HVAC industry with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.
B. Regulatory Requirements: Comply with the codes and standards specified.
C. must be manufactured in an ISO 9001 registered facility.
D. AMCA 99 - Standards Handbook.
E. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
F. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
G. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
H. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
I. AHRI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
J. AHRI 410 - Forced Circulation Air-Cooling and Air-Heating Coils.
K. AHRI 430 - Standard for Central Station Air Handling Units
L. NFPA 70 - National Electrical Code.
M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
N. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.8 Quality Assurance:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning".
D. Comply with NFPA 70 for unit and all auxiliary components.
E. Performance Ratings: Conform to AHRI Standards; bear AHRI 430 certified rating seal. If unit is not AHRI 430 rated, unit shall be tested in accordance with the standards to establish acceptability.
F. Sound Ratings: Test air handling unit in accordance with AMCA 300 (ASHRAE 68) and AHRI 260 Guidelines.
G. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

H. Equipment shall fit into the space available with adequate clearances meeting manufacturer's requirements for service and as determined by the Engineer. The Contractor shall not assume that all of the manufacturers listed as acceptable manufacturers will provide a unit that will fit in the space allocated.

1.9 Approval Submittals:

A. Product Data: Submit manufacturer's product data to include the following:

1. Provide all technical information relevant to the product being provided, including but not limited to all the information shown on the drawing schedules and of this section. It is the responsibility of the supplier to highlight any variances in equipment characteristics.
2. Dimensions, weights, capacities, certifications, shipping splits, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges, and finishes of materials.
3. Provide fan curves with specified operating points clearly plotted.
4. Provide coil selection worksheets at scheduled operating points. Clearly indicate proper consideration for altitude and air density. Indicate coil tube fin and casing construction.
5. Provide filter information, including initial APD, final APD, dust spot efficiency, final dust holding capacity, filter media description, filter frame details, and filter removal details.
6. Submit sound power levels for both air handling unit inlet, outlet, and radiated at rated capacity. If the unit exceeds sound power levels at scheduled conditions, the manufacturer must provide sound attenuators and meet specified brake horsepower requirements without additional connected power requirements.
7. Submit electrical requirements for power supply wiring including wiring diagrams interlocks and control wiring. Clearly indicate factory installed and field installed wiring. Submit load amperage draw, required, maximum overcurrent protection, and short circuit current ratings. Short circuit current rating shall be no less than 65kA.

B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room or space layout and relationships between components and adjacent structural and mechanical elements.
2. Support location, type, and weight.

1.10 Warranty:

A. The complete unit shall be covered by a parts warranty issued by the manufacturer covering the first year of operation. This warranty period shall start upon receipt of start-up forms for the unit or eighteen months after the date of shipment, whichever occurs first.
B. The installing contractor shall provide labor warranty during the unit's first year of operation.

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide product indicated on schedules by one of the following: Ventrol, Haakon, or Ingenia.
2.2 Casing Construction and Performance:

A. Exterior Panel: Provide minimum 16-gauge coated galvanized steel.
B. Forming: Form walls, roofs, and floors as required for minimal deflection. Maximum deflection at any point on the unit casing shall be limited to 1/200th of the overall panel width or height. The unit casing leakage shall not exceed 0.5 CFM per square foot of cabinet area at the scheduled inches positive or negative static pressure.
C. Casing Joints: Provide no-through metal construction to preclude fastener condensation and heat transfer. Field joints are only acceptable at shipping splits and shall be installed to match appearance and performance of factory joints.
D. Sealing: Seal all joints with water-resistant sealant to comply with leakage requirement. Field applied sealant is only acceptable at shipping splits and shall be installed to match appearance and performance of factory applied sealant.
E. Interior Liner: Provide minimum 20-gauge galvanized steel in all sections.
F. Casing air leakage shall be field tested to less than 1% at 8" wg positive or negative pressure.

2.3 Casing Insulation and Fastening:

A. Materials: Provide minimum 3 inch thick, R-15 minimum foam insulation that complies with NFPA 90A and 90B and have a fire hazard classification of 25/50 (per ASTM-84 and ULF 723).
B. Location and Application: Factory applied in all sections to extend fully inside each casing section to the internal surface of panels. Secure insulation tightly within casing to preclude movement and maximize thermal performance. Insulation shall be installed and sealed between outside and inside casing.

2.4 Base Construction:

A. Provide heavy gauge structural steel tubing, C-channel, or I-beam welded perimeter construction with external lifting lugs and internal welded cross members to support internal unit components. Provide no-through metal construction to preclude fastener condensation and heat transfer. Field joints are only acceptable at shipping splits and shall be installed to match appearance and performance of factory joints.
B. Provide 2" floor cavity closed cell spray foam insulation with embedded drain pans and piping. Insulation shall be UL 94HF1 rated and sealed between the bottom liner and floor liner.
C. Floor Liner: Provide continuous 0.125 in aluminum checker plate flooring installed on the base framing with attachment and reinforced from below such that no mechanical fastening is required from above.
D. Provide no-through metal construction to preclude fastener condensation and heat transfer. Field joints are only acceptable at shipping splits and shall be installed to match appearance and performance of factory joints.
E. Sealing: Seal all joints with water-resistant sealant to comply with leakage requirement. Field applied sealant is only acceptable at shipping splits and shall be installed to match appearance and performance of factory applied sealant.
F. Bottom Liner: Provide minimum 20-gauge galvanized steel in all sections.
G. Air leakage rates shall be less than 1% at 8" wc.

2.5 Access Doors:

A. Door Fabrication: Formed, reinforced, and welded, double-wall and insulated panels with thermal breaks of same materials, thicknesses, and performance as casing.
B. Hinges: A minimum of two wedge-lever-type latches, operable from inside and outside. Provide Ventlock 310 high pressure latches. Arrange doors to be opened against air-pressure differential.

C. Gasket: Neoprene, applied around entire perimeters of panel frames.
D. Fabricate windows in all doors of double-glazed, safety glass with an air space between panes and sealed with interior and exterior rubber seals.
E. Size: At least 18 inches wide by 5'-10" or full height of unit where the height of the unit does not allow a full height door. Fan access section door must be width of largest motor size.

1. Minimum locations and size: refer to drawings for basis of design.

F. Service Light: 100-W equivalent LED fixture in each section with single switched junction box located outside fan section door.

2.6 Drains:

A. Condensate Drain Pans:

1. Fabricated double bottom style 16-gauge stainless steel drain pan with welded corners and two percent slope in three planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) to direct water toward drain connection. Extend drain pan 8" past face of coil to collect any carryover moisture.
2. Drain Connection: Located at lowest point of pan and sized to prevent overflow or accumulation. Terminate with threaded nipple on one or both ends of pan.
3. Provide stacked chilled water coils where height of the unit exceeds 48”. Provide intermediate drain pan to collect condensate from top coil. Extend upper drain pan outlets to lower pan with stainless steel downspout.

B. Access Section Drains:

1. Provide floor type drain in all sections and terminate 1" outlet through base rail with cap.

2.7 Fan:

A. Fans: Provide types SWSI Class II or Class III fans with airfoil blades. Fans shall be equipped with 200,000 hour L-50 life pillow block bearings. The fan shaft shall be turned, ground and polished solid steel rated at maximum rpm below critical speed. Fan wheel and sheaves shall be keyed to the shaft. The fan wheels shall be fabricated of heavy gauge steel.
B. Fan shall be IRD balanced at design RPM to a vibration velocity less than or equal to 0.08 inches per second peak (BV5) measured at each bearing pad prior to shipment with motor, sheaves and belts in place. Fans shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound. Fans, motors and drives shall be internally spring isolated by the unit manufacturer on a structural steel base complete with flexible connections. Provide Amber Booth Seismically restrained isolators with 2-inch deflection. Provide high pressure lube lines extended to the exterior at the fan access door. Expanded metal belt guards shall be provided on all fans.
C. Provide belt driven fans with an adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Provide open drip proof motors on indoor units with electrical characteristics as scheduled. Provide premium high efficiency motors, as per Division 26, Basic Materials and Methods section, "Motors". All motors shall include isolated bearings or shaft grounding. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 2.5 residual unbalance.

D. Provide belt-driven fans less than 15 hp with adjustable pitch sheave permitting fan speed to be varied. Drives shall be selected for 150% motor nameplate horsepower, but in no case less than two belts. Provide fixed sheave set after balancing work is completed. Sheave changes to support optimization of system operation during TAB work shall be included in the bid.
E. Fan wheels and scrolls shall be steel or aluminum epoxy coated after fabrication, but prior to balancing.
F. Fans shall be licensed to bear the AMCA certified ratings seal for fan inlet sound, fan outlet sound, and air performance.

2.8 Filters:

A. Prefilters: Filters shall be 30% efficient, MERV 7 pleated, disposable type. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid, and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
B. Prefilters shall be installed in a prefabricated channel rack.
C. Prefilters shall be lift-out upstream of the filter.

2.9 Final Filters:

A. Final filters shall be high performance, 2” deep pleated, totally rigid, and disposable type. Each filter shall consist of high density charged fiber media, media supports, and enclosing frame with gasket seal.
B. Final filter media shall have an average of 90-95% on the ASHRAE Test Standard (52-76) and a MERV 15 rating. Filters shall be Underwriters' Laboratories Standard 900 approved. Basis of Design: Columbus Industries, Inc CI Micro Shield Zero-Bypass.
C. Holding Frames: Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets on all 4 sides of the filter and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lbs pressure without deflection and be attached or removed without the use of tools.
D. Final filters shall be slide out through access door.

2.10 Water Coils:

A. All coils shall meet or exceed all capacities specified on the mechanical schedule for the project at full rated conditions and part-load conditions. All coil performance shall be certified by the manufacturer in accordance with ARI Standard 410.
B. Construct coils of configuration plate fins and seamless tubes. Aluminum fins shall have collars drawn, belled and firmly bonded to tubes by means of mechanical expansion of tubes. Do not use soldering or tinning in bonding process.
C. Construct coil casings of minimum 16 gauge steel with formed end supports and top and bottom channels. Coils in cooling service shall have stainless steel casings and coils in heating-only service shall have galvanized steel casings.
D. Coils shall be fully enclosed within casing and cooling coils shall be on mounted 304 stainless steel angle racks manufactured to allow coils to slide out individually. Heating coils shall be mounted on galvanized angle racks manufactured to allow coils to slide out individually.
E. Removable coil access panels shall be provided for removal of coils through the casing wall. Coils shall be individually removable away from the access side. Coils must be individually racked, removable through the side access panels.
F. Pipe connections shall be on the same end, extended through the casing for ease of connection, employing a plate over the connection to minimize leakage, and shall be threaded flanged.

G. Water coils shall be drainable.
H. Clearly label supply and return headers on outside of units such that direction of coil water-flow is counter to direction of unit air-flow.
I. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
J. Coil height shall not exceed 36". Provide multiple stacked coil as required.
K. Construct headers of round copper pipe.
L. Construct tubes of 0.625 O.D. minimum 0.025 thick of Copper and construct fins of 0.010 thick of Aluminum.
M. Provide vent and drain for complete coil drainage.

2.11 UVC Light Fixture:

A. UV-C fixturing shall consist of a power supply, power supply housing, "plenum rated" wiring loom, lamp plug, lamp-plug protector, encapsulated lamp, and lamp support.
B. Power supply shall be CSA and UL Listed as a variable input type (120-277 Vac ±10%), 50-60 Hz with a programmed rapid start. They shall be designed as high power factor, class P, sound rated "A", type 1 outdoor and with inherent thermal protection and no PCBs. They shall be capable of operating in temperatures of from 33-190°F, designed to facilitate plug-and-play wiring and be capable of producing the specified output and organism destruction at no more than 15W of power consumption for each square foot of treated, cross sectional area. The power supply shall be capable of properly powering 1- 145W UV-C lamp or 1- or 2- 75W UV-C lamps while ensuring at least 9000 hours of lamp life, and with greater than 80% of its initial output, at the lamps "end of lamp life" phase. Power supply shall be protected against "end of lamp life" conditions, warranted for 5 years, and be labeled for field wiring. Power supply shall be installed interior or exterior to air handler within a power supply housing.
C. Power supply housing shall be constructed of 20ga galvanized, powder coated steel. They shall be designed to facilitate NEC regulated power supply installation outside plenums. Each housing shall be capable of properly holding, grounding, and wiring either four or eight ballasts within to protect against electrical shock and moisture, as well as RF and EMI leaks.
D. Plenum rated wiring looms shall be of sufficient length to facilitate lamp connection to a remotely located power supply. The lamp and loom shall be capable of being mounted anywhere in the system and/or as shown on the drawings. The loom shall be meet UL Subject 13 and UL 1581, and Article 725 of the NEC. The loom jacket shall be constructed of UV-C resistant materials and shall have an internal aluminum/Mylar shield.
E. Lamp plug shall be of the 4-pin type capable of accommodating a single-ended HO lamp.
F. Lamp plug protector shall of UV resistant materials and designed to shrink 3-1 over the lamp plug and wiring loom for protection against electrical shock, moisture, and separation.
G. Lamp supports may be single or dual types, magnetically or permanently affixed within the irradiated cavity to interior surface of air handler or to vertical supports (by others). They shall be constructed of UVC resistant materials and provide for maximum flexibility in quick lamp positioning, removal, and holding power.
H. Each lamp shall contain less than 8 milligrams of mercury and shall be hermetically laminated with a thin layer of UV-C transmissible Teflon® to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained. Lamp life shall be 9000 hours with no more than a 20% output loss at the end of the lamp's

life. Lamps shall be constructed with UV-C proof material bases and shall not produce ozone.

I. Fixtureless lamps are to be installed in sufficient quantity and in such a manner so as to provide an equal distribution of the available UV-C energy. When installed, the UV-C energy produced shall be of the lowest possible reflected and shadowed losses and shall be distributed in a 360-degree pattern within the cavity to provide the highest UV-C energy absorption by microbial products in the air.

J. Intensity – The minimal UV-C energy striking a surface shall be sufficient to continuously destroy a mono-layer of mold and/or bacteria in less than one hour while operating in air temperatures of 1-70°C.

K. Installation – The ballast housing shall be capable of installation within the air stream and/or within a power supply housing. Lamps shall be mounted to irradiate the intended surface(s) as well as all of the available line of sight airstream through proper lamp placement and incident angle reflection.

L. All doors to any UV-C assembly and/or within view of any UV-C assembly must include mechanical interlock switch to ensure that all UV-C assemblies will be de-energized when any of these accesses are opened.

M. Provide auxiliary relay to control the UV-C lights via building automation system.

2.12 Variable Frequency Drives:

A. Comply with applicable requirements in Division 23 Section "Variable Frequency Drives".

B. Provide cooling provisions and filtration for VFD enclosure.

PART 3 - EXECUTION

3.1 Examination:

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

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

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

3.2 Installation:

A. Equipment Mounting:

1. Arrange installation of units to provide access space around air-handling units for service and maintenance.

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters upon building occupancy.

C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 Connections:

A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.
C. Connect piping to air-handling units with flexible connectors.
D. Connect condensate drain pans and extend to nearest floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
E. Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping" and Section "Hydronic Piping Specialties". Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
F. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Ductwork Accessories".

3.4 Field Quality Control:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
B. Tests and Inspections:
   1. Hydronic Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
   2. Airside Leak Test: Completely pressurize casing and field pressure test any unit requiring field assembly. Field assembled units shall be tested for 1% or less leakage at design airflow and 8" wg at positive and negative pressure. Test shall be conducted without additional sealant systems required by factory and with only blank-offs at inlet and outlet.
   3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Make corrections.
C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections. Make correction at manufacturer's direction and retest for compliance.
D. Prepare test and inspection reports once units are operational. Include description of corrective actions taken for any failed tests and inspections.

3.5 Adjusting:

A. Adjust damper linkages for proper damper operation.
B. Comply with requirements in Division 23 Section "HVAC Testing and Balancing" for air-handling system testing, adjusting, and balancing.

3.6 Cleaning:

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters following cleaning.

END OF SECTION

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 control systems work required by this section is indicated on drawings and schedules, and by requirements of this Section.
B. Control sequences are specified elsewhere.
C. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control and power wiring between field-installed controls, indicating devices, and unit control panels. Power to control panels, valves, dampers interlock wiring.

1.3 Acceptable Control System Manufacturers:

A. Johnson Controls, Inc (Metasys NAE only)
B. Siemens Industry, Inc. (Desigo only)
C. Automated Logic Corporation

1.4 Basis of Design:

A. The basis of design for all projects shall be a complete microprocessor controlled BACnet compatible Building Automation System (BAS) tested and ready for operation and that meets the standards of ANSI/ASHRAE Standard 135.
B. BACnet Addressing:

1. Each device address shall be unique. Addresses consist of a network number (up to 65,535) and a device media access control (MAC) address. Device MAC addresses can be the same, as long as they are in different networks. For MS-TP networks (up to 255 devices per network number), the Control Contractor shall obtain address assignments from UF.
2. In the UF multi-vendor environment it is important to manage the assignment of these addresses to ensure that there are no duplicates on the same network. A site-specific plan for assigning MAC addresses has been developed and vendors shall be required to follow it. Guidance on how to do this for each of the relevant BACnet systems shall be provided by UF.

C. The BAS shall utilize electronic sensing, microprocessor-based digital control, and electric actuation to perform the required control sequences and functions. In some cases it may be necessary to utilize existing pneumatic actuators, with the approval of FS. The BAS shall generally consist of control and/or monitoring of the systems as listed below.

1. Control and Monitoring

a. Supply Air Systems
b. Exhaust Air Systems
c. Zone Terminal Units
d. Variable Frequency Drives

2. Monitoring Only
   a. Energy Meters
   b. Lighting System (occupancy sensor status)
   c. Domestic Water Booster Pump System
   d. Others as required by specific project needs
3. All outputs, whether sequenced or not, shall have separate and programmable hardwired outputs. For example, outside air, return, relief air, etc., shall each be controlled by a separate output of the controller.

1.5 Reference Standards:

A. ANSI/ASHRAE Standard 135 (latest version), BACnet
B. UL 864/UUKL Smoke Control Listing as applicable
C. NFPA 70 National Electrical Code
D. Florida Building Code - Energy Conservation Code
E. ASHRAE 90.1
F. NFPA 72
G. NFPA 92
H. NFPA 96
I. UF Telecommunication Standards

1.6 BAS Network Components:

A. Building Level Controllers (BLC)
B. Advanced Application Controllers (AAC)
C. Application Specific Controllers (ASC)
D. Connection to existing UF BAS Network via BAS virtual LAN
E. Third-party equipment integration as required

1.7 Quality Assurance:

A. Sensors and transducers shall closely match the expected sensing or control range.
B. Provide weather protection (NEMA 4 or greater) cover or weatherproof control devices where required for controllers located outdoors. Provide weatherproof sealant on all penetrations. Penetrations on top of rooftop equipment are prohibited.
C. All control devices located outdoors shall be rated for the anticipated ambient conditions.
D. Include provisions for supplemental ventilation/cooling when control devices and controllers must be located within outdoor control panels that are not rated for the planned environment.

1.8 Commissioning:

A. Control Contractor is to demonstrate all functions of the BAS to the Commissioning Agent (CxA), Owner and/or Engineer.
B. Control Contractor is to provide trends, schedules, reports, etc. to Commissioning Agent (CxA), Owner and/or Engineer as requested to document system performance. When a project includes commissioning, the contractor shall request format and setup parameters from the designated commissioning agent.

1.9 Submittal Requirements:

A. Submittal packages should be organized, highlighting specific part numbers, options and accessories as applicable. Submittal package shall include a Table of Content and active links.

B. Product Data Package to include:

1. Product data (sensors, valves, dampers, devices, controllers, etc.)
2. Control Dampers Schedule: Include a separate line for each damper and a column for each of the damper attributes, including: Damper tag, code number, fail position, damper type, blade type, bearing type, seal type, duct size, damper size, blade action (parallel or opposed) actuator type, actuator model number, actuator torque rating and quantity of actuators required to ensure total closure of damper(s). Provide leakage and flow characteristics data for all control dampers.
3. Air Flow Measuring System: Provide schedule including a separate line for each flow measuring device and column for device type, model number, size, and location.

C. Shop Drawing Package to include:

1. To include wiring diagrams, points list, sequence of operation, control power distribution and sourcing, etc. Drawings shall include installation wiring details for all proposed equipment including but not limited to controllers, sensors, actuators, relays, and all 3rd party equipment interfaces.
2. Include a points list schedule for each real hardware and virtual point in the BAS, including: Point name, point description, point type, system name and display units, device type, address, cable destination, module type, terminal ID, controller number, reference drawing, and cable number. Cable destination and terminal ID may also be identified in panel detail drawings.
3. Sequence of operation shall include all initial set-point values, time delay values, references to specific device tags. The sequences shall be detailed and include all vendor specific pre-engineered logic. In general, the vendor specific sequences shall satisfy the Engineer's design intent and provide the details specific to the vendor's application specific software.
4. Include identification of immersion wells, pressure taps, associated shut-off valves, flow switches, level switches, flow meters, air flow stations and other such items furnished by control vendor but installed by other trades.
5. Include initial setpoint or adjustable range of field instruments requiring field adjustment (low limit, high pressure, low pressure, etc.).
6. BAS network architecture riser diagrams including all Tier 1 (Ethernet) nodes, Tier 2 (MSTP) interconnections, communication protocol and 3rd party integration protocols. Include repeater locations, 120 VAC power points and source circuit number, central transformers and 24 VAC power wire routing. Include network number, device ID, addresses, device instance numbers, MAC addresses, and controller type for each proposed controller unit. In addition, show all optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. Tag all equipment with a unique identifier.
7. Provide floor plans locating all control units, include all Tier 1 and Tier 2 communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc.

shall be located on the floor plans. As-built wire routing conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

8. Schematic flow diagram of system showing all equipment and control devices. Diagram shall include designation of all inline devices, wells, taps, and other devices furnished under this Section but installed by other trades.
9. Provide color format samples of each typical system graphic display screen and associated menu penetrations to show hierarchy and functional interrelationships for systems specified. Sample graphic should show all proposed components, data point location/type and color schemes. Include sample floor plan and home page graphics.
10. Zone Terminal Unit Schedule: Provide a separate line for each terminal unit indicating terminal identification, occupied/unoccupied cfm setpoints, box area, thermostat/sensor location, heating/cooling setpoints and bias setting. The schedule shall include typical calibration factors to be filled in by TAB contractor during startup and verification. The final settings information shall be included in O&Ms and included in TAB report.
11. Required Electrical Wiring: Information including wire jacket colors for low voltage signal wiring, low voltage power wiring and communication cable. Indicate wire gauge for each type of cable. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring which is existing, factory-installed and portions to be field-installed.
12. Integration Plan: Provide a coordination plan for all 3rd party systems to be integrated under this project and include the following information:

    a. All vendor specific protocols (generally BACnet or MODBUS) requirements.
    b. Vendor point list, cross referenced with designated BAS point name. Include the full list of vendor available integrated points (with point name and description) and the specific points to be mapped over to the BAS (with point name and description). Indicate points that are read-only points and points that are read-write.
    c. Include a list of all communication hardware and software needed to implement full systems integration.

13. Training Plan: The Contractor shall submit a written training plan to the A/E, and CxA for review and approval prior to training. The plan shall include the following elements (see section 1.13 for additional requirements):

    a. Equipment (included in training)
    b. Intended audience
    c. Location of training
    d. Objectives
    e. Subjects covered (description, duration of discussion, normal modes, failure modes, troubleshooting strategies, special methods, etc.)
    f. Duration of training on each subject
    g. Instructor name and qualifications for each subject

h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

1.10 Operating and Maintenance Manual Requirements:

A. The operation and maintenance manual shall be organized in the following manner, highlighting specific part numbers, options and accessories as applicable.

1. Include descriptions of maintenance for all components supplied, including (but not limited to) sensors, actuators and controllers.
2. Provide a separate calibration procedure report indicating all sensor types, recommended calibration procedures and recommended calibration frequency.
3. Include inspection requirements, periodic preventive maintenance recommendations, fault diagnosis, instructions for repair or replacement of defective components Include parts lists, name, address, and phone number of equipment provider including all 3rd party material.
4. Provide product operational and maintenance data in electronic PDF format and install on vendor specific server. PDF shall include a Table of Content page with hyperlinks to specific product sections. Provide means to access this data using intuitive operator interaction (quick links from main system graphics). All product sheets shall be marked to indicate specific part numbers, options and accessories used on project.
5. Include name and 800 number of a 7 day a week 24 hour a day service line for needed service during the first year of operation.
6. Software Tab Section: The operating and maintenance manuals shall include a software tab. Provide separate CD including all requested information and include under this tab section. Include the following:

a. All building level and system level programs. Application specific system level programs shall include all configuration files showing final menu selections and applicable default settings.
b. Describe general operating procedures, starting with system overview and include printed graphic displays of all systems.
c. Include trend graphs of all relevant control loops with no less than 24 hours of data sampled at 10 minute intervals. Trend graphs shall include controlled variable, output signal and setpoint.
d. Software Backup: Include one archive copy of all accepted versions of source code and compiled code for all application programs and data files on compact disc media. All control software must be readily accessible by Owner using BLC system server. Software file naming for ASC controllers shall match ID reference on mechanical drawing – ID reference tags shall be unique. These backups shall be complete with all code and files sufficient to reinstall the complete project data base.

B. As-Built Drawings:

1. Submit as-built shop drawings indicating all changes made during project. The drawing files shall be in pdf format and original control format software such as Visio or AutoCAD.
2. Provide as-built shop drawings in electronic PDF format and install on vendor specific server. Provide means to access this data using intuitive operator interaction (quick links from main system graphics). All sequences shall include as programmed conditions and final setpoints. Each system web page shall

allow for an automatic link to the relevant as-built control diagram and sequence of operation.

3. Include updated BAS network architecture riser diagrams including all Tier 1 (Ethernet) nodes, Tier 2 (MSTP) interconnections, communication protocol and 3rd party integration protocols. Include repeater locations, 120 VAC power points and source circuit number, central transformers and 24 VAC power wire routing. Include network number, device ID, addresses, device instance numbers, MAC addresses, and controller type for each proposed controller unit. In addition, show all optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. Tag all equipment with a unique identifier.
4. Mount (within major system control panels) laminated control flow drawing, sequence, point schedule and control panel wiring diagrams indicating all field points connected. Include control drawings for terminal unit controllers with major system control panel.
5. The control panel wiring diagrams shall utilize the same field device tag names used within the associated control diagram and software database.

C. Controller Performance Report:

1. Submit a controller performance report as summarized below. This report shall be a reflection of the current state of the controller after all programming, trending, alarming and commissioning efforts have been completed. Note: When documenting universal inputs/outputs the Contractor shall not report these under Analog/Digital input/output categories.

Tag	Model #	Software Version	Analog Input Capacity	Analog Inputs Used	Analog Output Capacity	Analog Outputs Used

Continued

Digital Input Capacity	Digital Input Used	Digital Output Capacity	Digital Output Used	Memory Capacity	Memory Utilized	Processor % Utilization

Continued

Universal Input Capacity	Universal Input Used	Universal Output Capacity	Universal Output Used

D. Building Level Supervisory Controller Performance Report:

1. Submit a supervisory controller performance report as summarized below. This report shall be a reflection of the current state of the controller after all

programming, trending, alarming and commissioning efforts have been completed.

Tag	Model #	Software Version	Memory Capacity	Memory Utilized	Processor % Utilization

1.11 Warranty:

A. Warranty starts upon completion of commissioning or substantial completion, whichever comes later. The date of such certification shall be the start of the warranty period(s).
B. At the end of final startup, testing, and commissioning phase, if equipment and systems are operating satisfactorily, the A/E and each of the UF's agents shall certify that the controls system's operation has been tested and accepted in accordance with the terms of this specification.
C. Submit warranty documentation upon substantial completion of project or phase (if applicable) and acceptance by Engineer and Owner.
D. Repair or replace systems or parts found defective at no cost to Owner during the warranty period.
E. Include parts, labor, and necessary travel during warranty.
F. Provide vendor specific and 3rd party warranty and registration information as applicable.
G. Provide services incidental to proper performance.
H. First year of warranty includes parts and labor for entire system (including 3rd party equipment). Adjust, repair, or replace, at no additional cost to the owner, control system failures during the 1st year (includes software issues). Include an evaluation of control loops and required loop tuning as applicable.
I. Provide a second year parts only warranty coverage for all equipment provided under this section. This second year warranty shall cover all defective hardware after final acceptance by the A/E and the Owner. Two year coverage shall include all 3rd party equipment.
J. Provide as part of base bid a 5 year extended warranty for all actuators (valves and dampers).
K. Warranty response time shall be as indicated. The designated UF representatives representing the operations and service departments shall be the authorized callers and will determine the required response level.

    1. Emergency service – must respond within two hours of being notified.
    2. General warranty service – must respond within 4 hours of being notified.
    3. Scheduled service – must respond within 48 hours of being notified.

L. Include project-specific software, graphic software, database software, and firmware updates/patches which resolve known software deficiencies at no additional charge, during the 2 year warranty period.

1.12 Extended Warranty:

A. Provide an add alternate with bid to include extended warranty services as an additive alternate price.

B. Include 8 quarterly inspections during the 2 year warranty period. Each quarterly inspection shall include a final report documenting the tasks and findings described below. The quarterly inspections shall be coordinated through UF. The following tasks list shall define the scope of services for these inspections.

1. Verify calibration on at least 25% of all analog inputs and analog outputs during each quarterly visit.
2. Trend and document the performance of at least 25% of all control loops during each quarterly visit. Evaluate trends and correct known deficiencies. Include trend reports within report.
3. Verify startup and shutdown sequences for at least 25% of all major equipment. At least one major equipment sequence shall be tested in its entirety per quarterly visit.
4. Review entire system noting any specific anomalies or system performance issues. Repair known deficiencies and document those deficiencies that are not the responsibility of this Contractor.
5. Discuss performance issues with UF and document discussions.
6. Review alarm reports to determine any repetitive or unusually high number of incidents with each quarterly visit. Repair known deficiencies and document those deficiencies that are not the responsibility of this Contractor.
7. Review system and document operator overrides or points removed from service for all physical or software points.
8. Review and document communication failure/restarts of devices on the BAS Network.

1.13 <u>Owner Instruction</u>:

A. During system startup and at such time as acceptable performance of the BAS system equipment and software has been established, the Contractor shall provide on-site operator instruction. This instruction shall be performed during normal working hours by a competent representative of the BAS vendor that is familiar with the system's software, hardware and accessories. The Contractor shall maintain a roster of all attendees at all training sessions.

B. At a time mutually agreed upon during system training as stated above, the Contractor shall give 16hours divided into four sessions of instruction to the Owner's designated personnel on the operation of all equipment within the BAS and describe its intended use with respect to the programmed functions specified. The training session schedule shall be determined by UF and shall be completed within the first year warranty period. The training shall include but not be limited to the following:

1. Review the following BAS deliverables with respect to general content and organization:

   a. Operations and Maintenance manuals
   b. As-Built Control Drawing Package
   c. Graphical User Interface
   d. Reporting packages and content
   e. As-Built Control Sequences
   f. Maintenance service agreements, state of warranty date and similar continuing commitments
   g. Review location of all BAS equipment / panel locations

2. Operations:

a. Startup procedures
b. All equipment or system start-up procedures
c. All equipment or system shut-down procedures
d. Routine and normal operating sequence for all systems
e. Special operating instructions and procedures not addressed above
f. Seasonal and weekend operating instructions
g. Software backup procedures and file locations

3. Emergencies:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping, manual overrides and BAS override procedures.
c. Safety device procedures and actions.
d. Operating procedures for system, subsystem, or equipment failure.
e. Shutdown instructions for each type of emergency.
f. Operating instructions for conditions outside of normal operating limits.
g. Special operating instructions and procedures.
h. Adjustments:

1) Proper adjustment procedures and points intended to be adjusted.
2) Economy and efficiency adjustments.
3) Adjustments for efficient energy use.

4. Troubleshooting:

a. Diagnostic instructions procedures for each typical system installed.
b. Test and inspection procedures for each typical system installed.
c. Maintenance:

1) Inspection procedures.
2) Types of cleaning agents to be used and methods of cleaning.
3) Procedures for calibration.
4) Procedures for preventive maintenance.
5) Procedures for routine maintenance.
6) Instruction on use of special tools.

5. Repairs:

a. Diagnosis and repair instructions.
b. Disassembly; component removal, repair, and replacement; and reassembly instructions.
c. Instructions for identifying parts and components.
d. Review of spare parts needed for operation and maintenance.

END OF SECTION

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NAMING AND IDENTIFICATION

PART 1 - GENERAL

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

1.2 Refer to Division-26 sections for identification requirements of electrical work; not work of this section.

1.3 Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-25 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.2 Field Device Tagging:

A. The BAS vendor shall label each system device with a point address or other clearly identifiable notation inside the device cover when mounted in the space and on the cover when mounted above the ceiling or in a mechanical room. Labels shall be black on white standard laminated tape. Control valve and duct mounted damper actuators shall be hanging style engraved tags (white background with black lettering).

B. All control equipment shall be clearly identified in accordance with as-built control shop drawing designation.

C. Control enclosures and panels: Include mechanically attached engraved phenolic nameplate with panel number, address, power source, and system(s) served. Panel mounted controlling instruments, temperature indicators, relays, switches, gauges, etc. shall be factory installed and permanently labeled. Devices shall be located inside or flush mounted on face of panel.

D. Provide a label directly below devices (VAV, FCU, Reheats, Air Valves, etc.) mounted above ceiling. Label the approximate location on ceiling grid. Where associated devices such as reheat valves, sensor stations or other remote instrumentation not mounted within the terminal unit shall also be labeled on the grid below. Include ceiling grid tags for static pressure sensor location. Labels shall be black on white standard laminated tape. Where hard ceilings are used, labels shall be affixed to access door.

E. Duct static-pressure sensors and wet differential-pressure sensor locations shall be:

1. Indicated on the As Built control drawings.
2. Identified on the BAS Floor Plan online graphic.
3. Identified in the building using a label on the nearest ceiling grid, or access-panel where concealed.

2.3 Control Wiring Identification:

A. Communication: Manufacturer approved cable labeled to indicate “BAS communication” at no less than 10 ft. intervals. Communication cable shall be labeled with Device #, previous and destination device (e.g. VAV101/VAV102 would be used to label the communication bus between VAV101 and VAV102).

B. I/O: Label I/O wiring with unique tag to match device identifier (e.g. sensor Discharge Air Temperature (DA-T) wire shall be labeled at panel and device as “DA-T”).

C. Raceway Identification. All the covers to junction and pull boxes of the BAS raceway system shall be painted white.

2.4 Naming Standards:

NAMING AND IDENTIFICATION

A. The intent of this section is to provide a standard naming convention for control points used within the University of Florida (UF) Building Automation System (BAS). With respect to building renovations, only the renovated system shall comply with this standard.

B. The design of the hardware and software shall integrate with the existing vendor specific servers at the University of Florida campus using new or existing global building controllers. The network shall be implemented via the campus shared Ethernet system. The campus shared Ethernet backbone uses BACnet over IP communication protocol.

C. This section addresses the methods for developing and implementing a point naming standards, with particular emphasis on the implementation of point naming standards in a BACnet-based HVAC control system.

D. Each complete BAS control point name consists of two levels or tiers. Each level offers a particular description and, when all levels are assembled into the naming convention, furnishes an explanation for the control point. The levels are broken down as follows: level 1 is the equipment/system identifier, and level 2 is the specific control point associated with the equipment/system. Reference the tables provided for each level under “Predefined Words and Indices” to compile each complete BAS control name. The standard naming convention shall be:

System - Control Point.

Level 1 - Level 2

E. A dash (-) will function to index components or systems and as a space filler for multiple words. For example, if multiple fan coil units exist in the building (‘FCU’ is the predefined name for a fan coil unit), the level 1 name shall be FCU-1, FCU-2, FCU-3, etc. In addition, the level 2 name for the discharge air temperature of the same FCU-3 shall be DA-T. The preferred separation symbol for Level 1 and Level 2 names shall be a dash (-). For example, the complete BAS control point name for the discharge air temperature sensor on FCU-3 would be FCU-3-DA-T. Reference the “Point Naming Standards” table for additional examples.

F. Subfolders shall be created in the BACnet interface to help organize a building’s control points and facilitate navigation. Placing corresponding control points into subfolders such as location (first floor, roof, penthouse, etc.) and room type (labs, clean rooms, etc.) will assist in avoiding exceptionally long lists on common screens. Creating subfolders shall be left up to the controls contractor but subject to approval.

G. It is understood that this standard will not satisfy every situation but it is expected that the standard be followed whenever possible. The completed list of point names will require review and possible modification prior to implementation over the UF BAS BACnet/IP interface. Any word that is added and not included in the predefined tags below shall be submitted for approval with a complete description.

H. The Level 1 – Point names shall be consistent with equipment tags shown on plans.

I. The Level 2 – Point names shall be consistent with that shown in point lists on plans.

J. BACnet Controller Naming Standards

1. To be coordinated with UF.
2. When working within an existing building, the naming shall be consistent with existing devices.

END OF SECTION

PART 1 - GENERAL

1.1 Provide a complete microprocessor controlled BACnet compatible building automation and control systems tested and ready for operation.

1.2 Contractor shall furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize microprocessor-based digital control.

1.3 Contractor shall furnish and install:

A. Building Level Controllers (BLC) or Advanced Application Controllers (AAC)
B. Application Specific Controllers (ASC)
C. Gateways
D. Control Panels
E. Uninterruptible Power Supply (UPS)
F. Service Tools

1.4 In addition to network equipment, this section also includes:

A. Communication and Low voltage cable and pathway requirements.
B. Power requirements.
C. Other miscellaneous items required but not specified for a complete operational system.

1.5 Related Sections:

A. Section 23 08 10 – Commissioning
B. Section 26 05 33 – Raceways
C. Section 26 05 34 – Boxes and Fittings
D. Section 26 05 31 – Wires and Cables

1.6 Related Standards:

ANSI/ASHRAE Standard 135-2008	BACnet
FCC Part 15, Subpart J Class A	Computing Devices
UL 864/UUKL	Smoke Control Listing (Ninth Edition)
UL 873	Temperature-Indicating and Regulating Equipment
UL 916	Energy Management Systems
NEMA	Comply with NEMA Standards pertaining to components and devices for electrical controls
NFPA 70	National Electrical Code

PART 2 - NETWORKING AND COMMUNICATION EQUIPMENT

2.1 The design of the hardware and software shall integrate with the existing vendor specific servers at the University of Florida campus using new or existing Building Level Controllers (BLC) or Advanced Application Controllers (AAC).

2.2 Ethernet home-runs: Each Ethernet connection shall be a home-run back to the nearest (within 100 Meters) telecom closet. The location shall be included on the riser diagram in the set of BAS shop drawings and engineer's telecomm design drawings.

2.3 All network parameters must be assigned and approved by the owner prior to implementation.

2.4 The system must be fully BACnet compliant at the time of installation. This means that the system must use BACnet as the native communication protocol between building level controllers and servers on the network. The communication between controllers shall be ARCNET or MS/TP over RS485.

2.5 The BACnet communication protocol is the required protocol for all tiers of the network.

2.6 Controller Software Features:

A. Equipment Cycling Protection: Include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
B. Heavy Equipment Delays: Provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads (user selectable).
C. Power Fail-Motor Restart: Upon the resumption of normal power, the control system shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off in an orderly way to avoid large demands on the electrical system.
D. Incorporate comment lines for program clarity. Comment sections shall include a summary of the actual sequence of operation.
E. New supervisory device and controller installation shall be fully compatible with the current existing server for the purpose of archiving and restoring data.

2.7 Controller Hardware:

A. Failsafe hardware shall be provided such that BAS failures result in immediate return to local or default control. If the controller uses database values from other controllers, and the communication network fails or malfunctions, control loop outputs shall continue to function using last value received from central BAS.
B. Controllers should not exceed 80% of I/O capacity. The 80% capacity requirement shall apply to inputs and outputs separately and not be an aggregate of both.
C. Controller memory shall not exceed 75% of processor/memory utilization when all required features and project programming has been implemented. The vendor shall provide a report that documents the initial processor/memory utilization upon completion of system startup/commissioning (see standards section 25 00 00 for additional reporting requirements). Final percent utilization shall take into account all programs, trending, alarming and point count.
D. Multiple system controller sharing is strictly forbidden at the University of Florida. Each system/terminal unit requiring any type of PID control loop shall include a dedicated controller that can manage the assigned control loop without dependence on peer to peer communication. It is acceptable to combine multiple status or multiple start/stop points into one controller when no PID loop or complicated logic is required.
E. The Controllers shall utilize FLASH memory, battery backed RAM or firmware which shall ensure the integrity of the database during brief power losses.

2.8 Building Level Controller (BLC) and Advanced Application Controllers (AAC):

A. Acceptable BLC or AAC Products used for building level supervisory control:

1. ALC: LGR Ethernet Router
2. Johnson Controls – Network Automation Engine (NAE-55)
3. Siemens Apogee - PXC (Programmable Controller) Modular

B. The BLC/AAC shall be a microprocessor based communications device. One of the functions of the BLC/AAC is to provide a communications gateway between the building BAS network and the IP Ethernet network. The BLC/AAC shall communicate via IP and be connected to the UF campus Ethernet infrastructure. A sufficient number of controllers shall be supplied to fully meet the requirements of the project. Controller networks shall use the BACnet protocol.

C. The BLC/AAC when used as a supervisory device shall support a network of at least 90 controllers, but no more than 60 controllers may be placed on any building level BACnet network (BLC and AAC) so that adequate future capacity is reserved for the University of Florida.

D. The BLC/ALC when used as a supervisory device shall provide a port which can be connected to Operator Workstations or portable computers.

E. The BLC/ALC when used as a supervisory device shall provide full arbitration between multiple users, whether they are communicating through the same or different BLC/AACs.

F. The BAS vendor shall not use 100% of the manufacturers' published object count or resources of the BLC/AAV. At least 20% of the published rating shall be reserved for future use by UF.

G. The BLC/ALC when used as a supervisory device shall not be used as both a major or critical system controller and router. Each major or critical system shall have a dedicated controller(s) that are not also tasked to route system information to and from the campus BAS network.

H. The BLC/ALC when used as a supervisory device and if the memory is lost for any reason, the user shall have the capability of reloading the BLC/AAC via the Local Area Network (LAN) or via central server.

I. Memory: Each BLC/ALC when used as a supervisory device shall have sufficient memory to support its own operating system and databases including:

1. Control processes
2. Energy management applications
3. Alarm management
4. Historical/Trend data for 100% of all physical I/O for all programs in any controller connected to the Global Building Controller, at a minimum of 500 samples per trend
5. Maintenance Support Applications
6. Custom processes
7. Operator I/O

J. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

K. An Uninterruptible Power Supply (UPS) unit is required for the BLC/AAC supervisory controllers, repeater(s) and/or Application Controllers (on primary or terminal equipment) that serve or monitor emergency and/or critical equipment, locations or points.

L. The operator shall have the ability to manually override DO automatic or centrally executed commands at the BLC/AAC via local display unit or by way of a local manual Hand/Off/Auto (HOA) device. Local terminal display unit (IF USED) shall be permanently installed in each BLC/AAC panel and shall be password protected. Controlled equipment with external HOA capability shall satisfy this requirement. In all cases the BAS shall monitor and report when any output has been placed in Hand mode.

M. The operator shall have the ability to manually override AO automatic or centrally executed commands at the BLC/AAC via local display unit or by way of a local manual Hand/Off/Auto (HOA) device. Local terminal display unit (IF USED) shall be permanently installed in each BLC/AAC panel and shall be password protected.

External equipment override (e.g. VFD speed override) shall satisfy this requirement. In all cases the BAS shall monitor and report when any output has been placed in Hand mode.

N. When utilizing hardwired components for the override functions, they shall be mounted within the controller's key-accessed enclosure.

2.9 Application Specific Controllers (ASCs):

These types of controllers are typically used in terminal units, fan coil units, chilled beams, and simple laboratory applications.

A. Performance and capacity of AAC/BLC units shall be extended through the use of stand-alone remote ASCs.
B. If being installed outdoors, the Application Controllers shall be capable of being mounted directly in or on the equipment located outdoors.
C. Primary Equipment shall be controlled using one Application Controller. A single controller with adequate Input/Output and resource capacity shall be used for a single piece of equipment as opposed to using two or more smaller controllers to house the programs for one piece of equipment. All exceptions must be pre-approved by UF on a per project basis.
D. Specific to air terminal unit controllers:

1. The controller shall be capable of controlling the air terminal unit in all control strategies as described in contract documents.
2. If required by the sequence of operation, ASCs used as a zone air terminal unit controller shall be able to accept a relay input from an occupancy sensor. This input shall toggle the air terminal unit between occupied and unoccupied modes using internal logic and incorporate occupied/unoccupied scheduling information that the air terminal unit receives from the BLC or AAC.
3. Provide a means of automatically disconnecting the differential pressure sensing lines to ensure a true no flow condition during automatic recalibration events.
4. Each Application Controller for VAV applications shall have an integral direct coupled electronic actuator. The assembly shall mount directly to the damper operating shaft with a universal V-Bolt clamp assembly. The actuator shall not require any limit switches, and shall be electronically protected against overload. When reaching the damper or actuator end position, the actuator shall automatically stop. The gears shall be manually disengaged with a button on the assembly cover. The position of the actuator shall be indicated by a visual pointer. The assembly shall have an anti-rotational strap.

2.10 Gateways:

A. When applicable the gateway(s) are required for the sub-system(s) communication they shall be provided by the equipment OEM. The gateway(s) is(are) further specified below:

1. The gateway submittal shall be provided by the OEM to the BAS vendor to be included with the BAS Shop Drawings Submittal, for review and approval.
2. All system information specified in the sequence of operation and related documents shall be available to the BAS. Read and write capability, as indicated by an object table provided by the OEM, shall be provided for the mechanical and electrical equipment indicated and be available to the BAS system. The OEM shall provide to the BAS vendor a table of gateway objects and their

functionality, including normal operating limits. The equipment OEM will expose all available objects as BACnet objects for use by BAS vendor.

3. A Modbus interface may be used only when a BACnet interface is not available from the equipment OEM. If the equipment manufacturer does not have this capability, they shall contact the authorized representative of the BAS vendor for assistance and shall include in their equipment price any necessary hardware and/or software obtained from the BAS vendor to comply with this section.
4. OEM Configuration Tools and Licenses: Configuration Tools, and all software licenses, required to configure all OEM controllers installed on this project, shall be provided by the project.

END OF SECTION

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PART 1 GENERAL

1.1 Alarming:

A. In general most of the alarms generated within the BAS shall be set up for graphic display only and shall not be routed to remote notification devices. The only exception is generally with respect to equipment status alarms (i.e. AHU Fans, etc.)

B. The project shall include enhanced alarm programs for all system points. These points shall be programmed for appropriate seasonal high or low alarm limits. Enhanced alarm programs shall prevent abnormal alarms from occurring when the associated system has been deactivated. For example: air handler, building chilled water, heating water system, etc. Alarms shall occur only while systems are active and being supplied with chilled/hot water or steam and at normal operating temperatures and pressures. Alarm destinations, alarm messages, and point graphic assignments shall be included so that alarms are indicated and printed at a pre-defined Owner reporting device and recorded on a transaction log. Alarms shall have accurate descriptions and response instructions, so that alarms may be quickly associated with appropriate graphic display.

C. The BAS vendor shall define the specific system reactions for each point. Alarms shall be enhanced and prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. The BAS vendor shall initially define all point priority levels for handling of all system alarms. Users shall have the ability to manually inhibit alarm reporting for each point.

D. Alarm reports and messages shall be directed to a user-defined list of operator devices or PCs based on time (after hour destinations) and/or based on priority.

E. In addition to the points descriptor and the time and date, the BAS vendor shall create, print, display and store an alarm message for each point to more fully describe the alarm condition or to direct operator response. Alarm events may be configured to send an alarm message to a specified client e-mail address, cellular phone number via SMS text messaging.

F. The following alarm table shall be used and edited for each project.

REMOTE ALARM NOTIFICATION REQUIREMENTS			
POINT TYPE	SETUP	REFERENCE POINT	DELAY
FANS	FEEDBACK	STATUS POINT	5 MINUTES
DAMPERS – 2 POSITION	FEEDBACK	STATUS POINT	5 MINUTES
AHU C/C COIL CONDENSATE	ALARM	FEEDBACK	5 MINUTES
CO2 ALARM	ALARM	FEEDBACK	5 MINUTES

LOCAL GRAPHIC ALARM REPORTING REQUIREMENTS			
POINT TYPE	SETUP	REFERENCE POINT	DELAY
SPACE TEMPERATURE	+/- 2 DEGF	HTG AND CLG SETPOINT	15 MINUTES
SPACE HUMIDITY	> 70%RH	HIGH LIMIT	30 MINUTES
DISCHARGE AIR TEMPERATURE	+/- 2 DEGF	HTG AND CLG SETPOINT	15 MINUTES
STATIC PRESSURE	+/- 25%	SETPOINT	5 MINUTES
PRE-FILTERS	> 1.0 IN WG	HIGH LIMIT	30 MINUTES
VFD FAULT	ALARM	FEEDBACK	5 MINUTES

1.2 Schedules:

A. A list of schedules to be implemented shall be reviewed and approved by the Professional. The list shall also include the schedule times (Occupied and Unoccupied) to be implemented.

1.3 Trends:

A. All input and output control and status points, and setpoints, will have trends set-up and enabled. Each trend will store a minimum of 500 samples in the associated controller utilizing a first-in/first-out algorithm so that the oldest data is over-written as new data is stored. All trended points shall be configured for historical trending at the vendor specific server.

B. All trends shall be programmed to be triggered according to the type of point, as follows:

1. All equipment start/stop control point trends will be triggered on the control point's change of state.
2. All equipment status point trends will be triggered on the status point's change of state.
3. All space-temperature and outside-air trends will be triggered on any change of value of +/-2 F.
4. All space-humidity and outside-air-humidity trends will be triggered on any change of value of +/- 5% RH.
5. All fan air temperature trends will be triggered on any change of value of +/- 2 F.
6. All damper motor control point trends will be triggered on any change of value of 10% of its control range.
7. All air flow trends will be triggered on any change of value of +/- 10% of its control range.
8. All VFD motor control point trends will be triggered on any change of value of +/- 5% of its control range.
9. All fan air static pressure trends will be triggered on any change of value of +/- .05 inches water column.

C. Custom Trends:

1. The BAS vendor shall provide additional trending as required to support commissioning and performance testing. The trending frequency, change of state filtering and point type requirements shall be defined by the testing authority. These Custom Trends are in addition to the Trends for all input and output control and status points noted above, and will mostly involve display of multiple trends in the same view (i.e. Trend Graph or Trend Study). The Cx-provider will provide 15-calendar-days advance notification of when the Custom Trends need to be fully implemented.

1.4 Basic System Summary Reports:

A. Basic system summary reports shall be set-up with a minimum of one per system, providing a summary of values of the key points in that system, at the same point-in-time ("snapshot"). Some reports might require multiple "pages" for viewing. Contact UF for examples.
B. Reports shall be presented in a standard table format.
C. Basic system summary reports for HVAC systems support functional performance and diagnostic activities. The following shall be used for general guidelines:

1. Reports shall be organized according to the project specific applications. They shall include summaries such as key setpoints, status, outputs, feedback status.

a. For example, a zone terminal report shall provide, at a glance, a summary of the % cooling demand of all zone terminals, and corresponding cooling requests at zone level causing reset of supply air temperature at AHU and unmet SAT setpoint at AHU level, causing DP reset at chilled water pump and/or chilled water supply temperature reset at chiller level.
b. Example reports can be found in this section.

END OF SECTION

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PART 1 - GENERAL

1.1 Provide a complete microprocessor controlled BACnet compatible building automation and control systems tested and ready for operation.

1.2 Contractor shall furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. The BAS for this project will generally consist of monitoring and control of systems listed below. Reference also controls drawings, sequences of operation, and point lists.

1.3 Contractor shall furnish and install:

A. Air Handlers
B. Exhaust Fans
C. Variable Frequency Drives

1.4 In addition to monitored and controlled equipment, this section also includes:

A. Communication and Low voltage cable and pathway requirements.
B. Power requirements.
C. Instrumentation – Product specifications and Installation requirements.
D. Other miscellaneous items required but not specified for a complete operational system.
E. Products supplied but not typically installed under this section:

1. Control Dampers

1.5 Related Sections:

A. Section 23 05 13 – HVAC Motors
B. Section 23 05 48 – Vibration Isolation
C. Section 23 05 93 – Testing, Adjusting, and Balancing of HVAC Systems
D. Section 23 08 10 – HVAC Commissioning
E. Section 26 05 33 – Raceways
F. Section 26 05 34 – Boxes and Fittings
G. Section 26 05 31 – Wires and Cables

1.6 Related Standards:

ANSI/ASHRAE Standard 135-2008	BACnet
FCC Part 15, Subpart J Class A	Computing Devices
UL 864/UUKL	Smoke Control Listing (Ninth Edition)
UL 873	Temperature-Indicating and Regulating Equipment
UL 916	Energy Management Systems
NEMA	Comply with NEMA Standards pertaining to components and devices for electrical controls
NFPA 70	National Electrical Code

1.7 Systems Description:

A. Scope includes labor and materials including but not limited to:

1. Tools and other equipment
2. Software, licenses, configurations, and database entries
3. Interfaces, wiring, tubing, labeling

4. Engineering and calculations
5. Calibration, testing, verifications, training, and other services
6. Documentation, samples, submittals
7. Permits, professional licenses, etc.
8. Other Administrative fees such as parking, shipping, handling, etc.
9. The BAS shall be fully expandable with the addition of hardware and/or software. Expansion shall not require removal of existing DDCP, sensors, actuators, or communication networks.
10. System must be of a modular design to ensure reliability and system performance.
11. All electrical work required as an integral part of this section is work of this section.
12. Provide final power connections including conduit, wire, and/or control panel disconnect switches to all control devices from appropriate electrical j-box.

1.8 Quality Assurance:

A. Provide components not specifically indicated or specified, but necessary to make system function within the intent of contract documents and sequence of operation.
B. All electrical products to be listed and labeled by UL and comply with NEMA Standards.
C. Control wiring shall be in accordance with National Electric Code.
D. Engineering services shall be performed by factory-trained engineers. Include relevant documentation in submittal package.
E. System shall be installed by factory trained mechanical and electrical installers either in direct employ of this Contractor or by subcontractors who are under direct supervision of this Contractor.
F. Use only manufacturer trained technicians who are skilled, experienced, trained, and familiar with the specific equipment, software, and configurations to be provided under this section. Include relevant documentation in submittal package.
G. Coordinate with the Owner to ensure that the BAS will perform in the Owner's IT environment without disruption to any of the other activities taking place on that LAN or WAN. Coordinate device IDs with owner to prevent duplication within existing BACnet environment.
H. Coordinate timely delivery of materials and supervise activities of other trade contractors to install inline devices such as immersion wells, pressure tappings, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items furnished under this section but installed by other trades.
I. Select sensors and transducers to most closely match the expected sensing or control range.
J. Mark and detail exact location of inline devices, wells, and taps to be installed by Mechanical Contractor on coordination drawings and confirm locations in the field.
K. Instrumentation with factory J-boxes shall not be used as junction boxes.
L. Install control equipment, wiring, and air piping in neat and workmanlike manner to satisfaction of A/E, and in accordance with manufacturer's recommendations. Maintain clearances, straight length distances, etc. required for proper operation of each device.
M. Install control devices in accessible location. Coordinate all control device locations with other trade contractors. Contractor to report to A/E conditions that prevent reasonable accessibility.

N. Wire VFDs so that all safeties and interlocks remain operational (inclusive of isolation dampers, isolation valves, end switches, interlocks, safeties, etc.) when drive is placed in Auto, Hand or Bypass mode.
O. Provide weather protection cover or weatherproof control devices where required for control devices located outdoors.
P. All control devices located outdoors shall be rated for the anticipated environment.
Q. Include provisions for supplemental ventilation when control devices must be located within outdoor control panels and when control devices are not rated the planned environment.
R. All digital equipment furnished under this contract shall have been tested and made to comply with limits for Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.
S. Acceptance Criteria: The system shall report all values with an end-to-end accuracy equal to or better than those listed below: The intent of this guideline is to establish criteria for the Control Contractor and Commissioning Agent with regard to calibration and acceptance. Reference specific instrumentation sections for required accuracies.

Measured Variable	Criteria
Space Temperature	+/- 1.0°F
Ducted Air (Single Probe)	+/- 0.5°F
Ducted Air (Averaging)	+/- 2.0°F
Outside Air	+/- 1.0°F
Dew Point	+/- 2.0°F
Relative Humidity (Duct and Space)	+/- 5% RH
Air Flow (Terminal Unit)	+/- 5% (CFM) of reading
Air Flow (Measuring Station)	+/- 5% (CFM) of full scale
Air Pressure (Ducts)	+/- 0.10" WC
Air Pressure (Space)	+/- 0.01" WC
Electrical (A, V, W, PF)	5% of reading
Carbon Monoxide (CO)	+/- 5% of reading
Carbon Dioxide (CO2)	+/- 75 ppm

T. Stability of Control: Control loops shall maintain measured variable at setpoint within the tolerances listed below and shall, upon any change to the feedback variable recover within 5 minutes of the initial event. The intent of this guideline is to establish criteria for the Control Contractor, A/E, and Commissioning Agent with regard to control loops and acceptance.

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure (Ducts)	+/- 0.2" WC	-6 to +6" WC
Air Pressure (Room)	+/- 0.010" WC	-0.100 to +0.100" WC
Air Flow	+/- 100 CFM or 1% of setpoint (whichever is less)	
Temperature	+/- 0.5°F	
Room Temperature	+/- 1.0°F	
Humidity	+/- 3% RH	
Fluid Pressure	+/- 1.0 psi/psid	1 to 150 psi/psid
Carbon Dioxide (CO2)	+/- 50 ppm	100 to 2000 ppm

1.9 Provide all points required to implement control sequences specified, whether or not they are listed in schedules.

1.10 All outputs, whether sequenced or not, shall have separate programmable hardware outputs. For air handling units, minimum outside air, maximum (economizer) outside air, return, relief air, smoke dampers, heating valves, cooling valves, etc., shall each have a separate output.

1.11 Point and Alarming Expectations: The system shall include points and alarms as described in Contract Drawings.

1.12 Commissioning:

A. Assist Testing Adjust Balance Contractor in verifying system operation for all modes of operation.
B. Demonstrate the sequence of operation for each system and/or sub-system to Commissioning Agent (CxA) and/or Engineer. Perform all other requirements and perform all services as required in Cx specification sections.
C. Use vendor specific forms and Cx Agent documentation to document the operation and performance of all control systems.
D. Demonstrate functional tests for each point, control sequence, and control loop.
E. Provide trends, schedules, printouts, etc. to Cx Agent and Engineer as requested to document system performance.

1.13 Submittals:

A. Organized submittals based on specification numbers with major tabs to separate major sections and a master index indicating all elements of submittal.
B. Identify specific parts and accessories proposed for project. Order submittals based on the specification section and include the following:

1. Detailed Bill of Material list for each system, identifying quantity, part number, description, and optional features selected.
2. Setting or adjustable range of control for each control device.
3. Control Dampers
4. Schedule including a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Frame Type, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, Actuator Type, Actuator model number, Actuator torque rating and quantity of actuators required to ensure total closure of damper(s).
5. Leakage and flow characteristics data for all control dampers. Leakage ratings to be based on AMCA Standard 500 and dampers to bear AMCA leakage certification seal.
6. Room Schedule including a separate line for each terminal unit indicating terminal identification, minimum/maximum cfm, box area, thermostat/sensor location, Htg/Clg Setpoints, and bias setting. The schedule shall include typical calibration factors to be filled in by TAB contractor during startup and verification.
7. Air Flow Measuring System Schedule including a separate line for each flow device and column for device type, model number, size, location.
8. Cabling indicate all required electrical wiring. Information including wire jacket colors for low voltage signal wiring, low voltage power wiring and communication cable. Indicate wire gauge for each type of cable.
9. FCC compliance

1.14 Operating and Maintenance Manuals:

A. Include descriptions of maintenance for all components supplied under this section, including (but not limited to) sensors, actuators, and controllers.
B. Include inspection requirements, periodic preventative maintenance recommendations, fault diagnosis, instructions for repair or replacement of defective components, calibration instructions, parts lists, name, address, and phone number of manufacturer's representative.
C. Provide product operational and maintenance data in electronic PDF format (Acrobat latest version - 9.0 or greater) on vendor specific server, and provide means to access this data using intuitive operator interaction (quick links from main system graphics).
D. Include name and 800 number of a 7 day a week 24 hour a day service line for needed service during the first year of operation.

PART 2 - PRODUCTS

2.1 Dampers and Actuators:

A. All actuators shall carry a minimum 5 year warranty. Preferred manufacturer is Belimo.
B. Damper and valve actuators shall be electric type and include the following features.
   1. Actuators shall be electric motor/gear drives which respond proportionally to analog voltage or current input. Stroke time shall be in accordance with project requirements. Stroke time for terminal equipment shall generally be compatible with its associated local controller, but typically no more than 2 minutes.
   2. Provide spring return feature for fail open or closed positions as required by control sequence.
   3. Provide integral end switches as required by control sequence.

2.2 Discrete Electric Instrumentation:

A. General:
   1. Electrical devices, switches, and relays shall be UL listed and of type meeting current and voltage characteristics of the project.

2.3 Temperature Switches (Electric Thermostats):

A. Line voltage or low voltage type suitable for application with adjustable setpoint and setpoint indication.
B. Low voltage type to have heat anticipation.
C. Thermostats with remote sensing bulb shall have liquid filled sensing element and exposed setpoint adjustment.
D. Wall mounted space thermostat enclosure shall have concealed sensing element and exposed setpoint adjustment.
E. Unless otherwise stated, space thermostat covers shall be factory standard cover.

2.4 Temperature Low Limit Switches (Freeze Stats):

A. Electric 2-position 4 wire, 2 circuit temperature sensing element with manual reset.

2.5 Position Switches (End Switches):

A. Dampers: Rotary end switches shall consist of switch mounted on a ½" damper crank arm (Similar to Kele & Associates TS-475).
B. It is not acceptable to use the actuator auxiliary proof for confirmation of open position when proof is used to protect equipment.
C. Door position switches shall be magnetic proximity type.

2.6 Relays:

A. Equal to IDEC type or RIB series. Coil shall match control circuit characteristics. All relays shall include LED indication of status.
B. Provide DIN rail mountable (Snap type) mounting sockets.

2.7 Wall Mounted Space Sensors:

A. Sensors shall be platinum or nickel RTD type, with the following minimum performance:

Temperature Coefficient of Resistivity (TCR):	.00385 ohm/ohm/°C	
Accuracy:	± 0.5F at 70°F (Class B)	
Conformance:	DIN-IEC 751	
Operating Range:	-50 to 500°F	0 to 99% RH

B. Thermistors will be acceptable in lieu of platinum or nickel RTD provided thermistor carries 5-year guarantee that device will maintain its accuracy within tolerance of ± 0.36°F between 32°F and 150°F, and 0.5°F between -20°F and 212°F.
C. Unless otherwise stated, space sensor covers shall be factory standard cover.

2.8 Room Thermostats:

A. Setpoint range shall be resettable only from remote BAS or from any server/client PC. Temperature sensors shall be compatible with the associated controlled devices (e.g. DDC air terminal controller). Mounting box shall be recessed type unless otherwise indicated or required by the building construction materials.
B. Room Temperature Sensors shall incorporate a thermistor/RTD element and an integral portable operator terminal plug-in port.
C. Temporary override push-button/timers shall be installed at all locations.
D. Provide warmer/cooler setpoint adjustment. Minimum and maximum adjustable range shall be set through the BAS only.
E. Unless otherwise stated, room thermostat covers shall be factory standard cover.
F. Unless otherwise stated, room thermostat shall not include a local LCD display.

2.9 Duct Mounted Probe Temperature Sensors:

A. Nickel or platinum RTD type, with the following minimum performance:

Temperature Coefficient of Resistivity (TCR):	.00385 ohm/ohm/°C	
Accuracy:	+/- 0.1% at 32°F (Class B)	
Conformance:	DIN-IEC 751	
Operating Range:	0 to 150°F	0 to 99% RH

B. Thermistors or nickel RTD will be acceptable in lieu of platinum RTD provided thermistor carries 5-year guarantee that the device will maintain its accuracy within a tolerance of ± 0.36°F between 32°F and 150°F, and 0.5°F between -20°F and 212°F.
C. Furnish sensors as shown on drawings or required for proper operation.
D. Space humidity sensors shall be wall mount type with cover to match room thermostats and/or temperature sensors.
E. Sensing element shall be resistive bulk polymer, or thin film capacitive type. Sensor/transmitter shall have the following minimum performance.

Accuracy:	± 2% RH at 25°C over 20-95% RH including hysteresis, linearity, and repeatability.
Temperature Effect:	Less than 0.06% per °F.

Sensitivity:	0.1% RH.
Repeatability:	0.5% RH.
Hysteresis:	Less than 1%.
Long Term Stability:	Less than 1% RH drift per year.
Adjustment:	± 20% RH zero, non-interactive.
	± 10% RH span, non-interactive.
Operating Range:	0-99% RH, non-condensing, sensor.
	0-95% RH, non-condensing, electronics.
Output:	4-20 mA, 0-10Vdc, 0-100% linear, proportional.
Power:	12-36 VDC.

F. Space humidity sensor covers shall be factory standard cover unless otherwise stated.

PART 3 - EXECUTION

3.1 Software:

A. Coordinate graphics and points for consistency with existing campus system. Contractor shall be responsible for data base clean-up when a project is renovated. The graphic database, user view data base and software will be modified to reflect the final project.

B. Continuously archive all data in standard database platform. Including but not limited to:

1. I/O points
2. Software points such as:
   a. Alarm limits
   b. Setpoints
   c. Parameters
   d. Schedules
   e. Alarm messages
   f. Reports
   g. Trends/History
3. Provide BAS Reports including:
   a. Alarm summary
   b. Schedules
   c. Control loop performance
   d. Equipment specific energy performance calculations such as Energy Recovery Devices
   e. Measurement and verification reports consistent with the requirements of the M+V plan developed by a separate 3rd party agent.

C. The Contractor shall implement long term trending for all physical input and output points and all set-points. The initial trend interval settings shall be set to 15 minutes. In addition, the Contractor shall increase the resolution of all control loop trending to every 5 minutes during the testing/acceptance phase (minimum of 2 weeks). Control loop trending shall include controlled variable, setpoint, and output from actuated device. Coordinate all trending requirements with Commissioning Agent and Engineer.

3.2 Alarming:

A. The Contractor shall create enhanced alarm programs for all system points. These points shall be programmed for appropriate seasonal high or low alarm limits. Enhanced alarm programs shall prevent abnormal alarms from occurring when the associated system has been deactivated. For example: air handler mixed air, preheat, cooling, humidity, and static pressure control points, building chilled water, heating water system control points, etc. Alarm destinations, alarm messages, and point graphic assignments shall be included so that alarms are indicated and printed at a pre-defined Owner reporting device and recorded on a transaction log. Alarms shall have accurate descriptions and response instructions, so that alarms may be quickly associated with appropriate graphic display.

B. The Contractor shall define the specific system reactions for each point. Alarms shall be enhanced and prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. The Contractor shall initially define all point priority levels for handling of all system alarms. Users shall have the ability to manually inhibit alarm reporting for each point.

C. Alarm reports and messages shall be directed to a user-defined list of operator devices or PCs based on time (after hour destinations) and/or based on priority.

D. In addition to the points descriptor and the time and date, the Contractor shall create, print, display and store an alarm message for each point to more fully describe the alarm condition or to direct operator response. Alarm events may be configured to send an alarm message to a specified client e-mail address, cellular phone number via SMS text messaging.

3.3 Graphic Displays:

A. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list.

B. Provide graphics for each floor plans of the building as a minimum. Coordinate with the Architect/Engineer (A/E). Size graphics to allow the operator to read room numbers and descriptions. Incorporate the capability to navigate section to section as required to view entire floor and to navigate floor to floor.

C. Color shall be used to indicate normal and alarm conditions within all spaces. Color or common border lines shall be used to link HVAC equipment with zone(s) served.

D. User shall be able to access the various system schematics and floor plans via a graphical penetration scheme and/or menu selection.

E. User shall be able to penetrate from floor plan to associated HVAC system text-based display.

F. Create enhanced alarm programs for all system points. These points shall be programmed for appropriate seasonal high or low alarm limits.

G. Refer to the following graphics guideline section and Graphic Standards - Appendix B for additional examples and samples.

1. All schedules.
2. All points in an override condition.
3. System specific summary screens.
4. Include an AHU terminal unit summary screen for each AHU that serves multiple terminal units. The summary screen shall include the following information and shall be continuously updated with real time data.

Air Terminal Summary

Room #	CFM Actual	CFM Stpt	% Error	Min CFM Stpt	Max CFM Stpt	Reheat Valve Command	Htg Stpt	Temp Actual	Clg Stpt
TOTAL									

3.4 Control Wiring and Pathways:

A. Provide all electrical wiring required for a complete and functional control system, including power circuit to control panels and field devices in accordance with all applicable local codes and the latest version of National Electric Code and NFPA when applicable.

B. Sizing of cable, conduit, j-boxes and raceways to accommodate system with 25% spare capacity. Minimum conduit size shall be 3/4" at all locations. All wall mount devices shall be in conduit and routed to nearest accessible ceiling location stubouts shall be a minimum of 12" from wall line.

C. Labeled wiring with unique tag to match I/O device identifier tag (e.g. sensor DA-T wire shall be labeled at panel and device as "DA-T"). Communication cable shall be labeled with Loop/Trunk #, previous and destination device (e.g. L1VAV101/VAV102 would be used to label the loop 1 communication bus between VAV101 and VAV102).

1. Low voltage wiring concealed above accessible ceilings does not require raceway, however, cables run above accessible ceilings shall be run within a j-hook pathway system spaced no more than 4 ft apart. Cables run in concealed areas or within un-accessible spaces shall be installed in EMT. Run pathways and cables parallel and perpendicular to building structure.

D. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit shall be UL listed.

E. Run direct current instrument conductors separately from alternating current conductors. Where allowed by NEC wiring classification, AC-DC route crossings shall be at 90 degrees. Install special sensor to converter cables in accordance with drawings or in compliance with manufacturer's instructions. Extra precautions shall be taken when pulling and shortening these "vendor furnished" cables. Any extra length on these cables shall be neatly coiled into minimum 3" diameter coils and installed into junction box.

3.5 BAS Network Communication Cable:

A. Run communication or low voltage power cable in separate pathways or in j-hooks with proper clearances.

B. Install special cable connectors in accordance with manufacturer's recommendations.

C. BAS network communication cable shall not be spliced unless a terminal strip enclosure is used.

D. No T-Tapping within the communication system except at designated controller termination points.

E. BAS network communication shall be shielded with the shields taped back where applicable.
F. All control wiring located in mechanical or exposed spaces shall be run in EMT.
G. All Input / Output wiring shall be shielded in accordance with equipment requirements.
H. Refer to Division 26 for additional requirements, except as noted.
I. Power wiring to control compressors and dryers shall be as indicated on electrical power plans. Provide field mounted starters to Electrical Contractor for installation and supervise installation.

3.6 Raceway Identification: All the covers to junction and pull boxes of the BAS raceway system shall be painted white.

3.7 Air Tubing:

A. Conceal all piping, except for piping in mechanical rooms and other areas where mechanical system piping is exposed.
B. Install exposed piping and conduit parallel to or at right angles to building structure and support adequately at uniform intervals. Use only tool-made bends.
C. Polyethylene tubing not exceeding 18" may be used for final connection to instrument or actuator except in high temperature locations such as mechanical rooms with steam heat exchangers or areas exposed to outside environment. Use hard copper for these applications.
D. Install polyethylene tubing with no concealed splices and number code all tubing.
E. Make tests on sectional piping during progress of installation to ensure no leakage.
F. Piping type shall be as follows:

1. Inside Panels: Use polyethylene tubing.
2. Piping Serving Smoke Dampers and Combination Fire-Smoke Dampers: Use hard copper for mains and exposed piping and hard or soft copper for branches and concealed piping.

G. Exposed Spaces:

1. Use hard copper tubing or Polyethylene tubing may be used if run in fully enclosed EMT raceway where environment is within temperature limits of polyethylene tubing.
2. Use PVC coated copper tubing for wet environments.

H. Concealed:

1. Use hard copper, soft copper or polyethylene tubing.

I. Concrete Buried:

1. Use hard copper, soft copper or polyethylene tubing in metal or plastic conduit.

3.8 Local Control Panels:

A. Provide local control panel for each system where more than one control device requires field mounting (air handling units, miscellaneous control system including pump controls, etc.). Single devices may be mounted exposed on piping or ductwork. Install local control panel where indicated on drawings or suitable location adjacent to system served. Do not mount panels on equipment.
B. Mount panel on wall with suitable brackets or on floor with self-supporting stand.
C. Mount top of panel no higher than 6 feet above floor.
D. Install panels so front cover door can swing full open without interference and maintain a minimum of 36" clearance.

E. Unless otherwise indicated, mount controllers, adjusting switches, pressure gages, temperature indicators, and other indicating or manually operated devices inside panel with permanent labels identifying device and controlled device or function.
F. In-line pneumatic gages shall be hard mounted to back panel and shall include permanent labels identifying end device. Other factory standard labeling methods are acceptable as long as the device name and function are clearly identified and is permanent. Labels shall correspond to control drawing tags and identifiers.
G. Labels shall correspond to control drawing tags and identifiers.
H. Panel will be labeled with location and breaker number of power feed.

3.9 Network Routers and Bridges:

A. Provide router as required, to bridge BACnet/IP and the data link used between the controllers (BACnet ARCNET, BACnet MS/TP).
B. Proprietary networks (networking between buildings and central server) and proprietary protocols are not acceptable.
C. Coordinate final location with Owner and other trades.

3.10 Building Level Controller:

A. Provide controllers as required.
B. Coordinate final location with Owner other trades.

3.11 Advanced Application Controllers – Hardware (AAC):

A. Provide all processors, power supplies, and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
B. Size controller to meet the requirements of this specification and the project point I/O schedule +15% additional capacity of each point type.

3.12 Application Specific Controllers (ASC):

A. Provide the following types of application specific controllers (embedded or as a predefined software application) as a minimum:

1. Variable Air Volume (VAV) boxes

B. Provide communication to the BAS.
C. Coordinate location and power requirements with other trades.

3.13 Servers:

A. Archive all historical data such as trends, alarm and event histories, and transaction logs on existing server.

3.14 Actuators:

A. Provide actuator for each automatic damper with sufficient capacity to operate damper or valve under all conditions. Select actuators to provide tight shut off against maximum system temperatures and pressure encountered.
B. Each actuator shall be full-proportioning or two-position type as required or specified, and shall be provided with a spring-return capability for fail open or fail closed position during power interruption as indicated and/or as required.
C. Damper operating speeds shall be selected or adjusted so operators will remain in step with controller without hunting regardless of load variations.

D. 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/damper shaft/ideal movement) due to deflection of actuator mounting.

E. Sizing:

1. Calculations for sizing dampers shall be based on actual characteristics of ductwork system being installed.

F. Opposed blade dampers shall be sized for minimum of 10% of duct section pressure drop. Parallel blade dampers shall be sized for minimum of 30% of duct section pressure drop. Duct section is defined as ductwork containing flow control damper starting with inlet or branch tee and ending with outlet or branch tee.

G. Calculate actual duct pressure drops for each duct section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals.

H. If control system fixes pressure drop, use those pressure setpoints. Use duct blank-offs to provide additional pressure drop as required to obtain linear damper response.

I. Contractor is responsible for obtaining adequate system information necessary for sizing.

J. Contractor to provide dampers as shown on drawings or as scheduled.

K. Two position dampers shall be sized as close as possible to duct size, but in no case is damper size to be less than duct area.

3.15 General Instrumentation:

A. Discrete Electric Instrumentation:

1. General:

a. Terminate at terminal blocks inside enclosures unless otherwise specified.
b. Include auxiliary contact for remote status indication of safety devices.

2. Temperature Switches (Electric Thermostats):

a. Provide temperature switches as shown or as required for sequence of operation.

3. Low Limit Temperature Switches (Freeze Stats):

a. Install low limit controls where indicated on drawings or as specified. Unless otherwise indicated, install sensing element at downstream side of heating coils.
b. Distribute sensing element across entire area of medium being sensed. Install controls at accessible location with suitable mounting brackets and element duct collars where required.
c. Low limit trip activation shall cause all water coils to be overridden to full flow unless otherwise noted.
d. Controls shall be capable of opening circuit if any one-foot length of sensing element is subject to temperature below established setpoint.
e. Sensing element shall not be less than one lineal foot per square foot of coil surface area. Unless otherwise indicated, calibrate temperature switch setpoint to 38°F.
f. Low Limit switches shall be hardwired into safety circuit of motor control device. Additional dry contact shall be used for BAS feedback.

g. Location of installed device must be accessible from outside of unit, must be protected from the water and must be mounted no more than 60” AFF. Provide a single remote (hardwired) reset switch when conditions require device to be mounted above 60” AFF or when multiple devices are used.
h. Distribute sensing element across entire face of coil being protected (generally downstream of heating coil). Serpentine sensing element, starting at the lowest point (6” above coil bottom) of the coil being protected. Operation of low limit trip shall provide protection to all coils.
i. Provide multiple devices for large AHUs where required to ensure complete coverage.

4. 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 mounted on exterior of starter or VFD.
d. Mount relay for easy accessibility.
e. Mount relay for easy visual accessibility.
f. All equipment start/stop relays shall include an integral HOA function.

5. Pressure Switches:

a. Provide pressure switches where indicated on drawings or as required to accomplish sequences.
b. Coordinate installation of flow switches for proper location and installation.

6. Pressure Switches (Air Side):

a. Pressure Switches: Provide pressure switches where indicated on drawings or as required to accomplish sequences.
b. Coordinate installation of flow switches for proper location and installation.

7. Target Type (Paddle) Flow Switches:

a. Furnish paddle switches as required.
b. Coordinate installation of flow switches for proper location and installation.

8. Flow Switches:

a. Furnish flow switches as required.
b. Coordinate installation of flow switches for proper location and installation.

9. E-P Switches (Solenoid Valves):

a. Provide E-P switches where indicated on drawings or as required to accomplish sequences.

10. Position Switches (End Switch):

a. Provide position switches where indicated on drawings or as required to accomplish sequences.
b. It is not acceptable to use the actuator auxiliary proof for confirmation of open position when proof is used to protect equipment.

11. Current Switches:

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.
c. Current switch shall be adjusted to sense status at all normal operating ranges.
d. Split core with LED status and local adjustment of trip point. Self-calibrating models are not permitted.

B. Analog Electronic Instrumentation:

1. Metering and Totalization:

a. Coordinate the delivery and installation of meter.
b. Installation where indicated on drawings.
c. Mount remote display unit at eye level in accessible location.

2. Wall Mounted Space Sensors:

a. Install space thermostats/sensors where indicated, as required to perform specified controls, or directed to meet job site conditions.
b. Mount space sensors 4 ft above floor unless otherwise indicated.
c. Any room sensor mounted on exterior walls shall be mounted on thermally insulated sub-base.
d. Relocate room sensors if required due to draft, interferences with cabinets, writing board, etc., or improper sensing.
e. Provide a conduit from sensor box to above the ceiling where it shall stub out into an accessible area parallel with the ceiling.

3. Room Thermostats

a. Install space thermostats where indicated, as required to perform specified controls, or directed to meet job site conditions.
b. Mount thermostats at 4 ft above floor unless otherwise indicated.
c. Any room thermostat mounted on exterior walls shall be mounted on thermally insulated sub-base.
d. Relocate room thermostats if required due to draft, interferences with cabinets, writing board, etc., or improper sensing.
e. Provide a conduit from thermostat box to above the ceiling where it shall stub out into an accessible area parallel with the ceiling.
f. Setpoint ranges shall be resettable only from remote BAS. Temperature sensors shall be compatible with the associated controlled devices (e.g. DDC air terminal controller).
g. Mounting box shall be recessed type unless otherwise indicated, or required by the building construction materials.
h. Thermostat shall incorporate a thermistor/RTD element and an integral portable operator terminal unit plug-in port for remote communication and testing.
i. Temporary override push-button shall be installed at all locations where required.
j. Use only warmer/cooler setpoint adjustment dial (no graduated scale). Minimum and maximum adjustable range shall be set through the BAS. Default shall be +/- 3°F.
k. In general room thermostat covers shall be factory standard cover.

l. Unless otherwise stated, room thermostat shall not include a local LCD display.
m. Mount all sensor types at the same height whenever possible.
n. Room thermostats in gymnasium, locker rooms and other areas exposed to possible damage shall be protected by heavy-duty cast and die formed guard.

4. Duct Mounted Probe Sensors:

   a. Provide sensors where shown or drawings or to accomplish sequences.
   b. Install outside air sensors in weatherproof, non-corrosive solar shield.

5. Insertion Temperature Sensors:

   a. Provide sensors where shown or drawings or to accomplish sequences.
   b. Install wet sensors in stainless steel or brass wells with thermal grease.
   c. Wells mounted in pipe 3" and larger shall be installed in horizontal or vertical lines provided element is always in flow (for condensate and other gravity return lines, install in bottom of pipe).
   d. Wells mounted in pipe 2-1/2" and smaller shall be installed at a 90° pipe junction consisting of tee fitting (2" minimum size) and appropriate reducing fittings. Install sensor well pointed upstream in tee.

6. Duct Mounted Averaging Temperature Sensors:

   a. Use where temperatures are prone to stratification or where ducts are larger than 9 sq. ft. (1 sq. m); length as required. All sensors located within the AHU compartment shall be averaging.
   b. Serpentine sensor in duct to maximize coverage of measured area.
   c. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   d. Mounted to suitable supports using factory approved non-metal element holders to ensure correct minimum bend radius.
   e. Provide isolation where sensor comes into contact with dissimilar metal.
   f. Rigid averaging temperature probes are not allowed.

7. Dew Point or Wet Bulb Temperature Transmitter:

   a. Provide dew point transmitters where indicated or to accomplish sequences.

8. Space Humidity Sensors/Transmitters:

   a. Install space humidity sensor where indicated, as required to perform specified controls, or directed to meet job site conditions.
   b. Mount sensors at same height as temperature sensors.
   c. Any sensor mounted on exterior walls shall be mounted on thermally insulated sub-base.
   d. Relocate sensor if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.
   e. Provide a conduit from sensor box to above the ceiling where it shall stub out into an accessible area parallel with the ceiling.

f. Use combination temperature/humidity sensors whenever possible. Both temperature and humidity accuracy requirements shall still apply when using the combination type sensor.

9. Duct Mounted Humidity Sensors/Transmitters:

   a. Provide duct humidity sensor where indicated, as required to perform specified controls, or directed to meet job site conditions.
   b. Duct humidity sensors shall be accessible.
   c. Use combination temperature/humidity sensors whenever possible. Both temperature and humidity accuracy requirements shall still apply when using the combination type sensor.

10. Thermal Dispersion or Vortex Shedding Air Flow Sensors/Transmitters:

   a. Provide air flow sensor where indicated, as required to perform specified controls, or directed to meet job site conditions.
   b. Shall include NIST traceable calibration certificate.
   c. Manufacturer shall provide all cabling required to connect probe assemblies and transmitter electronics. Transmitter and/or systems, which require periodic calibration to maintain accuracy specified shall not be acceptable.
   d. Provide a local display to indicate calculated cfm. Display shall be remotely mounted at no higher than 60 inches above finished floor.

11. P-E Traducers (Pressure Transmitters):

   a. Provide transducers as required to perform specified controls, or directed to meet job site conditions.
   b. Mount transducers in control panels.
   c. Provide gauge for all transducers.
   d. Exhaust air system static pressure transducers/transmitters shall be furnished with protective integral HEPA air filters on sensing lines within 12 inches of dust penetration when installed in hazardous exhaust duct.
   e. Provide local LCD display.
   f. Provide test ports for external connection and calibration.
   g. Mount all transducers in associated control panels.
   h. Terminate transducers directly to the controller that is implementing control loop. Using remote controllers and software data sharing is not allowed.

12. Dual Air System Static Pressure and Differential Pressure (Velocity) Transmitter:

   a. Provide transducers/transmitters to convert velocity pressure differential or static duct pressure relative to sensor location into electronic signal.
   b. Mount transducers in control panels.
   c. Terminate transducers directly to the controller that is implementing control.

13. Building and Space Pressure Differential Transmitter:

   a. Provide directional mass flow transmitter installed in 2" thin-wall rigid conduit (EMT) or PVC between spaces to measure relative velocity created by the pressure difference.
   b. Extend 2" EMT or PVC pipe between spaces for room pressure control, or between space and outside for building static pressure control.

c. Provide algorithm in software to convert air velocity to pressure differential (DP = C (V/4005)2). Field determine coefficient C by calibrated measurement.
d. Construct shroud of aluminum, painted to match building exterior.
e. Provide local LCD display.
f. Use outdoor air static pressure pickup port similar to Dwyer A420 when measuring building static.

14. Electric to Pressure Transducers:

    a. Provide pressure transducers integral to DDC panels or separate components to convert digital analog signal to variable pneumatic air pressure signal.
    b. Provide output gauge for all transducers.
    c. Mount in control panel.

15. Carbon Dioxide Sensor:

    a. Provide carbon dioxide sensor where indicated, as required to perform specified controls, or directed to meet job site conditions.
    b. CO2 sensors shall carry a minimum 5 year warranty. Preferred manufacturer is Veris.

16. Terminal Unit Location Identification:

    a. Provide a label directly below terminal unit devices mounted above ceiling. Label the approximate location on ceiling grid.

END OF SECTION

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PART 1 - GENERAL

1.1 The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the electrical work as herein called for and shown on the drawings.

1.2 Related Documents:

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

B. This is a Basic Requirements Section. Provisions of this section apply to work of all Division 26 sections.

C. Review all other contract documents to be aware of conditions affecting work herein.

D. Definitions:

1. Provide: Furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for subsequent requirements.
3. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be construed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.

B. Verify all field dimensions and locations of equipment to ensure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.

C. Coordinate work in this division with all other trades in proper sequence to ensure that the total work is completed within contract time schedule and with a minimum cutting and patching.

D. Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on electrical drawings, be guided by architectural details and conditions existing at job

and coordinate this work with that of others.

E. Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings, and passageways. Cut no structural members without written approval.

F. Carefully examine any existing conditions, wiring, devices, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

G. Because of the small scale of the drawings, it is not possible to indicate all precise locations for all devices and equipment. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate devices, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or raceway cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

A. The Contractor shall guarantee labor, materials, and equipment for a period of one (1) year from Substantial Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

B. Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

A. When approved, the submittal control log and submittals shall be an addition to the specifications herewith and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1. Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

a. Submittals shall be properly organized in accordance with the approved submittal control log.

b. Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

c. Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

d. Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

e. Submittals that include a series of fixtures or devices (such as lighting or panelboards) shall be organized by the device name or type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether those items are used on other fixtures.
f. Do not include pages in submittal which do not apply to the project. If submittal includes products not intended for installation, clearly indicate all materials in the submittal which are intended for installation.
g. The electrical design shown on the drawings supports the equipment basis of design specifications at the time of design. If equipment by any division is submitted with different electrical requirements, it is the responsibility of the submitting contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the proposed electrical configuration in the relevant submittal with a written statement that this change will be provided at no additional cost. Submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

B. If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.
C. Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.
D. Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations, and details to scale (not smaller than 1/4" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications, and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports, and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final "Approved" or "Approved as Noted" copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein. Submit manuals at the Substantial Completion inspection.

PART 2 - PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the

best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

A. All equipment and materials shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

B. Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings, and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated, or painted.

C. The label of the approving agency, such as UL, by which a standard has been established for the particular item, shall be in full view.

D. The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

E. A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

F. Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

G. Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material, and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

H. Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.3 Requests for Substitution:

A. Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product, or material specified.

B. Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

1. Required product cannot be supplied in time for compliance with Contract time requirements.
2. Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.
3. Substantial cost advantage is offered to Owner after deducting offsetting disadvantages including delays, additional compensation for redesign,

investigation, evaluation, and other necessary services and similar considerations.

C. All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

1. Principal of operation.
2. Materials of construction or finishes.
3. Thickness of gauge of materials.
4. Weight of item.
5. Deleted features or items.
6. Added features or items.
7. Changes in other work caused by the substitution.
8. Electrical ratings and properties.
9. If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

PART 3 - EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any installation which is not orderly and reasonably neat, or does not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

A. The Contractor shall be responsible for complete coordination of the electrical systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for raceway or other appurtenances passing through slabs or walls.

B. Any additional steel supports required for the installation of any electrical equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

C. It shall be the Contractor's responsibility to see that all equipment such as terminal cabinets, fire alarm components, control panels, and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

D. All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

E. The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

F. Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

G. Start of work will be construed as acceptance of suitability of work of others.

3.3 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.4 Phasing: Provide all required temporary wiring, lighting, fire alarm, equipment, and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.5 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.6 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts, and washers. Level equipment.

3.7 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 26. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.8 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.9 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 Record Drawings:

A. During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all switches, receptacles, devices, equipment, and other systems which are not installed exactly as shown on the contract drawings.

B. Contractor shall review field set with up-to-date marks regularly with Engineer. Pay requests will not be approved for work which has not been adequately documented in the field set.

C. Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.11 Acceptance:

A. Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

B. Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

C. Operation and Maintenance Manuals: Provide O&M manual as dictated by Division 1.

Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Upload completed manual as a single searchable PDF to the project Sharepoint website. Non-searchable scanned documents are not acceptable. Do not include approved submittals in O&M document.

Manuals shall contain:

1. Detailed operating instructions and instructions for making minor adjustments.
2. Complete wiring, control, and single line diagrams.
3. Routine maintenance operations.
4. Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
5. Copies of approved submittals.
6. Copies of all manufacturer's warranties.
7. Copies of test reports and verification submittals.

D. Record Drawings: Submit record drawings.
E. Acceptance will be granted on the basis of tests and inspections of job. A representative of firm that performed test and balance work shall be in attendance to assist. Contractor shall furnish necessary mechanics to operate system, make any necessary adjustments and assist with final inspection.
F. Control Diagrams: Frame under clear plastic and mount on equipment room wall.
G. Single Line Diagrams: Frame under clear plastic and mount on equipment room wall.

PROJECT NAME

PROJECT NUMBER

ARCHITECT: Company Name

ENGINEER: Mitchell Gulledge Engineering

CONTRACTOR: Contractor Name

SAMPLE

SUBCONTRACTOR: Sub Name

SUPPLIER: Supply Company

MANUFACTURER: Manufacturer

DATE: mm/dd/yyyy

Any standard heading is acceptable.

SECTION: 26 XX XX/Section Name

1. Product 1: Manufacturer, Model
2. Product 2: Manufacturer, Model
3. Product 3: Manufacturer, Model
4. Product 4: Manufacturer, Model
5. Product 5: Manufacturer, Model

List each product individually. Include manufacturer name and model.

Include GC or CM Approval stamp indicating review and acceptance by responsible contractor.

END OF SECTION

PART 1 - GENERAL

1.1 The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the fire protection work as herein called for and shown on the drawings.

1.2 This is a Basic Electrical Requirements section. Provisions of this section apply to work of all Division 26 sections.

PART 2 - CODES

2.1 All work under Division 26 shall be constructed in accordance with the codes listed herein. The design has been based on the requirements of these codes; and while it is not the responsibility of the Contractor to verify that all work called for complies with these codes, he shall be responsible for calling to the Architect/Engineer's attention any drawings or specifications that are not in conformance with these or other codes prior to ordering equipment or installing work.

2.2 Comply with regulations and codes of utility suppliers.

2.3 Where no specific method or form of construction is called for in the contract documents, the Contractor shall comply with code requirements when carrying out such work.

2.4 Where code conflict exists, generally the most restrictive requirement applies. Comply with current code edition, unless noted.

2.5 Additional codes or standards applying to a specific part of the work may be included in that section.

2.6 The following codes and standards shall govern all work:

A. Florida Building Code – Sixth Edition (2017)
B. Florida Building Code – Sixth Edition (2017) – Existing Building
C. Florida Building Code – Sixth Edition (2017) – Energy Conservation
D. Florida Building Code – Sixth Edition (2017) – Mechanical
E. Florida Building Code – Sixth Edition (2017) – Plumbing
F. Florida Building Code – Sixth Edition (2017) – Fuel Gas
G. Florida Building Code – Sixth Edition (2017) – Accessibility
H. Florida Fire Prevention Code Sixth Edition

1. Fire Code (NFPA 1 – 2015 Edition)
2. Life Safety Code (NFPA 101 – 2015 Edition)

I. National Electric Code (NFPA 70 – 2014)
J. Fire Alarm and Signaling Code (NFPA 72 – 2013)

PART 3 - STANDARDS

All materials, installation and systems shall meet the requirements of the following standards, including the latest addenda and amendments, to the extent referenced:

3.1 Underwriters' Laboratories (UL)
3.2 American National Standards Institution (ANSI)
3.3 American Society of Testing Materials (ASTM)
3.4 National Fire Protection Association (NFPA)
3.5 National Electrical Manufacturers Association (NEMA)
3.6 Institute of Electrical and Electronics Engineers (IEEE)
3.7 National Electrical Contractors Association (NECA)
3.8 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
3.9 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

3.10 Illuminating Engineering Society of North America (IESNA)
3.11 Telecommunications Industry Association (TIA)
3.12 Electronics Industry Alliance (EIA)
3.13 Lightning Protection Institute (LPI)

END OF SECTION

PART 1 - DIVISION 1 - GENERAL REQUIREMENTS

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

1.2 This is a Basic Electrical Requirements section. Provisions of this section apply to work of all Division 26 sections.

1.3 Coordinate with the General Contractor for all cutting and patching. Contractors performing Division 26 work shall inform the General Contractor of all cutting and patching required prior to bidding and shall coordinate installation.

PART 2 - DIVISION 3 - CONCRETE

2.1 Refer to Division 3, Concrete for:

A. Rough grouting in and around electrical work.
B. Patching concrete cut to accommodate electrical work.

2.2 The following is part of Division 26 work, complying with the requirements of Division 3:

A. Curbs, foundations, and pads for electrical equipment.
B. Man holes, hand holes, and vaults of electrical work.
C. Underground structural concrete to accommodate electrical work.
D. Concrete encasement of electrical conduits and cables.

PART 3 - DIVISION 4 - MASONRY

3.1 Refer to Division 4, Masonry for:

A. Installation of access doors in walls.

PART 4 - DIVISION 5 - METALS

4.1 Refer to Division 5, Metals for:

A. Framing openings for electrical equipment.

4.2 The following is part of Division 26 work:

A. Supports for electrical work.

PART 5 - DIVISION 6 - WOOD AND PLASTIC

5.1 Refer to Division 6, Wood for:

A. Framing openings for electrical equipment.

PART 6 - DIVISION 7 - THERMAL AND MOISTURE PROTECTION

6.1 Refer to Division 7, Thermal and Moisture Protection for:

A. Installation of all roof curbs and roof supports for electrical work.
B. Caulking and waterproofing of all wall and roof mounted electrical work.
C. Providing all roof curbs and all flashing for metal roofs.

6.2 The following is part of Division 26 work, complying with the requirements of Division 7.

A. Fire barrier penetration seals.

PART 7 - DIVISION 9 - FINISHES

7.1 Refer to Division 9, Finishes for:

A. Painting piping, and equipment.
B. Painting structural metal and concrete for electrical work.
C. Painting access panels.
D. Painting color-coded electrical work indicated for continuous painting. See color schedule in Division 26 section, "Electrical Identification".
E. Installation of access doors in gypsum drywall.

7.2 Colors shall be selected by the Architect for all painting of exposed electrical work in occupied spaces, unless specified herein. Do not paint insulated or jacketed surfaces.

7.3 Perform the following as part of Division 26 work:

A. Touch up painting of factory finishes.
B. Painting of all hangers.

PART 8 - DIVISION 10 - SPECIALTIES

8.1 Refer to Division 10 - Specialties for:

A. Fire extinguishers and fire extinguisher cabinets and accessories.

PART 9 - DIVISION 11 - EQUIPMENT

9.1 Refer to Division 11 - Equipment for all food service equipment to be provided. This includes the cooking hoods with fire suppression.

9.2 Refer to Division 11 - Equipment for all laboratory equipment including cabinets, casework, student stations, demonstration desks, fume hoods, snorkel exhausts, canopy hoods, safety stations, eyewashes, and all related fixtures, fittings, and trim.

PART 10 - DIVISION 23 - HVAC

10.1 Mechanical and Electrical Contractors shall coordinate the exact electrical requirements of all mechanical equipment being provided. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The electrical design shown on the drawings supports the mechanical equipment basis of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this design will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost to the Owner.

10.2 Mechanical contractor shall provide all HVAC control wiring including the Energy Management Control system sensors, alarms, and input/output signals and all relays, interlocks, warning lights, and control devices, complying with the requirements of Division 26. The intent is for the mechanical contractor to be responsible for the entire HVAC control system, including point-to-point wiring, and associated raceway and boxes. Electrical contractor shall notify mechanical contractor upon discovery of any mechanical controls installation which does not meet Division 26 requirements.

10.3 Electrical Contractor is expected to be familiar with the entirety of the mechanical scope. Review mechanical sheets, specifications, and other portions of the Contract Documents prior to bidding. Electrical Contractor is responsible for all line voltage (greater than 100V) work unless otherwise noted. Electrical Contractor shall coordinate with Mechanical Contractor, and shall make themselves available as

necessary to support the mechanical scope.

10.4 Electrical contractor shall provide disconnect switches, starters, and contactors for mechanical equipment unless specifically noted as being furnished as part of mechanical equipment.

10.5 Electrical contractor shall provide all power wiring, raceway and devices, and make final electrical connections to all mechanical equipment, switches, starters, contactors, controllers, and similar equipment.

PART 11 - DIVISION 27 - COMMUNICATIONS

11.1 Electrical and Communications Contractors shall coordinate the exact Communications requirements of all electrical equipment being provided. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The Communications design shown on the drawings supports the electrical equipment basis of design. If electrical equipment is submitted with different Communications requirements, it is the responsibility of the electrical contractor to resolve all required Communications design changes (e.g. input/output voltage) and clearly show the new Communications design on the electrical submittal with a written statement that this design will be provided at no additional cost. Electrical submittals made with no written reference to the Communications design will be presumed to work with the Communications design. Any corrections required will be at no additional cost to the Owner.

11.2 Electrical Contractor is expected to be familiar with the entirety of the communications scope. Review communications sheets, specifications, and other portions of the Contract Documents prior to bidding. Electrical Contractor is responsible for all line voltage (greater than 100V) work unless otherwise noted. Electrical Contractor shall coordinate with Communications Contractor, and shall make themselves available as necessary to support the communications scope.

11.3 Unless otherwise instructed by Construction Manager or General Contractor, Division 26 shall be responsible for Division 27.

PART 12 - DIVISION 28 - ELECTRONIC SAFETY AND SECURITY (ESS)

12.1 Electrical and ESS Contractors shall coordinate the exact electrical requirements of all ESS equipment being provided. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The electrical design shown on the drawings supports the ESS equipment basis of design. If ESS equipment is submitted with different electrical requirements, it is the responsibility of the ESS contractor to resolve all required electrical design changes (e.g. input/output voltage) and clearly show the new electrical design on the ESS submittal with a written statement that this design will be provided at no additional cost. Electrical submittals made with no written reference to the ESS design will be presumed to work with the electrical design. Any corrections required will be at no additional cost to the Owner.

12.2 Electrical Contractor is expected to be familiar with the entirety of the fire alarm scope. Review fire alarm sheets, specifications, and other portions of the Contract Documents prior to bidding. Electrical Contractor is responsible for all line voltage (greater than 100V) work unless otherwise noted. Electrical Contractor shall coordinate with Fire Alarm Contractor, and shall make themselves available as necessary to support the fire alarm scope.

12.3 ESS contractor shall provide ESS modules, detectors, and other appurtenances for unless specifically noted as being furnished as part of electrical equipment.

12.4 ESS contractor shall provide all ESS wiring, raceway and devices, and make final ESS connections to all electrical equipment, detectors, modules, contacts, controllers, and

similar equipment.

12.5 Unless otherwise instructed by Construction Manager or General Contractor, Division 26 shall be responsible for Division 28.

END OF SECTION

PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. Division 26 Basic Materials and Methods sections apply to work of this Section.

1.2 Summary:

A. The extent of electrical grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
B. The type of electrical grounding and bonding work specified in this Section includes the following:

1. Solidly grounded.

C. Applications of electrical grounding and bonding work in this Section include the following:

1. Electrical power systems.
2. Raceways.
3. Enclosures, pull boxes, junction boxes, etc.
4. Equipment.
5. Lighting standards.

D. Refer to other Division 26 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work.

1.3 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.

1.4 Codes and Standards:

A. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and current NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits, and equipment.
2. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, "Electrical Grounding and Bonding Equipment", and 869, "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits, and equipment. In addition, comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors". Provide grounding and bonding products which are UL listed and labeled for their intended usage. Solder lugs are not acceptable.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. All products shall be the produce of reputable and reliable manufacturers.
B. The following manufacturers are recognized as being reputable and reliable:

1. Burndy, Inc.
2. Erico, Inc.
3. Harger, Inc.
4. Thermoweld, Inc.

C. Additional manufacturers shall be considered reputable and reliable only if they verifiably satisfy the following requirements:

1. History: Acceptable manufacturers shall have a history of producing similar products at least the past ten years. Such products shall have been sold in the state of Florida for at least the past five years.
2. Volume: Acceptable manufacturers shall have produced and sold similar products in excess of one hundred (100) times annually the amount of product projected for used in this project. This requirement shall apply to each of the past ten years.
3. Similar projects: Acceptable manufacturers shall have sold similar products which have been used in at least five similar projects in the past five years. Similar projects must be of a similar use, overall cost, and overall size.

D. Documentation of the above manufacturer requirements shall be provided to Engineer upon request, but is otherwise unnecessary. If documentation is required, it shall consist of a signed statement from Manufacturer's representative on Manufacturer's letterhead (or the letterhead of Manufacturer's approved representative). Additional documentation may be required in rare cases.

E. Any submittal by Contractor shall be considered indication by Contractor that Contractor stands behind for the suitability of a manufacturer, and that the manufacturer satisfies of the above requirements.

F. Contact Engineer prior to bid with any questions regarding acceptable manufacturers.

2.2 <u>Grounding and Bonding</u>:

A. Provide complete grounding and bonding assemblies, including, but not limited to,

1. Cables/Wires,
2. Connectors,
3. Solderless Lug Terminals,
4. Bonding Jumper Braid,
5. Additional accessories needed for a complete installation.

B. Where more than one type component product meets indicated requirements, selection is Contractor's option.

C. Where materials or components are not indicated, provide products which comply with NEC, UL, and applicable industry standards.

D. Conductors:

1. Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.

E. Bonding Plates, Connectors, Terminals, and Clamps:

1. Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by bonding plate, connector, terminal, and clamp manufacturers for indicated applications.

PART 3 - EXECUTION

3.1 Examination:

A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Engineer in writing of any condition detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer and Owner.

3.2 Installation of Electrical Grounding and Bonding Systems:

A. General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of current NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.
B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
C. Provide all circuits with an insulated equipment grounding conductor. Under no circumstances shall raceways be the sole equipment grounding conductor.
D. Terminate insulated equipment grounding conductors with grounding lug, bus, or bushing. Conductors shall not be looped under screw or bolt heads.
E. Grounding Electrode System and Grounding Electrode Conductor are existing to remain.
F. Connect together service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors.

    1. Provide minimum #12 AWG equipment grounding conductor in each conduit unless otherwise indicated. Equipment grounding conductor shall have continuous green insulation if #6 or smaller, green marking tape if #4 or larger.
    2. Equipment grounding conductor shall be connected to ground buses in equipment enclosures.
    3. Equipment grounding conductor bonded to all outlet, pull, and junction boxes by a lug or screw approved for the purpose before installation of the boxes. Ground pigtails and/or ground clips are not acceptable.

G. Grounding type bushings shall be installed on all feeder conduits entering panelboards, pull boxes and all conduit entering oversized, concentric, and eccentric knock-outs.
H. Tighten grounding and bonding connectors and terminal, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
I. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity. All ground clamps and lugs shall be listed for application and shall be made completely of bronze or brass.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. This Section is a general Division 26 materials and methods section, and applies to all other Division 26 sections involving materials and methods specified herein.

1.2 Description of Work:

A. Extent of electrical wire and cable work is indicated by drawings and schedules.
B. Types of electrical wire, cable, and connectors specified in this Section include the following:

1. Copper conductors.
2. Fixture wires.
3. Split bolt connectors.
4. Wirenut connectors.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

1. For power distribution circuits.
2. For lighting circuits.
3. For appliance and equipment circuits.
4. For motor branch circuits.
5. For control circuits.

1.3 Codes and Standards:

A. NEC Compliance: Comply with NEC requirements as applicable to construction, installation, and color coding of electrical wires and cables.
B. IEEE Compliance: Comply with applicable requirements of IEEE Stds. 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors", and Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring systems.
C. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8, and D 753.

1.4 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data.

PART 2 - PRODUCTS

2.1 General Wiring Products:

A. Unless otherwise noted, all wiring shall be copper, with conductivity of not less than 98% at 20°C (68°F).

2.2 Acceptable Manufacturers:

A. All products shall be the produce of reputable and reliable manufacturers.
B. The following manufacturers are recognized as being reputable and reliable:

1. Cerro Wire
2. Encore Wire Corporation
3. General Cable

4. Southwire Company

C. Additional manufacturers shall be considered reputable and reliable only if they satisfy the following requirements:

1. History: Acceptable manufacturers shall have a history of producing similar products at least the past ten years. Such products shall have been sold in the state of Florida for at least the past five years.
2. Volume: Acceptable manufacturers shall have produced and sold similar products in excess of one hundred (100) times annually the amount of product projected for used in this project. This requirement shall apply to each of the past ten years.
3. Similar projects: Acceptable manufacturers shall have sold similar products which have been used in at least five similar projects in the past five years. Similar projects must be of a similar use, overall cost, and overall size.

D. Documentation of the above manufacturer requirements shall be provided to Engineer upon request, but is otherwise unnecessary. If documentation is required, it shall consist of a signed statement from Manufacturer's representative on Manufacturer's letterhead (or the letterhead of Manufacturer's approved representative). Additional documentation may be required in rare cases.

E. Any submittal by Contractor shall be considered indication by Contractor that Contractor stands behind for the suitability of a manufacturer, and that the manufacturer satisfies of the above requirements.

F. Contact Engineer prior to bid with any questions regarding acceptable manufacturers.

2.3 Building Wires: Provide factory fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated.

A. Dual-listed THHN/THWN-2: For dry, damp, and wet locations.

B. All wiring for conventional devices shall be stranded wire with the exceptions as noted on the electrical drawings.

C. MC cable and other prefabricated cables are not permitted, except as called for in writing by Engineer. Prefabricated light fixture whips shall be permitted.

2.4 Color Coding: The following systems of color coding shall be strictly adhered to. There shall be no color change for switch legs. Switch legs shall be marked at all junctions with colored tape on each wire with tape of contrasting color. Three way travelers shall be purple. In cases where more than one set of travelers are in the same conduit, travelers shall be marked with circuit number and colored tape. Colored tape shall be same color as corresponding switch leg marking.

A. Note: Verify that the following corresponds to existing wiring prior to proceeding.

B. All wiring shall be the indicated color. Tape is not an acceptable method of indicating phase legs.

C. 120/208V Wye

1. Phase A: Black
2. Phase B: Red
3. Phase C: Blue
4. Neutral: White
5. EGC (Ground): Green

D. 277/480V Wye

1. Phase A: Brown
2. Phase B: Orange
3. Phase C: Yellow
4. Neutral: Grey
5. EGC (Ground): Green with Yellow Stripe

E. The color code assigned to each phase wire shall be consistently followed throughout.

PART 3 - EXECUTION

3.1 Delivery, Storage, and Handling:

A. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.
B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.
C. Handle wire and cable carefully to avoid abrading, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

3.2 Installation of Wires and Cables:

A. General: Install electrical cables, wires, and wiring connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation" and in accordance with recognized industry practices.
B. Unless otherwise noted, all branch circuit conductors shall be 12 AWG minimum.
C. Per UF Standards, demolish and replace of all aluminum branch circuit wiring discovered during construction.
D. Install all line voltage wiring in conduit, unless otherwise indicated in writing by Engineer.
E. Pull conductors simultaneously where more than one is being installed in same raceway.
F. Use lubricant for pulling conductors. Use only products indicated for the purpose by the manufacturer.
G. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceway.
H. Minimize conductor splices.
I. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced. Use splice and tap connectors which are compatible with conductor material.
J. Provide a 6" loop in each conductor in all joint boxes and pull boxes.
K. Conductors of systems of different voltages or types shall not enter the same conduit or junction box. The number of current carrying conductors and total number of conductors to be installed in conduits shall be as noted below.

1. Single phase 120V or 277V circuits: Limit three per raceway.
2. All other circuits: Dedicated raceway.
3. Deviation of installation as identified above requires prior written approval from Engineer.

L. Circuits shall be installed such that the continuity of the ground, neutral, and hot circuits shall not be interrupted by the removal of any device or fixture.
M. For the purposes of thermal derating calculations, neutrals shall be considered current carrying except for balanced three-phase linear loads.

N. Multiwire branch circuits are prohibited. All 120V and 277V circuits shall be provided a dedicated neutral conductor.

3.3 Field Quality Control:

A. Prior to energization of circuitry, check installed feeder wires and cables with megohmmeter to determine insulation resistance levels to ensure requirements are fulfilled. A list of feeders tested shall be submitted to the ENGINEER indicating the insulation resistance level for each cable. Owner shall be given the option to witness all tests.

B. Prior to energization, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. This Section is a general Division 26 materials and methods section, and applies to all other Division 26 sections involving materials and methods specified herein.

1.2 Description of Work:

A. Extent of raceway work is indicated by drawings and schedules.
B. Types of raceways specified in this section include the following:

1. Electrical metallic tubing (EMT)
2. Rigid metal conduit, galvanized (RMC)
3. Rigid nonmetallic conduit (RNC)
4. Liquid tight flexible metal conduit (LFMC)
5. Flexible metal conduit, steel only (FMC)

1.3 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. All products shall be the produce of reputable and reliable manufacturers.
B. The following manufacturers are recognized as being reputable and reliable:

1. Allied Tube & Conduit
2. Carlon
3. Cantex
4. Wiremold
5. Wheatland Tube

C. Additional manufacturers shall be considered reputable and reliable only if they verifiably satisfy the following requirements:

1. History: Acceptable manufacturers shall have a history of producing similar products at least the past ten years. Such products shall have been sold in the state of Florida for at least the past five years.
2. Volume: Acceptable manufacturers shall have produced and sold similar products in excess of one hundred (100) times annually the amount of product projected for used in this project. This requirement shall apply to each of the past ten years.
3. Similar projects: Acceptable manufacturers shall have sold similar products which have been used in at least five similar projects in the past five years. Similar projects must be of a similar use, overall cost, and overall size.

D. Documentation of the above manufacturer requirements shall be provided to Engineer upon request, but is otherwise unnecessary. If documentation is required, it shall consist of a signed statement from Manufacturer's representative on Manufacturer's letterhead (or the letterhead of Manufacturer's approved representative). Additional documentation may be required in rare cases.
E. Any submittal by Contractor shall be considered indication by Contractor that Contractor stands behind for the suitability of a manufacturer, and that the

manufacturer satisfies of the above requirements.

F. Contact Engineer prior to bid with any questions regarding acceptable manufacturers.

2.2 UL Listed Materials:

A. Provide raceway products and components which have been UL listed and labeled for the intended use.

B. Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems.

2.3 Products – Metal Conduit and Tubing:

A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thicknesses) for each indicated use.

B. Where types and grades are not indicated, provide proper selection determined by Contractor to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

C. Minimum size conduit shall be 1/2" or all systems.

D. Minimum size flexible conduit shall be 3/4” for all systems (3/8" for pre-assembled light fixture whips). Maximum length shall be 6 feet. Minimum length shall be 4 feet.

E. Cast zinc conduit fittings are prohibited. Any cast zinc fitting installed by this project shall be replaced at Contractor's expense.

F. All fittings shall be provided with insulated throats or plastic bushings prior to pulling wires or cables.

G. Electrical Metallic Tubing (EMT):

1. Conduit: Shall be mild steel, electrically welded, galvanized, and produced to ANSI Specification C80.3 and Federal Specification WW-C-563, latest revisions and shall be labeled with the Underwriter's Laboratories marking.
2. Fittings: Couplings and connectors for conduit shall be expansion gland compression type, steel, or malleable iron.

H. Rigid Steel Conduit:

1. Conduit: Shall be mild steel, manufactured, hot-dipped galvanized, and produced to ANSI specifications C80.1 and Federal Specification WW-C 581, latest revisions, and shall be labeled with the Underwriters' Laboratories marking.
2. Fittings: Cast malleable iron, galvanized, or cadmium plated.

   a. Use Type 1 fittings for rain-tight connections.
   b. Use Type 2 fittings for concrete tight connections.

I. Flexible Metal Conduit:

1. Conduit: UL 1. Formed from continuous length of spirally wound, interlocked zinc coated strip steel.
2. Fittings: Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type. Inside type fittings are not allowed.

   a. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
   b. 45° or 90° Terminal Angle Connectors: Two piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

J. Liquid Tight Flexible Metal Conduit:

1. Conduit: Provide liquid tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double wrapped steel; galvanized inside and outside; coat with liquid tight jacket of flexible polyvinyl chloride (PVC).
2. Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or noninsulated throat.

K. No ENT, corrugated flexible conduit, or MT cable shall be installed or reused.
L. No intermediate metal conduit (IMC) shall be installed.
M. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes, and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws. SLB type are not permitted.

2.4 Products – Nonmetallic Conduit and Ducts:

A. General: Provide nonmetallic conduit, ducts, and fittings of types, sizes, and weights for each indicated use. Where types and grades are not indicated, provide proper selection determined by Contractor to fulfill wiring requirements which comply with provisions of NEC and Specifications for raceways.
B. 90°C, UL rated, constructed of polyvinyl chloride. For direct burial, UL listed and in conformity with NEC Article 352.
C. Conduit and Tubing Accessories: Provide conduit, tubing, and accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

PART 3 - EXECUTION

3.1 Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Owner and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in acceptable manner.

3.2 Provide raceways for each installation location as follows:

A. Exterior above-grade locations: rigid galvanized steel
B. Damp and wet locations: rigid galvanized steel
C. Interior locations subject to physical abuse: rigid galvanized steel
D. Interior locations not subject to physical abuse: EMT.
E. Whips to light fixtures: 48" to 72" FMC or prefabricated whip.
F. Connections to any vibrating or mechanically active equipment: FMC.

1. Exception: Utilize LFMC in exterior locations, or where subject to moist or humid atmosphere, or where subject to water, oil, or grease exposure.

G. Connection to any equipment subject to movement: FMC

1. Exception: Utilize LFMC in exterior locations, or where subject to moist or humid atmosphere, or where subject to water, oil, or grease exposure.

H. FMC, LFMC shall not be used for any other applications without written consent from Engineer.

3.3 Raceway Size:

A. Sizes of raceways shall be not less than NEC requirements using THHN/THWN2 for

sizing and shall not in any case be less than indicated on the drawings.

B. Larger size raceways and/or pull boxes shall be installed if there is excessive length of unbroken run or excessive number of bends.

3.4 General Requirements:

A. Install conduits without damaging or penetrating structural members.
B. Metallic conduit in contact with concrete, grout, mortar, or other cementitious products such as grouted cells, headers, lintels, etc. shall be provided a bituminous coating before installation.
C. All conduit installed in walls and above ceilings shall be 100% complete and approved by inspectors before covering is installed. Such coverings include drywall, insulation, ceiling tiles, and any other material which obscures the installation.
D. Conduit installed above accessible ceilings shall be supported from the building structure and shall not be supported from or attached to the suspended ceiling suspension system.
E. Where feasible, avoid conduit runs within partitions and walls.
F. Mechanically assemble metal enclosures, and raceways for conductors to form a continuous conductive system.
G. Connect to electrical boxes, fittings, and cabinets to provide effective electrical continuity and rigid mechanical assembly.
H. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
I. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
J. Raceway penetrations of fire rated walls and/or floors shall be sealed to maintain the rating(s). All relevant materials and methods shall be per a UL detail satisfying NFPA rating requirements.
K. Provide UL listed firestops for penetrations through fire-rated assemblies.
L. Submit complete data on fire stopping materials and construction methods for review by Architect prior to proceeding with work.
M. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.
N. Use Manufacturer-provided dimensions to lay out all equipment electrical connections. Set conduit and boxes for connection to units only after receiving review of dimensions and coordinating with other trades.
O. Provide nylon pull cord in empty conduits.
P. Test all empty conduits with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
Q. Provide corrosion resistant engraved metal tags at each end of empty conduits designating destination. Place tags on wall or walk where conduit exits building.
R. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
S. Field bend conduit with benders designed for the purpose.
T. Any conduit with kinks, tears, or other material damage shall be replaced at Contractor's expense.
U. Conduits are not to cross utility shafts or duct openings.
V. Keep conduits a minimum distance of six inches (6") from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway

runs above water and steam piping.

W. Support riser conduit at each floor level with clamp hangers.
X. Use of running threads at conduit joints and terminations is prohibited.
Y. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
Z. Under no circumstances shall PVC or PVC-coated conduit be utilized within an air plenum. In particular, Contractor is to avoid LFMC within air handler plenums, etc.

3.5 Flexible Conduit:

A. Flexible conduit shall not pass through walls or ceilings. Provide a junction box at the point of transition.
B. Flexible conduit shall not be used within walls, except where written permission is given by Engineer and Owner.

3.6 Conduits Installed in Exterior, Wet, or Damp Locations:

A. Metallic raceways exterior, wet, or damp locations shall have conduit threads painted with cold galvanizing paint. Remove oil and clean prior to painting. Draw up coupling and conduit sufficiently tight to ensure water tightness.
B. All wall penetrations entering wet locations shall be sloped downward at least 1/2".

3.7 Special EMT Requirements:

A. EMT shall not be installed below 8" AFF.
B. EMT shall not be installed exposed below 72" AFF.
C. EMT shall be installed in dry and indoor locations only.

3.8 Conduits Above Grade:

A. Install exposed conduits and all conduit above grade and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls and building structure.
B. Install exposed conduit work as not to interfere with ceiling inserts, lights, or ventilation ducts or outlets.
C. Securing and Supporting:
    1. Secure conduits within three feet of fittings, boxes, etc., and on spacing not to exceed ten feet.
        a. Conduits may be supported in lieu of securing, where permitted by Code.
    2. Support conduits by use of hangers, clamps, or clips.
    3. Conduit shall not be supported from suspended ceiling supports or grid systems.
D. Limit penetrations of vapor- and water-barriers. Utilize curbs, etc. wherever possible. Seal any penetrations of vapor- and water-barriers with approved methods.
E. Conduit shall not be installed on roof tops or walkway covers.
F. Conduit penetrating concrete floors not within 12" of walls shall have couplings installed flush with top slab.
G. Flexible metal conduit shall not be installed in damp or wet locations, through walls, or used as a raceway in concealed or inaccessible areas. It shall be supported within 12" of connectors and at least once every 54".

3.9 General Conduit Fitting Requirements:

A. Grounding type bushings shall be installed on all feeder and subfeeder conduits entering panelboards, pull boxes, and transformers and all conduit entering oversized, concentric, and eccentric knock-outs.

B. Miscellaneous fittings such as reducers, chase nipples, 3 piece unions, split couplings, and plugs shall be designed and listed for the specific use.
C. Provide either plastic bushings or plastic insulating throats for all fittings prior to pulling wire.
D. Install insulated-type bushings for terminating conduits 1" and larger. Bushings are to have flared bottom and ribbed sides. Upper edge shall have phenolic insulating ring molded into bushing. Bushings shall be installed during rough-in and before installing conductors.
E. Snap-on bushings are prohibited.

3.10 Threaded Conduit Fitting Requirements:

A. Provided locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
B. Bushings for threaded conduits smaller than 1" shall have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Bushings shall be installed during rough-in and before pulling wire.
C. Bushing of standard or insulated type shall have screw type grounding terminal. Bushings shall be installed on all threaded conduit.

3.11 Identification:

A. Conduits shall be factory painted as follows:

1. Telecom: Blue
2. All others: unpainted, with color coded boxes and couplings per other sections.

END OF SECTION

PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. This Section is a general Division 26 materials and methods section, and applies to all other Division 26 sections involving materials and methods specified herein.

1.2 Description of Work:

A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.
B. Types of electrical boxes and fittings specified in this Section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Floor boxes.

1.3 Codes and Standards:

A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
B. UL Compliance: Comply with applicable requirements of UL 50, UL 514 Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.

1.4 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. All products shall be the produce of reputable and reliable manufacturers.
B. The following manufacturers are recognized as being reputable and reliable:

1. CDR
2. Hubbell-Raco
3. MacLean Highline
4. Republic Steel
5. Square D
6. Thomas & Betts
7. Quazite
8. Wiremold
9. Legrand

C. Additional manufacturers shall be considered reputable and reliable only if they verifiably satisfy the following requirements:

1. History: Acceptable manufacturers shall have a history of producing similar products at least the past ten years. Such products shall have been sold in the state of Florida for at least the past five years.
2. Volume: Acceptable manufacturers shall have produced and sold similar products in excess of one hundred (100) times annually the amount of product projected for used in this project. This requirement shall apply to each of the

past ten years.

3. Similar projects: Acceptable manufacturers shall have sold similar products which have been used in at least five similar projects in the past five years. Similar projects must be of a similar use, overall cost, and overall size.

D. Documentation of the above manufacturer requirements shall be provided to Engineer upon request, but is otherwise unnecessary. If documentation is required, it shall consist of a signed statement from Manufacturer's representative on Manufacturer's letterhead (or the letterhead of Manufacturer's approved representative). Additional documentation may be required in rare cases.

E. Any submittal by Contractor shall be considered indication by Contractor that Contractor stands behind for the suitability of a manufacturer, and that the manufacturer satisfies of the above requirements.

F. Contact Engineer prior to bid with any questions regarding acceptable manufacturers.

2.2 Products – Fabricated Materials:

A. Outlet Boxes:

1. Outlet wiring boxes shall be galvanized coated flat rolled sheet steel, of shapes, volumes, and dimensions as indicated, suitable for installation at respective locations.
2. Outlet boxes shall be constructed with mounting holes, and with cable and conduit size knockout openings in bottom and sides.
3. Minimum dimensions for device boxes, junction boxes, pull boxes, and other boxes in walls shall be four inch (4") square. Depth shall be

   a. as recommended by fire alarm device manufacturer,
   b. three and one-half inches (3-1/2”) for wiring devices using Lev-Lok connection technology,
   c. two and one-eight inches (2-1/8”) deep for IT (telecom, AV, access controls, etc),
   d. one and one-half inches (1-1/2”) for other locations.

4. Dimensions of ceiling boxes shall be a minimum four inch (4") square or octagonal. Depth shall be

   a. as recommended by fire alarm device manufacturer,
   b. three and one-half inches (3-1/2”) for wiring devices using Lev-Lok connection technology,
   c. three inches (3") for concrete work,
   d. two and one-eight inches (2-1/8”) deep for IT (telecom, AV, access controls, etc),
   e. one and one-half inch (1-1/2") deep for exposed work or furred ceiling work, and
   f. one and one-half inches (1-1/2”) for other locations.

5. Plaster rings and/or fixture studs shall be provided where required.
6. Flush-mounted boxes shall be provided with extension rings and/or covers with sufficient depth to bring the covers flush with the finished wall.
7. Outlet boxes for exposed wall mounting shall be cast metal type "FS" or "FD" boxes with suitable cast aluminum covers.
8. Outlet boxes shall be sound attenuated for back to back installations.
9. Exterior boxes:

a. All exterior boxes shall be appropriately listed or indicated for the use.
b. Boxes for exterior receptacles shall be provided with in-use weatherproof receptacle covers. Such covers shall have spring hinged lids.
c. Weatherproof covers shall meet code requirements for covers intended for use with attachment plugs.

10. Sectional or gangable boxes shall not be installed.
11. Through-wall boxes shall not be installed.
12. Box extensions or "goofings" shall not be installed.
13. "Handy" boxes, etc. shall not be permitted.

B. All pull boxes used outside and underground shall be pre-cast concrete polymer, with concrete polymer cover. Such boxes shall be of sufficient size to make all entrances and exits from box in one horizontal plane.
C. Junction and Pull Boxes: Provide galvanized code gauge sheet steel junction and pull boxes, with screw on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers.
D. Floor Boxes: Provide raintight adjustable floor boxes as indicated, with threaded conduit entrance ends, and vertical adjusting rings, gaskets, brass floor plates with flush screw on covers with ground flange and stainless steel cover screws. Carpet and tile plates to be brass.
E. Cover Plates:

1. All cover plates shall be abuse resistant nylon or stainless steel.

PART 3 - EXECUTION

3.1 General:

A. Install all electrical boxes and fittings as indicated, in accordance with manufacturer's instructions, applicable code, and recognized industry practices, to fulfill project requirements.
B. The location of any pull box shall be approved by Architect and Owner before installation, unless said pull box is installed in an accessible above-ceiling space, or a dedicated mechanical or electrical room.
C. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
D. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
F. All outlet and device boxes shall be independently supported from structure.
G. Install electrical boxes only in accessible locations.
H. Orient all boxes for ease of accessibility. Install overhead boxes cover-down unless otherwise directed.
I. Coordinate all boxes with other trades.

1. Any box without a minimum 6" front clearance will be adjusted or reinstalled at Contractor's expense.
2. Any box installed such that access is effectively blocked by other trades shall be adjusted or reinstalled at Contractor's expense.

J. Secure electrical boxes firmly and rigidly to structure, or solidly embed electrical boxes in concrete or masonry.

K. Protect installed boxes from construction debris and damage.
L. All outside, above grade pull boxes shall be galvanized.
M. All flush mounted boxes, regardless of system or voltage, shall be installed flush within 1/8" of wall finish or finished face of tackboards, sound boards, cabinets, etc. Box extension or goof rings shall not be installed.
N. Boxes shall not be installed back-to-back.
O. Boxes within the same stud cavity shall be separated by a minimum of 12".
P. Boxes for flush mounting in concrete block:

1. Boxes for flush mounting in concrete block shall be provided covers with square corners on the raised portion of the cover.
2. Such covers shall be of sufficient depth to be flush with the face of the block.
3. The bottom side of the covers or boxes shall be installed at the masonry course nearest to the dimension specified or noted, but not more than applicable code.
4. Boxes installed in block walls shall be secured in place with mortar.
5. Boxes shall be flush with any combustible surface including black splash, tack board or sound board.

Q. Exterior Boxes:

1. Unless otherwise noted, exterior boxes on walls shall be installed flush with wall. Coordinate with masonry as required.
2. Provide suitable installation for each application, including face plate gaskets and corrosion resistant plugs and fasteners.

3.2 Boxes in Rated Partitions:

A. Maintain all fire and heat ratings by installing boxes in rated partitions according to a UL detail for an acceptable product. No UL rating detail shall be used prior to approval by Architect.
B. All boxes installed in rated walls shall be rigidly secured to structure.
C. All voids between boxes and surrounding wall surfaces shall be completely filled with an approved material.

3.3 Outlet Boxes:

A. Position recessed outlet boxes accurately to allow for surface finish thickness.
B. Set floor boxes level and flush with finish flooring material.
C. Outlet Box Accessories: Provide compatible outlet box accessories as required for installation, including:

1. box supports,
2. bonding accessories,
3. mounting ears and brackets,
4. wallboard hangers,
5. box extension rings,
6. fixture studs,
7. cable clamps, and
8. metal straps for supporting outlet boxes.

D. Rigidly support all outlet boxes from both sides, or from back, such that box cannot move or deflect into the wall when devices are installed or modified.

3.4 Identification:

A. Box lids and conduit couplings shall be color coded as follows:

1. 120/208V Wye: Black, with hand written white labels.
2. 277/480V Wye: Brown
3. NEC 700 Emergency:
    a. Couplings: Yellow.
    b. 120/208V Wye Box Covers: Yellow with Black Stripe
    c. 277/480V Wye Box Covers: Yellow with Brown Stripe
4. NEC 702 Optional standby:
    a. Couplings: Orange.
    b. 120/208V Wye Box Covers: Orange with Black Stripe
    c. 277/480V Wye Box Covers: Orange with Brown Stripe
5. Fire Alarm: Red
6. Telecom: Blue
7. All others: Paint a unique color.
8. Exception: Coordinate color coding requirements with Architect and Owner where boxes are visible in public spaces.

B. Covers of all junction boxes, pull boxes, etc. shall be marked by circuit number using indelible ink, 3/4" minimum height. Locate marker so it can be readily identified without removal of the cover plate.

1. Exception: Where box covers are visible in public spaces, marker label shall be on the inside of the box cover.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. This Section is a Division 26 Basic Electrical Materials and Methods section, and is part of each Division 26 section making reference to wiring devices specified herein.

1.2 Description of Work:

A. Extent of electrical identification work is indicated by drawings, schedules, and other specification sections.
B. Types of electrical identification work specified in this Section include the following:
   1. Equipment/System identification signs.
C. See other specification sections for additional identification requirements for specific equipment and system components. Where electrical system signage is called for elsewhere in the Contract Documents, but not described in detail, provide signage per the requirements of this section.

1.3 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data.

PART 2 - PRODUCTS

2.1 Electrical Identification Materials:

A. Engraved Plastic Laminate Signs:
   1. Provide engraving stock melamine plastic laminate, in sizes and thicknesses indicated.
   2. Engrave with engraver's standard letter style, of sizes and wording indicated.
   3. Default color shall be white face with black core plies, resulting in black letters on a field of white. Provide alternative colors as indicated on plans or in other specification sections.
   4. Signs for Fire Alarm warning systems shall be red face and white core plies, resulting in white letters on a field of red.
   5. Thickness: Minimum one-sixteenth inch (1/16"), except as otherwise indicated.
   6. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.2 Lettering and Graphics:

A. General: Coordinate names, abbreviations, and other designations used in electrical identification work with corresponding designations shown, specified or scheduled.
B. Provide numbers, lettering, and wording as indicated, or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.

PART 3 - EXECUTION

3.1 Application and Installation:

A. General Installation Requirements:
   1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.

2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Equipment/System Identification:

1. Provide engraved plastic laminate signs with text matching terminology and numbering of the contract documents. Provide signs for each unit of the following categories of electrical work:

   a. Disconnect enclosures,
   b. Starters,
   c. Time clocks,
   d. Contactors,
   e. Access panels/doors to electrical facilities,
   f. Terminal cabinets,
   g. Any other enclosure housing active components.

2. Unless otherwise noted, install signs and labels to maximize visibility and readability without interference with operation and maintenance of equipment.
3. All power junction box covers shall be marked with panel name and circuit numbers. All other (Fire Alarm, intercom, etc.) junction box covers shall be marked according to system type. These markings shall be made with a permanent type marker.
4. Panel schedules shall be typed, and shall indicate room numbers and load information.
5. Above ceiling identification: to electrical equipment installed above finished ceiling, identification shall be placed:

   a. on access panel,
   b. next to access panel, or
   c. on to a permanent part of the ceiling system, such as a tee-bar of a lay-in type ceiling.

6. Secure all labels and signs to substrate with approved fasteners, unless fasteners would violate listings or create an unsafe condition. Where fasteners cannot be used, utilize approved permanent adhesive means of attachment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Documents:

A. Conform to Division 1 and other sections of this division.
B. This Section is a general Division 26 materials and methods section, and applies to all other Division 26 sections involving materials and methods specified herein.

1.2 Description of Work:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.
B. Types of electrical wiring devices in this Section include the following:

1. Switches
2. Wall Plates

1.3 Codes and Standards:

A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.
B. UL Compliance: Comply with applicable requirements of UL 20, 486A, 498, and 943 pertaining to installation of wiring devices. Provide wiring devices which are UL listed and UL-labeled.

1.4 Submittals:

A. Submit in accordance with General, Supplementary, and Special Conditions.
B. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. Manufacturers: Subject to compliance with requirements, manufacturers providing wiring devices which may be incorporated in the work include, but are not limited to, the following (for each type and rating of wiring device):

1. Hubbell, Inc.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour, Inc.

2.2 Fabricated Wiring Devices:

A. General: Provide factory fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Stds. Pub/No. WD.

1. Normal Power: Provide white color devices except as otherwise indicated.

B. Switches:

1. Snap: Provide toggle switches, rated 20 amps at 120/277 volts, quiet type, UL I without derating for tungsten lamp loads or inductive loads. The following catalog numbers are Leviton. "Slim" series (e.g. 1221S) are forbidden.

Type	**Catalog No.**
Single Pole	1221

2. Tamperproof type switches shall be rated 20 Amperes at 120/277.

PART 3 - EXECUTION

3.1 Installation of Wiring Devices:

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
B. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
C. Install wiring devices after wiring work is completed and inspected.
D. Install wall plates after painting work is completed.
E. Rear wire all wiring device connections. Side terminations are forbidden.
F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B. Use properly scaled torque indicating hand tool.
G. Wiring devices shall have pig-tail connection. Feed-thru wiring is not allowed.

3.2 Protection of Wallplates and Receptacles:

A. At time of substantial completion, replace any wall plates and/or receptacles which have been damaged during construction, including those burned and scored by faulty plugs.

3.3 Grounding:

A. Provide equipment grounding connections for all wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds. Grounding conductor shall be bonded to all boxes with a separate screw. Screws used to support boxes are not to be used for grounding. Bonding screws shall be installed in box during rough-in installation. Bonding screws shall be green hexagonal type.

3.4 Identification:

A. Switches: Each light switch shall be marked by circuit number using a numbered vinyl cloth adhesive marker, 1/4" minimum height. Locate marker behind cover plate so it can be readily identified by removal of the cover plate. Thomas and Betts E-Z Code Markers are acceptable.
B. Provide label on coverplate according to UF Standards.

END OF SECTION

PART 1 - GENERAL

1.1 Summary:

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for safety switches as required for the complete performance of the work, and as shown on the drawings and as herein specified.

B. Section Includes: the work specified in this section includes, but shall not be limited to, the following:

1. Switches shall be furnished and installed at locations as shown on the drawings. Switches shall be of the type approved, indicated, and specified herein.

1.2 Submittals:

A. General: See submittal procedures in Division 1.

B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the drawings and specifications. Clearly indicate all variations and options proposed for installation.

C. Shop Drawings: Submit scaled shop drawings depicting the intended installation location for each safety switch, relevant clearance requirements, and all other equipment intended for installation nearby. Indicate all relevant dimensions, and document that installation is feasible as proposed.

D. Include safety switches in dimensioned electrical room shop drawings.

1.3 Operation and Maintenance:

A. Operation and Maintenance Data: Prior to substantial completion, submit operation and maintenance data for safety switches. Submit as indicated in Section 26 00 00 and Division 1.

1.4 Quality Assurance:

A. Qualifications:

1. Manufacturer qualifications: Manufacturer shall be a firm engaged in the manufacture of safety switches of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.
2. Installer qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing safety switches similar in type and scope to that required for this project and shall be approved by the manufacturer.
3. Documentation of qualifications, examples of past projects, and references, shall be provided to owner and/or engineer upon request, but are not required as part of the standard submittal procedure.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of federal, state, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

1. Without limiting the generality of other requirements of this section, all work specified herein shall conform to or exceed the applicable requirements of the following standards; provided, that wherever the provisions of said publications are in conflict with the requirements specified herein, the more stringent requirements shall apply:

a. Switches shall be manufactured in accordance with the following standards:

1. UL 98 - enclosed and dead front switches
2. NEMA KS 1 - enclosed switches
3. NEMA 250 - enclosures for electrical equipment

1.5 Delivery, Storage, and Handling:

A. Deliver materials to the project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
B. Store materials in their original, undamaged packages and containers, inside a well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 Warranty:

A. General: See closeout procedures in Division 1.
B. Special Warranty: Submit a written warranty executed by the manufacturer, the installer, and the contractor, agreeing to repair or replace safety switches that fail in materials or workmanship within the specified warranty period.

1. Warranty period: Warranty period shall be one year from the date of substantial completion.

1.7 Operation and Maintenance:

A. Operation and Maintenance Data: Prior to substantial completion, submit operation and maintenance data for light fixtures. Submit as indicated in Section 26 00 00 and Division 1.

PART 2 - PRODUCTS

2.1 Manufacturers:

A. Approved Manufacturers: All safety switch products shall be the produce of one of the following:

1. Square D (Schneider Electric)
2. Bussmann (Eaton)
3. General Electric
4. Siemens

B. Basis of Design:

1. Items specified are to establish a standard of quality for design, function, materials, and appearance.
2. Equivalent products by other manufacturers are acceptable.
3. The design professional will be the sole judge of the basis of what is equivalent.
4. Any adjustments required to meet equivalency requirements shall be at contractor's expense.
5. See drawings for additional basis of design information.

2.2 Materials and Components:

A. General:

1. Minimum voltage rating shall be for the voltage indicated and scheduled on the drawings.

2. Minimum horsepower ratings shall be as indicated and scheduled on the drawings.
3. Minimum per-phase continuous current ratings shall be as indicated and scheduled on the drawings.
4. Fuses shall be provided as indicated on the drawings. Fuse clip current rating shall match equipment rating. Fuse current ratings shall be as indicated and scheduled on the drawings.
5. Minimum neutral continuous current ratings shall be as indicated and scheduled on the drawings.
6. Minimum short circuit current rating shall be as indicated and scheduled on the drawings, in RMS symmetrical amperes at the AC voltage indicated for the safety switch.
7. Enclosure NEMA rating shall be as indicated and scheduled on the drawings.
8. Safety switches shall be suitable for use as service equipment when application requirements comply with UL 67 and NEC articles 230.

B. Switch Interior:

1. All switches shall have switch blades which are visible when the switch is off and the cover is open.
2. Lugs shall be front removable and UL listed for 75°C conductors.
3. Switches required for type 12, 12K or type 4-4X-5 stainless steel applications shall have all copper current carrying parts.
4. All current carrying parts shall be plated to resist corrosion.
5. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
6. Switches shall have provisions for a field installable electrical interlock.

C. Grounding:

1. A solidly bonded copper equipment ground bar shall be provided.

D. Identification:

1. Nameplates shall contain product information and catalog number or factory order number. UL-listed label, and short circuit current rating shall be displayed on the interior.

E. Switch Mechanism:

1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
2. The operating handle shall be an integral part of the box, not the cover.
3. Provisions for padlocking the switch in the off position with a padlock shall be provided.
4. The handle position shall travel at least 90° between off and on positions to clearly distinguish and indicate handle position.
5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is on and prevent turning the switch on when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

F. Switch Enclosure:

1. General:

a. All switches shall have provisions to accept up to three 3/8 in hasp padlocks to lock the operating handle in the off position.
b. The enclosure shall have on and off markings stamped into the cover.
c. The operating handle shall be provided with a dual colored, red/black position indication.

2. Type 1:

a. Type 1 switch covers shall be attached with welded pin-type hinges.
b. Type 1 enclosures shall be finished with grey baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
c. Type 1 enclosures for switches rated 30-200A shall be provided with tangential knockouts to facilitate ease of conduit entry.

3. Type 3R:

a. NEMA 3R switch covers shall be top hinged, attached with removable screws and securable in the open position (type 3R).
b. Type 3R enclosures shall be finished with grey baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel.
c. Type 3R enclosures for switches rated 30-200A shall be provided with tangential knockouts to facilitate ease of conduit entry.
d. Type 3R enclosures through 200 ampere shall have provisions for interchangeable bolt-on hubs in the top endwall.

4. Type 4X:

a. Type 4X switch covers shall be attached with welded pin-type hinges.
b. Type 4X enclosures shall be finished with a brush finish on type 304 stainless steel.
c. Type 4X stainless steel enclosure shall contain no knockouts. Supply watertight hubs as indicated on the plans.
d. Type 4X cover sealing means for switches rated through 200 amperes shall be quick release trunk latches.
e. Type 4X stainless steel enclosures shall be dual rated as type 3R to facilitate their use in outdoor applications.

PART 3 - EXECUTION

3.1 Examination:

A. Verification of Conditions: examine areas and conditions under which the work is to be installed, and notify the contractor in writing, with a copy to the owner and the architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the installer.

3.2 Installation:

A. General: install safety switches and accessories in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the drawings.

1. Install safety switches in accordance with manufacturer's written instructions, NEMA PB 1.1, and NEC standards.
2. Install and configure software in accordance with manufacturer's written instructions.

3.3 Field Quality Control:

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
B. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.4 Demonstration:

A. Provide start-up service and train the owner's personnel.

1. Train the owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Review data in operation and maintenance manuals with the owner's personnel.
3. Schedule training with the owner, through the architect, with at least seven day's advanced notice.
4. Provide at least one hour of training for equipment covered by this section.

3.5 Protection:

A. Provide final protection and maintain conditions in a manner acceptable to the installer, that shall ensure that the safety switches shall be without damage at time of substantial completion.

END OF SECTION

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PART 1 - GENERAL

1.1 Summary:

A. This Section specifies the lightning protection system for the building(s) or structure(s). This system provides safety for the building and occupants by preventing damage to the structure caused by lightning. The design of this system is to be in strict accordance with this section of the specification and all contract drawings that apply.
B. The work covered under this section of the specifications consists of furnishing labor, materials and services required for the completion of a functional and unobtrusive lightning protection system approved by the architect and engineer.
C. The lightning protection system shall be installed by a firm actively engaged in the installation of Underwriters Laboratories Inc. (UL) Master Labeled Lightning Protection Systems and shall be so listed by Underwriters Laboratories Inc. The completed system shall comply with the latest editions of Underwriters Laboratories Inc. "Installation Requirements for Lightning Protection Systems, UL96A" and of the National Fire Protection Association's "NFPA® 780, Standard for the Installation of Lightning Protection Systems".

1.2 System Description:

A. The entire lightning protection system shall be designed and installed in accordance with:

1. National Fire Protection Assoc. (NFPA) Document # 780
2. Underwriters' Laboratories, Inc. (UL) Standard # 96A

1.3 Submittals:

A. A complete shop drawing shall be submitted to the architect and engineer for approval prior to commencement of the installation. The shop drawing will show the extent of the system layout designed for the structure along with details of the products to be used in the installation.

1.4 Quality Assurance:

A. The lightning protection system shall be installed by or under the supervision of a UL listed lightning protection installer.
B. The installers shall have completed factory training and be so certified by the manufacturer.

PART 2 - PRODUCTS

2.1 Standard:

A. All materials used in the installation shall be new and shall comply in weight, size, and composition as required by UL 96A and NFPA® 780 and shall be labeled or listed by Underwriters Laboratories, Inc. for use in lightning protection systems. The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment. The manufacturer shall be listed by UL as a manufacturer of lightning protection components.

2.2 Acceptable Manufacturers:

A. Advanced Lightning Technology, Ltd.
B. East Coast Lightning Equipment, Inc.
C. ERICO, Inc.

D. Harger, Inc.
E. Heary Brothers Lightning Protection Co., Inc.
F. Independent Protection Company, Inc.
G. Preferred Lightning Protection
H. Robbins Lightning, Inc.
I. Thompson Lightning Protection, Inc.

2.3 Materials:

A. Class I materials shall be used for systems on structures not exceeding 75 feet in height and Class II materials shall be used for systems on structures exceeding 75 feet above grade.
B. Copper shall be of the grade ordinarily required for commercial electrical work, generally designated as being 95 percent conductive when annealed. Aluminum conductors shall be of electrical grade aluminum.
C. Air terminals shall project a minimum of 10 inches above protected areas or objects. Air terminals shall be located within 2 feet of exposed corners and roof edges.
D. Metallic bodies having a thickness 3/16" or greater may serve as strike termination devices without the addition of air terminals. These bodies shall be made a part of the lightning protection system by connection(s) according to the Standards using main size conductors and bonding fittings with 3 square inches of surface contact area.
E. Cable conductors shall provide a two-way path from strike termination devices horizontally and downward to connections with the ground system. Cable conductors shall be free of excessive splices and sharp bends. No bend of a conductor shall form a final included angle of less than 90° nor have a radius of bend less than 8 inches. Structural elements and design features shall be used whenever possible to minimize the visual impact of exposed conductors.
F. Cable down conductors may be concealed within the building construction or enclosed within PVC conduit from roof to grade level. Down conductors shall be spaced at intervals averaging not more than 100 feet around the protected perimeter of the structure. In no case shall any structure have fewer than two down conductors. Where down conductors are exposed to environmental hazards at grade level, guards shall be used to protect the conductor to a point 6 feet above grade.
G. In the case of structural steel frame construction, cable down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals averaging not more than 100 feet around the protected perimeter of the structure.
H. Exposed cable conductors shall be secured to the structure at intervals not exceeding 3 feet – 0 inches. Fasteners, nails, screws, or bolts shall be of suitable configuration for the intended application and of the same material as the conductor or of electrolytically compatible materials. Galvanized or plated steels are not acceptable.
I. Connectors and splicers shall be of suitable configuration and type for the intended application and of the same material as the conductors or of electrolytically compatible materials.
J. Ground terminations are existing to remain.
K. Common interconnection of all grounded systems within the building is existing to remain.
L. Surge suppression is existing to remain.

PART 3 - EXECUTION

3.1 Standard:

A. The installation of the lightning protection system shall be done in a neat and workmanlike manner.
B. The lightning protection system shall be installed by or under the supervision of a UL listed lightning protection installer.
C. The installers shall have completed factory training and be so certified by the manufacturer.
D. Install the lightning protection system in accordance with the approved coordinated shop drawing and the referenced lightning protection system installation standards. Any deviations shall be brought to the immediate attention of the manufacturer so as not to delay certification.

3.2 Coordination:

A. Coordinate the installation of the lightning protection system with other trades.
B. Coordinate all roof penetrations, fasteners, and adhesive with the roofing contractor prior to installing any materials on the roof.

3.3 Inspection, Certification, and Maintenance:

A. Existing Structure with Existing Lightning Protection: The contractor shall certify that the system installed complies with the requirements of the Standards, and advise the owner of any additional work required on the existing system to bring it into compliance with current Standards and qualify for UL Master Label.
B. If the scope of the lightning protection system is limited by contractual or other reasons, the installer may limit the scope of the UL inspection. In those cases where the entire system is not inspected, a Master Label® Certificate of Inspection will not be issued by UL. They will issue a Letter of Findings of their inspection indicating compliance with the limited scope of the inspection.
C. At project closeout, the contractor shall provide the owner with accurate as-built drawings as well as recommended guidelines for maintenance of the system.

END OF SECTION

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PART 1 - GENERAL

1.1 The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the electronic safety and security work as herein called for and shown on the drawings.

1.2 Related Documents:

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

B. This is a Basic Requirements Section. Provisions of this section apply to work of all Division 28 sections.

C. Review all other contract documents to be aware of conditions affecting work herein.

D. Definitions:

1. Provide: Furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for subsequent requirements.
3. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be construed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.

B. Verify all field dimensions and locations of equipment to ensure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.

C. Coordinate work in this division with all other trades in proper sequence to ensure that the total work is completed within contract time schedule and with a minimum cutting and patching.

D. Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on electronic safety and security drawings, be guided by architectural details and

conditions existing at job and coordinate this work with that of others.

E. Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval.

F. Carefully examine any existing conditions, wiring, devices, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

G. Because of the small scale of the drawings, it is not possible to indicate all precise locations for all devices and equipment. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate devices, equipment, and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or raceway cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

A. The Contractor shall guarantee labor, materials, and equipment for a period of one (1) year from Substantial Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

B. Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

A. When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1. Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

a. Submittals shall be properly organized in accordance with the approved submittal control log.

b. Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

c. Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

d. Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

e. Submittals that include a series of fixtures or devices (such as control panels, initiating devices, or notification appliances) shall be organized by the device name or type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether those items are used on other fixtures.

f. The electronic safety and security design shown on the drawings supports the equipment basis of design specifications at the time of design. If equipment by any division is submitted with different electronic safety and security requirements, it is the responsibility of the submitting contractor to resolve all required electronic safety and security design changes (wire and conduit size, point(s) of connection, etc.) and clearly show the proposed electronic safety and security configuration in the relevant submittal with a written statement that this change will be provided at no additional cost. Submittals made with no written reference to the electronic safety and security design will be presumed to work with the electronic safety and security design. Any corrections required will be at no additional cost.

B. If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

C. Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

D. Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than 1/4" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications, and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports, and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final "Approved" or "Approved as Noted" copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein. Submit manuals at the Substantial Completion inspection.

PART 2 - PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them

at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

A. All equipment and materials shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

B. Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated, or painted.

C. The label of the approving agency, such as UL, by which a standard has been established for the particular item, shall be in full view.

D. The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

E. A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

F. Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

G. Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material, and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

H. Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.3 Requests for Substitution:

A. Where a particular system, product, or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product, or material specified.

B. Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

1. Required product cannot be supplied in time for compliance with Contract time requirements.
2. Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.
3. Substantial cost advantage is offered to Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation, and other necessary services and similar

considerations.

C. All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

1. Principal of operation.
2. Materials of construction or finishes.
3. Thickness of gauge of materials.
4. Weight of item.
5. Deleted features or items.
6. Added features or items.
7. Changes in other work caused by the substitution.
8. Electronic safety and security ratings and properties.
9. If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

PART 3 - EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any installation which is not orderly and reasonably neat, or does not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

A. The Contractor shall be responsible for complete coordination of the electronic safety and security systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for raceway or other appurtenances passing through slabs or walls.
B. Any additional steel supports required for the installation of any electronic safety and security equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.
C. It shall be the Contractor's responsibility to see that all equipment such as terminal cabinets, fire alarm components, control panels, and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.
D. All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.
E. The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.
F. Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.
G. Start of work will be construed as acceptance of suitability of work of others.

3.3 Interruption of Service: Before any equipment is shut down for disconnecting or tie-

ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.4 Phasing: Provide all required temporary wiring, lighting, fire alarm, equipment, and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.5 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.6 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts, and washers. Level equipment.

3.7 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 26. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.8 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.9 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 Record Drawings:

A. During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

B. Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.11 Acceptance:

A. Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

B. Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

C. Operation and Maintenance Manuals: Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

1. Detailed operating instructions and instructions for making minor adjustments.
2. Complete wiring, control, and single line diagrams.
3. Routine maintenance operations.

4. Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
5. Copies of approved submittals.
6. Copies of all manufacturer's warranties.
7. Copies of test reports and verification submittals.

D. Record Drawings: Submit record drawings.
E. Acceptance will be granted on the basis of tests and inspections of job. A representative of firm that performed test and balance work shall be in attendance to assist. Contractor shall furnish necessary mechanics to operate system, make any necessary adjustments and assist with final inspection.
F. Control Diagrams: Frame under clear plastic and mount on equipment room wall.
G. Single Line Diagrams: Frame under clear plastic and mount on equipment room wall.

PROJECT NAME

PROJECT NUMBER

ARCHITECT: Company Name

ENGINEER: Mitchell Gulledge Engineering

CONTRACTOR: Contractor Name

SAMPLE

SUBCONTRACTOR: Sub Name

SUPPLIER: Supply Company

MANUFACTURER: Manufacturer

DATE: mm/dd/yyyy

SECTION: 26 XX XX/Section Name

Any standard heading is acceptable.

1. Product 1: Manufacturer, Model
2. Product 2: Manufacturer, Model
3. Product 3: Manufacturer, Model
4. Product 4: Manufacturer, Model
5. Product 5: Manufacturer, Model

List each product individually. Include manufacturer name and model.

Include GC or CM Approval stamp indicating review and acceptance by responsible contractor.

END OF SECTION

PART 1 - GENERAL

1.1 The work covered by this division consists of providing all labor, equipment, and materials and performing all operations necessary for the installation of the fire protection work as herein called for and shown on the drawings.

1.2 This is a Basic Electronic Safety and Security Requirements section. Provisions of this section apply to work of all Division 28 sections.

PART 2 - CODES

2.1 All work under Division 28 shall be constructed in accordance with the codes listed herein. The design has been based on the requirements of these codes; and while it is not the responsibility of the Contractor to verify that all work called for complies with these codes, he shall be responsible for calling to the Architect/Engineer's attention any drawings or specifications that are not in conformance with these or other codes prior to ordering equipment or installing work.

2.2 Comply with regulations and codes of utility suppliers.

2.3 Where no specific method or form of construction is called for in the contract documents, the Contractor shall comply with code requirements when carrying out such work.

2.4 Where code conflict exists, generally the most restrictive requirement applies. Comply with current code edition, unless noted.

2.5 Additional codes or standards applying to a specific part of the work may be included in that section.

2.6 The following codes and standards shall govern all work:

A. Florida Building Code – Sixth Edition (2017)
B. Florida Building Code – Sixth Edition (2017) – Existing Building
C. Florida Building Code – Sixth Edition (2017) – Mechanical
D. Florida Building Code – Sixth Edition (2017) – Plumbing
E. Florida Building Code – Sixth Edition (2017) – Fuel Gas
F. Florida Building Code – Sixth Edition (2017) – Accessibility
G. Florida Fire Prevention Code Sixth Edition

1. Fire Code (NFPA 1 – 2015 Edition)
2. Life Safety Code (NFPA 101 – 2015 Edition)

H. National Electric Code (NFPA 70 – 2014)
I. Fire Alarm and Signaling Code (NFPA 72 – 2013)

PART 3 - STANDARDS

All materials, installation and systems shall meet the requirements of the following standards, including the latest addenda and amendments, to the extent referenced:

3.1 Underwriters' Laboratories (UL)
3.2 American National Standards Institution (ANSI)
3.3 American Society of Testing Materials (ASTM)
3.4 National Fire Protection Association (NFPA)
3.5 National Electrical Manufacturers Association (NEMA)
3.6 Institute of Electrical and Electronics Engineers (IEEE)
3.7 Telecommunications Industry Association (TIA)
3.8 Electronics Industry Alliance (EIA)

END OF SECTION

PART 1 - DIVISION 1 - GENERAL REQUIREMENTS

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

1.2 This is a Basic Electronic safety and security Requirements section. Provisions of this section apply to work of all Division 28 sections.

1.3 Coordinate with the General Contractor for all cutting and patching. Contractors performing Division 28 work shall inform the General Contractor of all cutting and patching required prior to bidding and shall coordinate installation.

PART 2 - DIVISION 3 - CONCRETE

2.1 Refer to Division 3, Concrete for:

A. Rough grouting in and around ESS work.
B. Patching concrete cut to accommodate ESS work.

PART 3 - DIVISION 4 - MASONRY

3.1 Refer to Division 4, Masonry for:

A. Installation of access doors in walls.

PART 4 - DIVISION 5 - METALS

4.1 Refer to Division 5, Metals for:

A. Framing openings for ESS equipment.

4.2 The following is part of Division 28 work:

A. Supports for ESS work.

PART 5 - DIVISION 6 - WOOD AND PLASTIC

5.1 Refer to Division 6, Wood for:

A. Framing openings for ESS equipment.

PART 6 - DIVISION 7 - THERMAL AND MOISTURE PROTECTION

6.1 Refer to Division 7, Thermal and Moisture Protection for:

A. Installation of all roof curbs and roof supports for ESS work.
B. Caulking and waterproofing of all wall and roof mounted ESS work.
C. Providing all roof curbs and all flashing for metal roofs.

6.2 The following is part of Division 28 work, complying with the requirements of Division 7.

A. Fire barrier penetration seals.

PART 7 - DIVISION 9 - FINISHES

7.1 Refer to Division 9, Finishes for:

A. Painting piping, and equipment.
B. Painting structural metal and concrete for ESS work.
C. Painting access panels.
D. Painting color-coded ESS work indicated for continuous painting. See color schedule in Division 28 section, "Electronic safety and security Identification".

E. Installation of access doors in gypsum drywall.

7.2 Colors shall be selected by the Architect for all painting of exposed ESS work in occupied spaces, unless specified herein. Do not paint insulated or jacketed surfaces.

7.3 Perform the following as part of Division 28 work:

A. Touch up painting of factory finishes.
B. Painting of all hangers.

PART 8 - DIVISION 10 - SPECIALTIES

8.1 Refer to Division 10 - Specialties for:

A. Fire extinguishers and fire extinguisher cabinets and accessories.

PART 9 - DIVISION 11 - EQUIPMENT

9.1 Refer to Division 11 - Equipment for all food service equipment to be provided. This includes the cooking hoods with fire suppression.

9.2 Refer to Division 11 - Equipment for all laboratory equipment including cabinets, casework, student stations, demonstration desks, fume hoods, snorkel exhausts, canopy hoods, safety stations, eyewashes, and all related fixtures, fittings, and trim.

PART 10 - DIVISION 23 - HVAC

10.1 Mechanical and Electronic safety and security Contractors shall coordinate the exact ESS requirements of all mechanical equipment being provided. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The ESS design shown on the drawings supports the mechanical equipment basis of design. If mechanical equipment is submitted with different ESS requirements, it is the responsibility of the mechanical contractor to resolve all required ESS design changes (e.g. input/output voltage) and clearly show the new ESS design on the mechanical submittal with a written statement that this design will be provided at no additional cost. Mechanical submittals made with no written reference to the ESS design will be presumed to work with the ESS design. Any corrections required will be at no additional cost to the Owner.

10.2 Mechanical contractor shall provide all HVAC control wiring including the Energy Management Control system sensors, alarms, and input/output signals and all relays, interlocks, warning lights, and control devices, complying with the requirements of Division 28. The intent is for the mechanical contractor to be responsible for the entire HVAC control system, including point-to-point wiring, and associated raceway and boxes. Electronic safety and security contractor shall notify mechanical contractor upon discovery of any mechanical controls installation which does not meet Division 28 requirements.

10.3 Electronic safety and security contractor shall provide fire alarm modules, detectors, and other appurtenances for mechanical equipment unless specifically noted as being furnished as part of mechanical equipment.

10.4 Electronic safety and security contractor shall provide all fire alarm wiring, raceway and devices, and make final ESS connections to all mechanical equipment, detectors, modules, contacts, controllers, and similar equipment.

10.5 All duct-mounted smoke detectors shall be furnished and wired by the ESS contractor and installed by the mechanical contractor.

PART 11 - DIVISION 26 - ELECTRICAL

11.1 Electrical and ESS Contractors shall coordinate the exact electrical requirements of all ESS equipment being provided. Where approval submittals are required, this coordination shall be accomplished prior to making the submittals. The electrical design shown on the drawings supports the ESS equipment basis of design. If ESS equipment is submitted with different electrical requirements, it is the responsibility of the ESS contractor to resolve all required electrical design changes (e.g. input/output voltage) and clearly show the new electrical design on the ESS submittal with a written statement that this design will be provided at no additional cost. Electrical submittals made with no written reference to the ESS design will be presumed to work with the electrical design. Any corrections required will be at no additional cost to the Owner.

11.2 ESS contractor shall provide ESS modules, detectors, and other appurtenances unless specifically noted as being furnished as part of electrical equipment.

11.3 ESS contractor shall provide all ESS wiring, raceway and devices, and make final ESS connections to all electrical equipment, detectors, modules, contacts, controllers, and similar equipment.

END OF SECTION

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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.
B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following divisions apply:
   1. Division 23 – HVAC
   2. Division 26 – Electrical
C. The system and all associated operations shall be in accordance with the following:
   1. Florida Building Code, 6th Edition (2017)
   2. Florida Fire Prevention Code, 6th Edition (2017)
      a. 2015 NFPA 1, Florida Edition.
      b. 2015 NFPA 101, Florida Edition.
   3. 2013 NFPA 72, National Fire Alarm Code
   4. 2014 NFPA 70, National Electrical Code
   5. 2015 NFPA 90A
   6. 2007 ASME A17.1, Safety Code for Elevators and Escalators
   7. 2008 ASME A17.3, Safety Code for Existing Elevators and Escalators
   8. 2009 ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities
   9. Local jurisdictional adopted codes and standards
   10. ADA Accessibility Guidelines

1.2 Summary:

A. This section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
C. The fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions:
   1. Fire alarm system detection and notification operations.
   2. Control and monitoring of
      a. equipment as indicated in the drawings and specifications.

1.3 Definitions:

A. ADA: Americans with Disabilities Act
B. AHJ: Authority Having Jurisdiction
C. ANSI: American National Standards Institute
D. ASME: American Society of Mechanical Engineers
E. FACP: Fire Alarm Control Panel
F. FM: Factory Mutual
G. IBC: International Building Code
H. ICC: International Code Council
I. IDC: Initiating Device Circuit
J. IEEE: Institute of Electrical and Electronic Engineers
K. IFC: International Fire Code
L. IMC: International Mechanical Code

M. IRI: Industrial Risk Insurers
N. LED: Light-Emitting Diode
O. NAC: Notification Appliance Circuit
P. NFPA: National Fire Protection Association
Q. NICET: National Institute for Certification in Engineering Technologies
R. RAC: Releasing Appliance Circuit
S. SLC: Signaling Line Circuit
T. UL: Underwriters Laboratories

1.4 Scope of Work:

A. This project involves the expansion of an existing Simplex 4006 system. Of primary importance are:

1. Duct mounted smoke detectors and AHU shutdown relays.

B. See the electrical drawings for additional scope information.
C. Note: Some portions of this specification may not be realizable with the existing system. Comply with those portions of this specification which the existing system is capable of supporting.
D. Regardless of any other project conditions, the final product shall be compliant with current code requirements in all areas affected by this project. Where the existing system is incapable of addressing current code requirements, the required functionality shall be added.

1.5 System Description:

A. General: Connect new duct mounted smoke detectors to existing fire alarm system in accordance with input/output matrix of operation.
B. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.
2. System connections for initiating device circuits shall be Class B.
3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.

C. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority two, supervisory and trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
3. Transmission to an Approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service

provider, under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.
5. Selective Alarm: A system alarm shall include:
    a. Indication of alarm condition at the FACP and the annunciator(s).
    b. Identification of the device/zone that is the source of the alarm at the FACP and the annunciator(s).
    c. Shutting down supply and return fans serving zone where alarm is initiated.
    d. Closing smoke dampers on system serving zone where alarm is initiated.
    e. Transmission of signal to the supervising station.
6. Supervisory Operations: Upon activation of a supervisory device the system shall operate as follows:
    a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
    b. Pressing the supervisory acknowledge key will silence the supervisory audible signal while maintaining the supervisory LED "on" indicating off-normal condition.
    c. Record the event in the FACP historical log.
    d. Transmission of supervisory signal to the supervising station.
    e. Restoring the condition shall cause the supervisory LED to clear and restore the system to normal.
7. Alarm Silencing: If the "alarm silence" button is pressed, all audible alarm signals shall cease operation.
8. Priority Two Operations: Upon activation of a priority two condition the system shall operate as follows:
    a. Activate the system priority two audible signal and illuminate the LED at the control unit and the remote annunciator.
    b. Pressing the priority 2 acknowledge key will silence the audible signal while maintaining the priority 2 LED "on" indicating off-normal condition.
    c. Record the event in the FACP historical log.
    d. Transmission of priority two signal to the supervising station.
    e. Restoring the condition shall cause the priority 2 LED to clear and restore the system to normal.
9. System Reset:
    a. The "system reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("in progress", "reset completed") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "alarm present, system reset aborted".
    b. Should an alarm condition continue, the system will remain in an alarmed
10. The service provider shall provide a minimum of two technicians for any system testing or commissioning.

D. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric smoke sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements.
    a. Reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.
5. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACP as "almost dirty". This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "dirty sensor" condition shall be indicated at the FACP and subsequently a system trouble is reported to the supervising station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "dirty sensor" condition shall not affect the sensitivity level required to alarm the sensor. If a "dirty sensor" is left unattended, and its average value increases to a third predetermined value, an "excessively dirty sensor" trouble condition shall be indicated at the control unit.
6. The FACP shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "self test abnormal" trouble condition.
7. Multi-sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7%/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.
8. Programmable Bases: It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

1.6 <u>Acceptance Submittals</u>:

A. General: Submit the following for review by owner, architect, and engineer prior to purchasing materials. Submit according to conditions of contract and Division 1 specification sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or

as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.
3. Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.
4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.7 O&M Submittals:

A. General: Submit the following for inclusion in operating and maintenance manual. Submit according to conditions of contract and Division 1 specification sections.

1. Updated system operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
2. Operating instructions for FACP.
3. Operation and maintenance data. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
4. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
5. Record of field tests of system.

1.8 Quality Control:

A. Installer Qualifications: A factory authorized installer shall perform the work of this section.

B. Each and every item of the fire alarm system shall be listed under the appropriate category by a nationally recognized testing laboratory and shall bear the respective "NRTL" label.

1.9 Project Conditions:

A. Interruption of Existing Fire-alarm Service: Do not interrupt fire-alarm service to facilities occupied by owner or others unless permitted under the following conditions, and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify architect no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without architect's written permission.

1.10 Sequencing and Scheduling:

A. Existing Fire-alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "not in service" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "not in service" until removed from the building.
B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment, wiring, and abandoned raceway.

1.11 Maintenance Service:

A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives
B. Basic Services: Routine maintenance visits on an "as needed" basis at times scheduled with the owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.
C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.
D. Maintenance Service Contract: No later than 60 days prior to the expiration of the warranty maintenance services, deliver to the owner a proposal to provide contract maintenance and repair services for an additional one-year term. As an option with this proposal, deliver to the owner a proposal to provide scheduled inspection and testing services for a one-year term. Owner will be under no obligation to accept maintenance service contract proposal or inspection and testing proposal.

PART 2 - PRODUCTS

2.1 Acceptable Equipment and Service Providers:

A. Manufacturers:

1. Subject to compliance with the requirements of this specification, provide products by one of the following:

a. Simplex (Tyco)
b. Or compatible with Simplex (Tyco)

B. Being listed as an acceptable manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
C. Alternate products must be submitted to Karen Olitsky, Procurement Agent III, at kolitsk@ufl.edu no later than 2/23/2021 at 5PM. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level III certified technicians and shall maintain a service

organization within 100 miles of this project location. The equipment and service provider shall have a minimum of 10-year experience in the fire protective signaling systems industry.

2.2 Systems Operational Description:

A. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Duct smoke detectors.

B. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.

C. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

D. Addressable Duct Smoke Sensor:

1. Standard Addressable Duct Smoke Sensor Unit: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Duct housing shall include relay or relay driver as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
b. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.
c. Duct housing shall provide a magnetic test area and red sensor status LED and duct housing shall provide a relay control yellow LED trouble indicator.
d. Duct housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
e. Duct housing shall provide two (2) test ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
f. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
g. Each duct smoke sensor shall be provided with a remote test station with

an alarm LED and test switch.

h. Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL listed to standard 268a.

E. Addressable Circuit Interface Modules:

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable circuit interface modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:

   a. Type 1: Monitor circuit interface module:

      1 For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.

      2 For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

4. All circuit interface modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

PART 3 - EXECUTION

3.1 Installation, General:

A. Install system components and all associated devices in accordance with applicable NFPA standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.
2. National Institute of Certification in Engineering Technologies (NICET) Fire Alarm Level III certified personnel.
3. Personnel licensed or certified by state or local authority.

3.2 Equipment Installation:

A. Furnish and install a complete fire alarm devices as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.
B. Existing fire alarm equipment shall be maintained fully operational until the new equipment has been tested and accepted.
C. Device Location-indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
D. Automatic Detector Installation: Conform to NFPA 72.

3.3 Preparation:

A. Coordinate work of this section with other affected work and construction schedule.

3.4 Connections:

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Duct mounted smoke detectors and relays.

3.5 Wiring Installation:

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the authority having jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electrical Code (NEC).
B. Contractor shall obtain from the fire alarm system manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the contractor without the prior written approval of the fire alarm system manufacturer.
C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Match existing system. Paint fire alarm system junction boxes and covers red.

3.6 Identification:

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 section "Electrical Identification".
B. Fire alarm system wiring shall be identified by tags at every point of access, including pull boxes, terminal boxes, device boxes, etc.
C. Install framed instructions in a location visible from fire-alarm control unit.

3.7 Grounding:

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.8 Field Quality Control:

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the drawings and specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:

a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the fire alarm system installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test supervising station signal transmitter. Coordinate testing with supervising station monitoring firm/entity.
b. Test each notification appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
c. Test fire alarm control panel and remote annunciator.
d. Test 10% of existing system as required by NFPA 72. Coordinate exact scope of this work with Owner and AHJ.

2. Provide minimum 10 days' notice of acceptance test performance schedule to owner, and local authority having jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 forms for documentation.

H. Final test, record of completion, and certificate of occupancy:

1. Test the system as required by the authority having jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 record of completion form to owner and AHJ.

3.9 <u>Demonstration</u>:

A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 Cleaning and Adjusting:

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of substantial completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

END OF SECTION

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