MEPNN Supplier Scouting Opportunity Synopsis

Section 1: General Information

Scouting Number	2025-024
Item to be Scouted	Call for BABA Suppliers - Irrigation and HVAC parts/components- List 2
Days to be scouted	30
Response Due By	02/21/2025
Description	In search of BABA compliant suppliers for various materials needed for an upcoming building project in Eastern New Mexico. See attached spreadsheet file for information regarding the items needed. The spreadsheet contains three separate tabs outlining items falling into the three specific requirements for each item. In your response, please indicate which item(s) the potential manufacturer may be able to supply.
Notify Requester Immediately	
State item to be used in	New Mexico

Section 2: Technical Information

Type of supplier being sought	Manufacturer
Reason	BABA
Describe the manufacturing processes (elaborate to provide as much detail as possible)	See attached spreadsheet "0-NIST Submissions"
Provide dimensions / size / tolerances / performance specifications for the item	See attached spreadsheet "0-NIST Submissions"
List required materials needed to make the product, including materials of product components	See attached spreadsheet "0-NIST Submissions"
Are there applicable certification requirements?	No
Are there applicable regulations?	No
Are there any other stndards, requirements, etc.?	No
NAICS 1	221310 Water Supply and Irrigation Systems
NAICS 2	
Additional Technical Comments	

Section 4: Business Information

Estimated potential business volume	See attached spreadsheet "0-NIST Submissions"
Estimated target price / unit cost information (if unavailable explain)	As this is related to BABA, acceptable pricing is to be determined in negotiation.
When is it needed by?	Project is expected to bid Winter 2025
Describe packaging requirements	Individualized wrapped or palletized
Where will this item be shipped?	Clovis, New Mexico

Additional Comments

Is there other information you would like to include?	Please review spreadsheet "NIST Submissions" with all products that need scouted. All of "docx" files are specifications with product information, part one is general information while part two is specific information to the product. Please review the spreadsheet for all relevant information, and don't hesitate to reach out with any questions. Thank you.
	Agency Providing Funds: Bureau of Reclamation: Albuquerque Area Office
	For all BABA related questions please contact:
	Ken Richards
	krichards@usbr.gov

SECTION 21 13 13 WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
 - b. B16.4, Gray Iron Threaded Fittings: Classes 125 and 250.
 - c. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - 2. American Water Works Association (AWWA):
 - a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
 - b. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - 3. ASTM International (ASTM):
 - a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A135/A135M, Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. A197/A197M, Standard Specification for Cupola Malleable Iron.
 - e. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - f. A563/A563M, Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
 - g. A795/A795M, Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - 4. FM Global (FM).
 - 5. National Fire Protection Association (NFPA):
 - a. 13, Installation of Sprinkler Systems.
 - b. 70, National Electrical Code (NEC).
 - c. 72, National Fire Alarm and Signaling Code.
 - d. 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.
 - e. 1963, Standard for Fire Hose Connections.

- 6. UL:
 - a. 193, Standard for Safety Alarm Valves for Fire-Protection Service.
 - b. 199, Safety Automatic Sprinklers for Fire-Protection Service.
 - c. 213, Rubber Gasketed Fittings for Fire-Protection Service.
 - d. 262, Standard for Gate Valves for Fire-Protection Service.
 - e. 312, Check Valves for Fire-Protection Service.
 - f. 346, Standard for Waterflow Indicators for Fire Protective Signaling Systems.
 - g. 393, Standard for Safety Indicating Pressure Gauges for Fire-Protection Service.
 - h. 405, Standard for Fire Department Connection Devices.
 - i. 464, Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
 - j. 753, Standard for Alarm Accessories for Automatic Water-Supply Control Valves for Fire-Protection Service.
 - k. 789, Standard for Indicator Posts for Fire-Protection Service.
 - 1. 1091, Butterfly Valves for Fire-Protection Service.
 - m. 1474, Standard for Adjustable Drop Nipples for Sprinkler Systems.
 - n. 1626, Residential Sprinklers for Fire-Protection Service.
 - o. 1767, Early-Suppression Fast-Response Sprinklers.

1.02 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.
- B. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.
- C. Abbreviations:
 - 1. American National Taper Pipe Thread (NPT).
 - 2. Authority having jurisdiction (AHJ).
 - 3. Hertz (Hz).
 - 4. Pounds per square inch, gauge (psig).
 - 5. Single-pole, double-throw (SPDT).
 - 6. Volts alternating current (V ac).
 - 7. Volts direct current (V dc).

1.03 DESIGN REQUIREMENTS

- A. Provide design criteria and area densities for automatic sprinkler systems as indicated on the Drawings.
- B. Provide sprinkler systems, including seismic bracing designed and installed in accordance with NFPA 13.
- C. Hydraulically design systems. Submit calculations to verify that, at minimum, densities indicated on the Drawings are met.
- D. Base hydraulic calculations on water flow tests conducted within time specified by local regulations and recorded at or near proposed system tie-in point.
- E. Contract Drawings are provided for general layout of sprinkler system. Contractor design responsibility includes determining exact layout and dimensions of system. Clearly identify deviations from Drawings or Specifications in the Shop Drawing submittal.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Drawings for wet-pipe sprinkler systems; include plans, elevations, sections, details, and attachments to other work.
 - b. Product Data: For pipe, fittings, valves, sprinklers and all other attachments and components needed to provide a complete and compliant installation. For electrical/alarm components include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - c. Contractor-Design Submittal: Sprinkler system design; include analysis data signed and sealed by qualified professional engineer. Submit for approval by Owner's insurance underwriter and the fire marshal prior to the start of construction.
 - d. Coordination Drawings:
 - 1) Sprinkler systems, drawn to scale, illustrating coordination of sprinkler system with:
 - a) Process piping.
 - b) Domestic water piping.
 - c) HVAC duct work.
 - d) Lighting fixtures.
 - e. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

- B. Informational Submittals:
 - 1. Qualification Data: Qualified installer, design technician, and professional engineer.
 - 2. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, approved by authorities having jurisdiction, including hydraulic calculations if applicable.
 - 3. Welding certificates.
 - 4. Manufacturer's printed installation instructions.
 - 5. Fire hydrant flow test report.
 - 6. Field test reports and certificates.
 - 7. Field quality control reports.
 - 8. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
 - 9. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 10. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 11. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.

1.05 QUALITY ASSURANCE

- A. Comply with the 2021 International Fire Code with local amendments, NFPA 13, building codes, and government regulations.
- B. Provide approvals, permits, and required inspections.
- C. Provide materials and equipment UL listed and in compliance with applicable NFPA standards and fire marshal's requirements. Submit documentation that specific items furnished under this section for this Project conform to such requirements.
- D. Welding Qualifications: Refer to NFPA 13 for qualifications and restrictions.
- E. Preinstallation Meeting:
 - 1. In accordance with Section 01 31 19, Project Meetings.
 - 2. Convene minimum 1 week prior to commencing work of this section.

1.06 QUALIFICATIONS

A. Provide layout drawings for fire protection systems prepared by or under the supervision of a NICET Fire Protection Engineering Technician, Level 3 or Level 4, subfield of Fire Protection Engineering Water-Based Systems Layout or as otherwise permitted by State or local Statute. If required by State or local Statute, provide Drawings reviewed and stamped by a registered professional

WET-PIPE SPRINKLER SYSTEMS 21 13 13 - 4

engineer having registration in the State of New Mexico or other procedure acceptable to the AHJ. Submit a copy of the current certification of the NICET technician and the registered Engineer with the initial submittal.

1.07 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.08 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Sprinkler Cabinet	One each
Sprinklers	Six of each different size unit
Special tools required to maintain or dismantle	One complete set for each different size unit

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application. Comply with additional requirements of NFPA 72.
 - B. Refer to Section 28 31 00, Fire Detection and Alarm, for additional requirements and interface to wet-pipe sprinkler systems.
 - C. Sprinkler system equipment, specialties, accessories, installation, and testing: comply with NFPA 13.
 - D. Piping Materials: Comply with requirements in Piping Schedule located below.

2.02 STEEL PIPE AND FITTINGS

A. Pipe:

- 1. FM Approved Standard Weight, Schedule 40 Galvanized and Black Steel Pipe: ASTM A53/A53M or ASTM A153. Pipe ends may be factory or field formed to match joining method.
- 2. Do not use light wall pipe or any pipe thinner than schedule 40 pipe.
- B. Fittings:
 - 1. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern. Provide galvanized fittings and couplings:
 - a. Where scheduled.
 - b. Exterior locations.
 - 2. Flanges:
 - a. Cast Iron: ASME B16.1 or AWWA C110/A21.10, AWWA C111/A21.11, AWWA C115/A21.15, 250 psi water service rating, Class 125 dimensions and bolt pattern.
 - b. Galvanized and Uncoated, Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, dimensions and bolt pattern.
 - 3. Grooved-Joint, Steel Pipe Appurtenances:
 - a. Galvanized and Uncoated, Grooved-End Fittings and Couplings for Steel Piping: UL 213 listed for fire protection service, FM approved, malleable-iron casting or ductile-iron casting; with dimensions matching steel pipe. Standard EPDM gaskets. Rigid type except where flexible type is required for vibration isolation or stress relief.
 - b. Manufacturers:
 - 1) Tyco.
 - 2) Victaulic Company.
 - 4. Certify fittings, couplings, flanges, and flange adaptors used with thinwall pipe or Schedule 10 pipe by the fitting manufacturer as dimensionally compatible with and fully connectable to the pipe used without field modifications.
 - 5. Welded or segmented fittings are not acceptable.

2.03 PIPING SCHEDULE

A. Piping Between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end pipe couplings; and grooved joints.

- B. Standard-pressure, Wet-pipe Sprinkler System, 8 inches and Smaller:
 - 1. Standard-weight or Schedule 40, black steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or Schedule 40, galvanized steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight or Schedule 40, black steel pipe with plain ends; uncoated, plain-end pipe fittings; and twist-locked joints.
 - 4. Standard-weight or Schedule 40, galvanized steel pipe with plain ends; galvanized, plain-end pipe fittings; and twist-locked joints.
 - 5. Standard-weight or Schedule 40, black steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end pipe couplings for steel piping; and grooved joints.
 - 6. Standard-weight or Schedule 40, galvanized steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end pipe couplings for steel piping; and grooved joints.
 - 7. Standard-weight or Schedule 40, black steel pipe with plain ends; steel welding fittings; and welded joints.

2.04 PIPE COATING

- A. Coat all exposed fire sprinkler piping in accordance with System No. 4, as specified in Section 09 90 00, Painting and Coating.
- B. Pipe Color: All exposed fire sprinkler piping shall be painted red.

2.05 PIPING JOINING MATERIALS

- A. Pipe Flange Gasket Materials: AWWA C110/A21.10, rubber, flat face, 1/8-inch (3.2 mm) thick.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal Pipe Flange Bolts and Nuts: ASTM A307 Grade B, galvanized, with galvanized nuts in accordance with ASTM A563/A563M Grade A.
- C. Unions: 150 psig galvanized malleable iron, ASTM A197, threaded, ground joint, integral seat.

2.06 VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
 - 3. Make flanged end and wafer type valves compatible for installation with flanges as specified.
- B. Ball Valves:
 - 1. Standard: UL 1091, except with ball instead of disc.
 - 2. 1-1/2 Inches and Smaller: Bronze body with threaded ends.
 - 3. 2 Inches and 2-1/2 Inches: Bronze body with threaded ends or ductileiron body with grooved ends.
 - 4. 3 Inches: Ductile-iron body with grooved ends.
 - 5. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Victaulic Company.
- C. Iron Butterfly Valves:
 - 1. Standard: UL 1091.
 - 2. Pressure Rating: 175 psig.
 - 3. Body Material: Cast or ductile iron.
 - 4. Stem: Stainless steel.
 - 5. Style: Lug or wafer.
 - 6. Manufacturers:
 - a. Global Safety Products, Inc.
 - b. NIBCO INC.
 - c. Tyco.
 - d. Victaulic Company.
- D. Check Valves:
 - 1. Standard: UL 312.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Type: Swing check or spring assisted swing check.
 - 4. Body Material: Cast or ductile iron.
 - 5. End Connections: Flanged or grooved.
 - 6. Manufacturers:
 - a. Kennedy Valve.
 - b. Mueller Company.
 - c. NIBCO INC.
 - d. Tyco.
 - e. Victaulic Company.

WET-PIPE SPRINKLER SYSTEMS 21 13 13 - 8

- E. Iron OS&Y Gate Valves:
 - 1. Standard: UL 262.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Body Material: Cast or ductile iron.
 - 4. End Connections: Flanged or grooved.
 - 5. Manufacturers:
 - a. Kennedy.
 - b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco.
 - e. Victaulic Company.
- F. Indicating-Type Butterfly Valves:
 - 1. Standard: UL 1091.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Valves 2 Inches and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded or grooved.
 - 4. Valves 2-1/2 Inches and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. Stem Material: Stainless steel.
 - d. End Connections: Flanged, grooved, or wafer.
 - 5. Valve Operation: Weatherproof actuator housing with handwheel and integral dual single-pole, double-throw (SPDT) (Form C) contacts, rated for a minimum of 10 amps at 125/250V ac, 2 amps at 30V dc, 10 mA minimum at 24V dc in tamper-proof cover with mounting and required hardware for attachment to indicated valves visual indicating device.
 - 6. Manufacturers:
 - a. Kennedy Valve.
 - b. NIBCO INC.
 - c. Tyco.
 - d. Victaulic Company.
- G. NRS Gate Valves:
 - 1. Standard: UL 262.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Body Material: Cast iron with indicator post flange.
 - 4. Stem: Nonrising.
 - 5. End Connections: Flanged or grooved.

- 6. Manufacturers:
 - a. Kennedy Valve.
 - b. Mueller Co.
 - c. NIBCO INC.
 - d. Tyco.
 - e. Victaulic Company.

2.07 TRIM AND DRAIN VALVES

- A. General:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM "Approval Guide," listing.
 - 2. Pressure Rating: 175 psig minimum.
- B. Angle Valves:
 - 1. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Potter-Roemer.
 - c. United Brass Works, Inc.
- C. Ball Valves:
 - 1. Manufacturers:
 - a. NIBCO.
 - b. Tyco.
 - c. Victaulic Company.

2.08 SPECIALTY VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM "Approval Guide" listing.
 - 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
 - 3. Body Material: Cast or ductile iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Alarm Check Valves:
 - 1. Standard: UL 193.
 - 2. Design: Vertical installation.

WET-PIPE SPRINKLER SYSTEMS 21 13 13 - 10

- 3. Valve internal components shall be replaceable without removing the valve from the installed position.
- 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
- 5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- 6. Manufacturers:
 - a. Tyco; Series AV.
 - b. Victaulic Company; Series 751.
 - c. Viking Corporation; Series J-1.
- C. Post Indicating Valve Assembly:
 - 1. Type V137 Resilient Seated Gate Valve 4 Inches to 12 Inches:
 - a. UL Listed and FM Approved for fire protection, iron body, resilient seat, bronze mounted, ASME B16.1 Class 125 flanged ends, nonrising stem, 2-inch operating nut, in accordance with AWWA C509, design working water pressure 200 psig, full port, fusion-epoxy coated inside and outside per AWWA C550, NSF 61 certified, indicator post flange and indicator post assembly with lockable handle.
 - b. Manufacturers and Products:
 - 1) Kennedy Valve; Ken-Seal II.
 - 2) M&H Valve; Style 4067.
 - 3) Mueller; P 2360.
 - 2. Indicator Post Assembly:
 - a. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.
 - b. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
 - c. Padlockable eye bolt for wrench.
 - d. Adjustable bury depth. Bury depth as required for valve installation.
 - e. UL Listed and FM Approved.
 - f. Manufacturers and Products:
 - 1) Clow; Style 2945.
 - 2) Mueller; A 20806.

2.09 FIRE DEPARTMENT CONNECTIONS

- A. Yard Type:
 - 1. Standard: UL 405.
 - 2. Type: Exposed, freestanding.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Corrosion-resistant metal.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 5. Inlets: Brass with threads according to NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- 6. Caps: Brass, lugged type, with gasket and chain.
- 7. Escutcheon Plate: Round, brass, floor type.
- 8. Outlet: Bottom, with pipe threads.
- 9. Number of Inlets: Two.
- 10. Sleeve: Brass.
- 11. Sleeve Height: 18 inches (460 mm).
- 12. Escutcheon Plate Marking: Similar to "AUTO SPKR."
- 13. Outlet Size: 3 inches.
- 14. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Elkhart Brass.
 - c. Guardian Fire Equipment, Inc.
 - d. Potter-Roemer.
- B. Fire Department Outlet Test Fitting:
 - 1. Brass body and polished chrome plate lettered HYDRANT.
 - 2. Polished brass female 4-inch NPT by 2-1/2-inch male hose thread snoots with caps and chains.
 - 3. Two-way hydrant with two outlets and inlet configuration as required for location.
 - 4. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Guardian Fire Equipment, Inc.
 - d. Potter Roemer.

2.10 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Ductile-iron housing with EPDM seals, bolts, and nuts.
 - 4. Type: Mechanical-cross fittings and mechanical-tee.
 - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 6. Size: Dimension to fit on sprinkler main and with outlet connections as required to match connected branch piping.
 - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.

- 8. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Tyco.
 - c. Victaulic Company.
- B. Flow Detection and Test Assemblies:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM "Approval Guide" listing.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Cast-iron or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded or grooved.
 - 6. Manufacturers:
 - a. Guardian Fire Equipment, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco.
 - d. Victaulic Company.
- C. Branch Line Testers:
 - 1. Standard: UL 199.
 - 2. Pressure Rating: 175 psig.
 - 3. Body Material: Brass.
 - 4. Size: Same as connected piping.
 - 5. Inlet: Threaded.
 - 6. Drain Outlet: Threaded and capped.
 - 7. Branch Outlet: Threaded, for sprinkler.
 - 8. Manufacturers:
 - a. Guardian Fire Equipment, Inc.
 - b. Potter-Roemer.
 - c. Tyco.
- D. Sprinkler Inspector's Test Fittings:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM "Approval Guide" listing.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Cast-bronze, cast-iron, or ductile-iron housing with sight glass.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded or grooved.

- 6. Manufacturers:
 - a. Guardian Fire Equipment, Inc.
 - b. Tyco.
 - c. Victaulic Company.
 - d. Viking Corporation.
- E. Flexible, Sprinkler Hose Fittings:
 - 1. Standard: UL 1474.
 - 2. Type: Flexible braided Type 304 stainless steel flexible tube hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Size: Same as connected piping, for sprinkler.
 - 5. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Fivalco Inc.
 - c. Victaulic Company.
 - d. Viking Group, Inc.

2.11 SPRINKLERS

- A. General:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or FM "Approval Guide" listing.
 - 2. Pressure Rating:
 - a. Automatic Sprinklers: 175 psig minimum.

B. Sprinkler Schedule:

- 1. Use sprinkler types below for the following applications:
 - a. Rooms without Ceilings: Upright sprinklers.
 - b. Wall Mounting: Sidewall sprinklers.
- 2. Provide sprinkler types below with finishes indicated:
 - a. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - b. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - d. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. See Drawings for additional information.
 - 4. Sprinkler Finishes:
 - a. Chrome plated.
 - b. Bronze.
 - c. Painted.
 - 5. Special Coatings:
 - a. Wax.
 - b. Lead.
 - c. Corrosion-resistant paint.
 - 6. Sprinkler Escutcheons:
 - a. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - b. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 - c. Sidewall Mounting: Chrome-plated steel, one piece, flat.
 - 7. Sprinkler Guards:
 - a. Standard: UL 199.
 - b. Type: Wire cage with fastening device for attaching to sprinkler.
 - 8. Manufacturers:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco.
 - c. Victaulic Company.
 - d. Viking Corporation.

2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
 - 1. Standard: UL 464.
 - 2. Type: Vibrating, 24V dc, electric alarm bell.
 - 3. Size: Minimum 8-inch (200-mm) diameter.
 - 4. Finish: Red enamel factory finish, suitable for outdoor use.
 - 5. UL listed and FM approved.
 - 6. Comply with NFPA 72 for installation, inspection, testing, and maintenance. Bell shall be powered with supervised circuit.
 - 7. Manufacturers:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.

- C. Water Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water Flow Detector: Electrically supervised.
 - 3. Components: Provide device with two sets of SPDT (Form C) contacts. Provide minimum switch electrical rating of 10 amps at 125/250V ac, 2 amps at 30V dc resistive, 10 mA at 24V dc.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - 6. Installation: Horizontal or vertical.
 - 7. UL listed and FM approved.
 - 8. Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. Tyco.
 - d. Viking Corporation.
- D. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - Components: Single unit composed of dual single-pole, double-throw (SPDT) (Form C) contacts, rated for a minimum of 10 amps at 125/250V ac, 2 amps at 30V dc, 10 mA minimum at 24V dc in tamperproof cover with mounting hardware for attachment to indicated valves.
 - 4. Design: Signals that controlled valve is in other than fully OPEN position.
 - 5. UL listed and FM Approved.
 - 6. Manufacturers:
 - a. ADT Security Services, Inc.
 - b. Potter Electric Signal Company.
 - c. System Sensor; a Honeywell company.

2.13 PRESSURE GAUGES

- A. Description:
 - 1. Standard: UL 393.
 - 2. Dial Size: 3-1/2-inch to 4-1/2-inch (90-mm to 115-mm) diameter.
 - 3. Pressure Gauge Range: 0 psig to 250 psig minimum.
 - 4. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
 - 5. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

- 6. Manufacturers:
 - a. AMETEK; U.S. Gauge Division.
 - b. Ashcroft, Inc.
 - c. Brecco Corporation.
 - d. WIKA Instrument Corporation.

2.14 SLEEVES AND PENETRATIONS FOR PIPING SYSTEMS

- A. Sleeves:
 - 1. Walls:
 - a. Interior and Exterior Walls: Schedule 40 carbon steel.
 - b. Concrete: Cast-iron wall sleeves with integrally cast water stop.
 - c. Interior Partitions: 22-gauge (U.S. Standard) minimum galvanized sheet steel.
 - 2. Interior Floor: Schedule 40 carbon steel.
 - 3. Slab on Grade: Cast-iron wall sleeves with integrally cast water stop.
 - 4. Underground (Beneath Foundations, Footings, Grade Beams): Standard weight corrugated steel, bituminous coating inside and outside, with close-fitting bituminous coated plate at each end.
- B. Sleeve and Penetration Packing:
 - 1. Modular Wall and Casting Seals: Link-Seal as manufactured by Thunderline Corporation, Flexicraft PipeSeal. Sleeve and modular wall and casting seal to be furnished together as a single integrated unit.
 - 2. Penetration Packing (With or Without Sleeve) for Interior Walls and Interior Elevated Floors:
 - a. UL listed, FM approved materials and sealant systems, by 3M Fire Barrier Wrap/Strip FS-195+.
 - b. Flexible elastomeric material unless specified otherwise.
 - c. Include additional materials and accessories to meet requirements of manufacturer and this section.
 - d. Compatible with penetrated surface.
 - e. Hazard Ratings:
 - Pipes Penetrating Fire Rated Walls, Fire Rated Ceilings, and Fire Rated Floor Slabs (1 hour or greater): Material having maximum flame spread of 25 and maximum smoke develop rating of 50, selected to maintain fire rating of penetrated surface.
 - 2) Pipes Penetrating Other Interior Walls: Material having maximum smoke develop rating of 50, selected to prevent smoke transmission through penetration.
 - 3) Pipes Penetrating Nonrated Interior Floors: Mineral wool and fire-rated caulk.

PART 3 EXECUTION

- 3.01 PREPARATION
 - A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291.
 - B. Submit test results promptly.
 - C. Reference Piping Schedule on the Drawings and Section 09 90 00, Painting and Coating, and Section 40 05 15. Piping Support Systems, for additional pipe and pipe support requirements.
 - 1. Pipe Color: All exposed fire sprinkler piping shall be painted red.

3.02 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water service piping for service entrance to building as shown on the Drawings.
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water service piping.

3.03 PIPING INSTALLATION

- A. Locations and Arrangements:
 - 1. Install piping in accordance with approved Shop Drawings, schematics, and diagrams which indicate general location and arrangement of piping.
 - 2. Deviations from approved piping Shop Drawings require written approval from AHJ. Submit written approval to Engineer before deviating from approved working plans.
- B. Piping Standard: Comply with NFPA 13 sprinkler piping installation requirements.
- C. Seismic Design Category (SDC) is shown on Structural General Notes on the Drawings.
- D. Based on the SDC, seismic bracing is not required for this Project.
- E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- F. Install unions adjacent to each valve in pipe 2 inches and smaller.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

WET-PIPE SPRINKLER SYSTEMS 21 13 13 - 18

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with NFPA 13 requirements for hanger materials.
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe.
 - 1. Include pressure gauges with connection not less than 1/4 inch and with soft metal seated globe valve, arranged to drain pipe between gauge and valve.
 - 2. Install gauges to permit removal, and where not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.

3.04 JOINT CONSTRUCTION

- A. Steel Piping:
 - 1. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer.
 - 2. Welded Joints: Construct joints according to NFPA 13, using qualified processes and welding operators according to Article Quality Assurance.
 - a. Shop-weld pipe joints where welded piping is indicated.
 - b. Do not use welded joints for galvanized-steel pipe.
 - 3. Cut-Grooved and Roll-Grooved Joints:
 - a. Cut square-edge groove or roll rounded-edge groove in end of pipe according to NFPA 13.
 - b. Install grooved joints in accordance with the manufacturer's latest published installation instructions.

- c. Provide grooved ends clean and free from indentations, projections, and tool marks.
- d. Join steel pipe and grooved-end fittings according to NFPA 13 for steel pipe joints.
- B. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire protection valves, drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and AHJ.
- B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply other than fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water supply connection. Install backflow preventers instead of check valves in potable water supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain line connection.
- E. Specialty Sprinkler Fittings: Install downstream of control valves instead of specified fittings if indicated in approved Shop Drawings.

3.06 SPRINKLER INSTALLATION

- A. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- B. Do not install any sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install any sprinkler with a cracked bulb.
- C. Remove sprinkler bulb protector by hand. Do not use any tools or devices that could damage the bulb.

3.07 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install yard-type, fire department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 00, Cast-in-Place Concrete.
 - 1. Install protective pipe bollards as shown on the Drawings for each fire department connection.
- B. Install automatic drain valve at each check valve for fire department connection.

3.08 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to NFPA 13 requirements.
- B. Identify system components.

3.09 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until leak free.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Coordinate with fire pump tests. Operate as required.
 - 7. Demonstrate that equipment hose threads match local fire department equipment.
- B. Sprinkler piping system is defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
 - Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13; include "Contractor's Material and Test Certificate for Aboveground Piping."

3.10 MANUFACTURER'S SERVICES

- A. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.
- B. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

END OF SECTION

SECTION 22 07 00 PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy-Efficient Design of New Buildings except Low-Rise Residential Buildings.
 - 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - c. C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - d. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - 3. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

- A. Action Submittals: Product description, include list of materials, thickness for each service scheduled, and locations.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
 - 2. Manufacturer's installation instructions.
 - 3. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 4. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.

1.03 QUALITY ASSURANCE

A. Provide standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.

- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
- C. UL Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Deliver insulation, jackets, cements, adhesives and coatings with a manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Mark "asbestos-free."

PART 2 PRODUCTS

2.01 GENERAL

- A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
- B. Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
- C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
- D. Fire Resistance:
 - 1. Provide noncombustible insulation, adhesives, vapor barrier materials and other accessories, except as specified herein.
 - 2. Use no fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration as a result of effects of moisture or high humidity are not acceptable.
 - 4. Fire Hazard Rating for Materials including Facings, Mastics, and Adhesives: Not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with NFPA 255 methods.
 - 5. Materials exempt from fire-resistant rating:
 - a. Nylon anchors.
 - b. Treated wood inserts.

- 6. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - a. Polyurethane insulation.
 - b. PVC casing.
 - c. Fiberglass-reinforced plastic casing.

2.02 PIPE INSULATION

- A. Type P1—Fiberglass (ASTM C547, Type 1 (Minus 20 Degrees F to 500 Degrees F):
 - 1. Fiberglass, UL-rated, preformed, sectional rigid, minimum 4 pounds per cubic foot (pcf) density, K factor 0.23 maximum at 75 degrees F mean, with factory-applied all-service jacket (ASJ) composed of reinforced kraft paper and aluminum foil laminate. Provide jacket with self-sealing lap to facilitate closing longitudinal and end joints.
 - 2. Manufacturers and Products:
 - a. CertainTeed; Preformed Pipe Insulation.
 - b. Johns Manville; Micro-Lok HP-T.
 - c. Owens/Corning; Fiberglas Pipe Insulation.
 - d. Knauf Pipe Insulation; Crown Pipe Insulation.

2.03 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
 - 2. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Ceel-Co; 550.

PART 3 EXECUTION

- 3.01 INSTALLATION OF INSULATION
 - A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
 - B. Apply insulation over clean, finish painted, and dry surfaces.
 - C. Install insulation after piping system has been pressure tested and leaks corrected.
 - D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.

- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- G. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
- J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- R. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

- S. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- T. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.
- U. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal exterior joints to make watertight.

3.03 INSULATION APPLICATIONS

- A. Hot Water:
 - 1. Type P1, fiberglass.
 - 2. 1-inch thickness minimum for all pipe sizes, or comply with Energy Code, whichever is greater.

- B. Pipe Hangers:
 - 1. Type P1, Fiberglass: UL-rated, preformed rigid pipe insulation inserts of thickness equal to adjoining insulation, 10 inches in length, with factory-applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.
 - 2. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.04 INSULATION FINISH APPLICATIONS

- A. Piping Insulation (Concealed Areas): Factory finish.
- B. Piping Insulation (Exposed to View, Indoors): Type F1, PVC.
- C. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.05 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 22 10 01.02 POLYVINYL CHLORIDE DRAIN WASTE AND VENT (PVC-DWV) PIPE AND FITTINGS		
Item	Size	Description
Pipe and Fittings	All	PVC-DWV, Solid Core, Schedule 40 nonpressure application, Class 12454B conforming to ASTM D2665 and ANSI/NSF Standard 14 system.
Joints	All	Solvent cemented conforming to ASTM D2855 except where connection to equipment may require future removal.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.

END OF SECTION

SECTION 22 10 01.14 CROSS-LINKED POLYETHYLENE (PEX-A) PIPE AND FITTINGS— POTABLE WATER SERVICE		
Item	Size	Description
General All	Copper Tube (CTS) nominal sizes. Pipe lengths, fittings, and flanged connections to be joined by expansion couplings; shall be of the same type, grade, and class of polyethylene compound and supplied from same raw material supplier.	
		Pipe tubing and fittings manufactured in accordance with ASTM F876, ASTM F877, ASTM F2023.
Pipe	3/8" to 1"	Domestic cold water (W1), domestic hot-water (DHW) and DHW recirculation installations, rated operating conditions to 140°degrees F (60°degrees C) at 80 psi (5.5 bar) in accordance with ASTM F2023 non-oxygen barrier typical cross-linked polyethylene resin.
		Pipe wall thickness shall reflect required SDR-9* and diameter, as shown in Table 8, ASTM F714.
		Identification: Solid color or colored stripes extruded into pipe outside surface for identification of type of service, in accordance with APWA Uniform Color Code.
		*SDR: Standard Dimension Ratio = OD/thickness.
Fittings and Connections	1" & smaller	Full flow ProPEX or ASTM F2080 expansion connections. Clamp type reduced flow fittings shall not be allowed. Brass fittings for tees and connection to other materials. Molded polymer fittings for couplings. Use PEX-A expansion rings to make PEX connections with leading- edge chamber and integral stop edge.
		Fittings and connectors shall be of the same manufacture, and any proprietary tools required for piping modifications shall be provided to the Owner at the end of the Project.
Manufacturer		Rehau.
		Uponor; Pro-PEX, "or-equal."

END OF SECTION

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS CROSS-LINKED POLYETHYLENE (PEX-A) PIPE AND FITTINGS—POTABLE WATER SERVICE 22 10 01.14 DATA SHEET - 1

SECTION 22 10 01 PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. American Public Works Association (APWA): Uniform Color Code.
 - 3. American Society of Sanitary Engineering (ASSE):
 - a. 1010, Performance Requirements for Water Hammer Arresters.
 - b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
 - c. 1070, Performance Requirements for Water Temperature Limiting Devices.
 - 4. ASTM International (ASTM):
 - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
 - g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
 - h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - j. A197/A197M, Standard Specification for Cupola Malleable Iron.
 - k. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 1. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - m. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS PLUMBING PIPING AND ACCESSORIES 22 10 01 - 1

- n. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
- o. A536, Standard Specification for Ductile Iron Castings.
- p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- q. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
- r. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- s. B32, Standard Specification for Solder Metal.
- t. B61, Standard Specification for Steam or Valve Bronze Castings.
- u. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- v. B75/B75M, Standard Specification for Seamless Copper Tube.
- w. B88, Standard Specification for Seamless Copper Water Tube.
- x. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- y. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
- z. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
- aa. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
- bb. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
- cc. B306, Standard Specification for Copper Drainage Tube (DWV).
- dd. C1460, Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground.
- ee. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- ff. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- gg. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- hh. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- ii. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- jj. D2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- kk. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 2

- mm. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- nn. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- oo. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- pp. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- qq. E438, Standard Specification for Glasses in Laboratory Apparatus.
- rr. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 5. American Water Works Association (AWWA):
 - a. C503, Wet Barrel Fire Hydrants.
 - b. C651, Disinfecting Water Mains.
 - c. C904 Standard for Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 in. Through 3 in., for Water Service.
- 6. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
- 7. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arresters Standard.
- 8. UL: 246, Standard for Hydrants for Fire-Protection Service.

1.02 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.03 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - 1. Building Service Piping: ASME B31.9, as applicable.
 - 2. Sanitary Building Drainage and Vent Systems: Local plumbing code.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product data sheets.
 - 2. Shop Drawings:
 - a. Show Contractor recommended changes in location of fixtures or equipment.
 - b. Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.
- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the work.
 - 3. Complete list of products proposed for installation.
 - 4. Test records produced during testing.
 - 5. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 6. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. Piping Schedule: Refer to the Drawings.
- B. Piping Material: Refer to Piping Data Sheet(s), Article Supplements.
2.03 PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

2.04 INSULATION

A. As specified in Section 22 07 00, Plumbing Piping Insulation.

2.05 VALVES

- A. Refer to Section 40 27 02, Process Valves and Operators, for additional product and material selection requirements.
- B. Materials:
 - 1. Bronze and brass valve components and accessories that have surfaces in contact with water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.
 - Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
 - b. Stainless steel Alloy 18-8 may be substituted for bronze.
- C. HB-1 Wall Hydrant:
 - 1. Non-freeze exposed with chrome-plated face, integral vacuum breaker, bronze casing, T handle key, and 1-inch inlet and hose connection.
 - 2. Manufacturers and Products:
 - a. J. R. Smith; Figure 5609.
 - b. Josam; 71050 Series.
- D. YH-1 Yard Hydrant (Wet Barrel, Courtesy Fire Hydrant, Bronze)
 - 1. Hydrant:
 - a. Bronze construction conforming to ASTM 62.
 - b. Nominal 4-1/2-inch main valve opening with 6-inch bottom connections.
 - c. Conform to AWWA C503.
 - d. Designed for a minimum working pressure of 200 psig.
 - e. Two 2-1/2-inch hose nozzles.
 - f. One 4-1/2-inch pumper nozzle.
 - g. Operating Nuts: 1-1/2-inch National Standard pentagon nut.
 - h. Mechanical joint inlet connection.
 - i. Red aboveground line.
 - j. Manufacturers and Product: Clow Valve, Model 2010.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS PLUMBING PIPING AND ACCESSORIES 22 10 01 - 5

- 2. Main Valve:
 - a. Depth of Bury: 3-1/2 feet.
 - b. Equip with O-ring seals.
 - c. Valve opens on counterclockwise rotation.
- E. Type V236 Globe Style Hose Valve 1 Inch to 3 Inches:
 - 1. All-bronze, NPT threaded ends, inside screw-type rising stem, TFE disc, complies with MSS SP-80, rated 300 WOG.
 - 2. Manufacturers and Products:
 - a. Stockham; Figure B-22T, Angle No. B-274.
 - b. Nibco; Figure T-235-Y, Angle No. T-335-Y.
- F. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
 - 1. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP 110.
 - 2. Manufacturers and Products:
 - a. Conbraco Apollo; 76F-100 Series.
 - b. Nibco; T-585-S6-R-66-LL.
- G. Type V307 Stainless Steel Ball Valve 4 Inches and Smaller:
 - 1. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, ASME Class 300 flanged ends, PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 700 psi CWP minimum, complies with NSF 61.
 - a. Manufacturer and Product: Conbraco Apollo; 87A-900 series.
- H. Type V602 Check Valve 2 Inches and Smaller:
 - 1. All bronze, threaded cap, threaded ends, swing type replaceable Teflon Disc and bronze disc holder, rated 150-pound SWP, 300-pound WOG.
 - 2. Manufacturers and Products:
 - a. Walworth, Figure 3412.
 - b. Milwaukee, Figure 510.

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 6

2.06 MISCELLANEOUS PIPING SPECIALTIES

- A. Strainers for Water Service:
 - 1. Bronze body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
 - 2. Screen: Heavy-gauge stainless steel or monel, 30 mesh.
 - 3. Manufacturers and Products: Nibco.

B. Vacuum Breakers 2 Inches and Smaller:

- 1. Angle type, as required.
- 2. Stainless steel or bronze construction.
 - Manufacturers:
 - a. Febco.
 - b. Watts.

C. Water Hose:

3.

- Furnish 50-foot length(s) of 1-inch and 50-foot length(s) of 1-1/2-inch, EPDM black cover and EPDM tube, reinforced with two textile braids. Furnish each length with brass male and female NST hose thread couplings to fit hose nozzle(s) and hose valve(s) specified.
- 2. Rated minimum working pressure of 200 psi.
- 3. Manufacturers:
 - a. Goodyear.
 - b. Boston.

D. Hose Nozzles:

- 1. Furnish 1-inch and 1-1/2-inch cast brass satin finish nozzle(s) with adjustable fog, straight-stream, and shutoff features and rubber bumper. Provide nozzle(s) with female NST hose thread.
- 2. Manufacturers:
 - a. Croker.
 - b. Elkhart.

E. Sleeves:

- 1. Manufacturers and Products:
 - a. J. R. Smith; Figure 1720.
 - b. Josam; No. 26400.
- F. Flashing Sleeves for Roof Penetrations:
 - 1. Single-Ply Membrane Roofing: Pipe seals as specified in Section 07 70 01, Roof Specialties and Accessories.

- G. Insulating Dielectric Unions and Flanges:
 - 1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
 - 2. Unions 2 Inches and Smaller: Screwed or solder-joint type.
 - 3. Unions 2-1/2 Inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
 - 4. Manufacturers:
 - a. Epco Sales, Inc., Cleveland, OH.
 - b. Capitol Insulation Unions.
- H. Oil Barrier Floor Drain Pipe Plug
 - 1. Disposable, removable cartridge that fits into the outlet pipe of a floor drain. Forms watertight seal in pipe.
 - 2. Vertically oriented when installed.
 - 3. Sized for use with 4-inch drain piping.
 - 4. Designed to allow water to flow through under normal conditions and to seal the drain opening to prevent discharge when oil is present.
 - 5. Manufacturer and Product: Solidification Products International (SPI) Inc; Petro-Plug.
- I. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Lead free, NSF certified. Do not use cored solder.
- J. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.
- K. Rubber Gaskets: ASTM C564.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Install plumbing systems to meet applicable plumbing code.
 - B. Field Obstructions:
 - 1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
 - 2. Do not modify structural components, unless approved by Engineer.

- C. Sleeves:
 - 1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
 - 2. Provide piping passing through walls, floors, or ceilings with standardweight pipe sleeves.
 - 3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
 - 4. Dry pack sleeves in existing work in-place and provide finished appearance.
 - 5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.
- D. Provide unions in piping systems at connections to equipment.
- E. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.
- F. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.
- G. Provide isolation valves and strainers at pressure regulators.
- H. Trench Excavation and Backfill: As specified in Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

3.02 INSTALLATION

- A. Copper Tubing:
 - 1. Cut tubing square and remove burrs.
 - 2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
 - 3. Prevent annealing of fittings and hard-drawn tubing when making connections.
 - 4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.
- B. Rigid PVC:
 - 1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.
 - 2. Ream, clean, and remove burrs from cut ends before joining pipe.
 - 3. Lay in trench by snaking pipe from one side to other.
 - 4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS PLUMBING PIPING AND ACCESSORIES 22 10 01 - 9

- 5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
- 6. Shield ends to be joined from direct sunlight prior to and during laying operation.
- 7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.
- C. PEX-A Polyethylene Piping:
 - 1. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.
 - 2. Install in compliance with the PEX Piping Systems Design and Installation Manual, and Systems Installation Guide.
 - 3. PEX piping shall be installed per ASTM E84 requirements for plenum applications.
 - 4. Support and provide all required hangers and supporting strapping as required by manufacturer to provide a code compliant installation.
 - 5. Install in straight runs free of sags and kinks and provide bend supports at all 1/2-inch and 3/4-inch drops.
 - 6. All penetrations through wall plates shall be protected or shielded as required to prevent damage to piping.
 - 7. Tubing passing through metal studs shall use grommets or sleeves at the penetration.
 - 8. Provide supports, fixed anchor points, and hangers in compliance with the Piping Systems Design and Installation Manual and Piping Systems Installation Guide, current edition, to minimize expansion and contraction.
 - 9. Install piping at each fixture with out of the wall support bracket to secure piping and prevent excess movement when water stops or shut valves are operated.
 - 10. Where manifolds are used, install centered in access panels to permit servicing.
- D. Valves: Install in accordance with manufacturer's recommendations.
- E. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.
- F. Measuring Devices: Install in accordance with manufacturer's recommendations.
- G. Hydrants:
 - 1. Locate hydrants to provide accessibility and to minimize potential damage from vehicles.
 - 2. Relocate improperly set hydrants.

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 10

- 3. Hydrant Located behind Curbs: Set barrel so pumper nozzle or hose nozzle caps are a minimum of 18 inches from gutter face of curb.
- 4. Hydrant Located in Space between Curb and Sidewalk: Not less than 8 inches, clear from sidewalks.
- 5. Hydrant Located between Sidewalk and Property Line: Minimum clearance 8 inches from sidewalk.
- 6. Set hydrants so safety flange is a minimum of 2 inches above finished ground or sidewalk level.
- 7. Place hydrant on base block carefully to prevent the base block from breaking.
- 8. Joints shall conform to Section 3.4 of AWWA C600 when cast or ductile iron pipe is used.
- 9. Maintain hydrant in a plumb position during subsequent Work.

3.03 SANITARY AND WASTE DRAINS AND VENTS PIPING

- A. Installation:
 - 1. Set piping above floor slab true and plumb.
 - 2. Set exposed risers as close to walls as possible.
 - 3. Slope drain lines at minimum 2 percent slope, unless otherwise noted. Vent lines shall be installed level or sloped, with no low spots.
 - 4. Where vent stacks pass through roof slab, fit with flashing sleeve secured to roof.
 - 5. Extend vents minimum 1 foot above roof.
 - 6. Provide cleanouts where shown and where required by code.

3.04 HVAC CONDENSATE PIPING

- A. Set piping true and plumb.
- B. Slope piping 1/8 inch per foot minimum.

3.05 WATER SUPPLY PIPING

- A. Water supply piping includes potable W1, tempered water (TW) systems and nonpotable W3 systems.
- B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer's recommended flow.
- C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.
- D. Provide exterior water piping with minimum 3 feet of cover or install below frost line, whichever is greater.

- E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer's recommended gravel fill around drain hole of post hydrants.
- F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.
- G. Provide bypass with globe valve for emergency throttling around each reducing valve.
- H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.
- I. Vacuum Breakers 2 Inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.
- J. Provide manual air vents at high points in domestic hot water system.

3.06 HANGERS AND SUPPORTS

A. In accordance with Section 40 05 15, Piping Support Systems.

3.07 INSTALLATION—CONCRETE ENCASED

- A. Where horizontal piping is encased in concrete such as a floor or equipment slab, rigidly mount pipe to rebar and subbase to prevent lateral movement, sagging, and uplifting during concrete installation and finishing. Provide at least two temporary strut supports wired to rebar and supported from the engineered fill or subbase below for each section of pipe.
- B. Where construction joints occur, or piping leaves concrete encasements at buildings, utility trenches, vaults, slabs and other structures, provide elastomeric foam insulation wrap around the pipe at the transition point.
 - 1. Minimum Wrap: five pipe diameters of 1/2-inch-thick.

3.08 INTERIM CLEANING

- A. As specified in Section 40 27 00, Process Piping—General.
- 3.09 TESTING
 - A. As specified in Section 40 80 01, Process Piping Leakage Testing.

3.10 CLEANING AND DISINFECTION

A. As specified in Section 33 13 00, Disinfecting of Water Utility Distribution.

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 12

3.11 CORROSION PROTECTION

A. As specified in Section 40 27 00, Process Piping—General.

3.12 PROTECTION OF INSTALLED WORK

- A. Protective Covers:
 - 1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
 - 2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
 - 3. Remove at time of Substantial Completion.

3.13 FIELD FINISHING

A. In accordance with Section 40 27 00, Processing Piping—General.

3.14 PIPING IDENTIFICATION

A. Refer to the Piping Schedule on the Drawings.

3.15 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are part of this specification:
 - 1. Plumbing Piping Data Sheets.

Section Number	Title
22 10 01.02	Polyvinyl Chloride Drain Waste and Vent (PVC-DWV) Pipe and Fittings
22 10 01.14	Cross-linked polyethylene (PEX-A) Pipe and Fittings Potable Water Service

END OF SECTION

SECTION 22 30 00 PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. American Society of Mechanical Engineer's (ASME).
 - 3. American Society of Sanitary Engineering (ASSE):
 - a. 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Backflow Preventers.
 - b. 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Backflow Fire Protection Assemblies.
 - 4. American Water Works Association (AWWA):
 - a. C510, Double Check Valve Backflow Prevention Assembly.
 - b. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - c. C550, Protective Interior Coatings for Valves and Hydrants.
 - 5. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 6. FM Global (FM).
 - 7. Food and Drug Administration (FDA).
 - 8. Foundation for Cross-Connection Control and Hydraulic Research at University of Southern California (FCCHR): Manual of Cross-Connection Control.
 - 9. International Code Council (ICC): International Plumbing Code (IPC).
 - 10. National Electrical Code (NEC).
 - 11. National Electrical Manufacturers Association, (NEMA): MG 1, Motors and Generators.
 - 12. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
 - 13. UL.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

1.02 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Manufacturer's product data.
 - 2. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
 - 3. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 4. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.

1.04 SPECIAL GUARANTEE

A. Where note below, provide manufacturer's extended guarantee in writing with Owner named as beneficiary. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of products found defective during the stated period after date of Substantial Completion.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER HEATERS

- A. Electric Water Heater (Commercial):
 - 1. Description:
 - a. Automatic, vertical, electric storage type.
 - b. Regulatory Compliance: UL Listed, ASME, ASHRAE 90.1, and NSF.
 - c. Tank: Steel, glass-lined, 150 psig working pressure, and ASME rate.
 - d. Insulation: Foam or fiberglass type with minimum R-value per ASHRAE 90.1.
 - e. Dip Tube: Required on inlet connection down to bottom section of tank.
 - f. Anode: Heavy-duty, tank mounted, screw-in type.
 - g. Pressure/Temperature Relief Valve: ASME rated.
 - h. Connections: Inlet and outlet with factory-installed dielectric unions and brass drain valve with hose thread.
 - i. Heating Element: Watt-density (maximum of 75 watts per square inch) incoloy sheath; immersion type.
 - j. Controls:
 - 1) Fully automatic, house in hinged control panel, and including the following:
 - a) Terminal block.
 - b) Close differential immersion-type thermostat.
 - c) Control transformer for 120-volt circuit and fusing.
 - d) Magnetic contactors for each stage.
 - e) Manual reset high-limit switch.

- f) Adjustable temperature range, 95 degrees F to 180 degrees F.
- g) Power circuit fusing as required by NEC and UL.
- k. Guarantee: 3 years.
- 2. Capacity: data sheet at end of section.
- 3. Accessories:
 - a. Drain Pan:
 - 1) Stainless steel construction.
 - 2) Side-wall drain with plug.
 - 3) Sized to fit water heater and float switch.
 - b. Float Switch (IP20-LSH-651-01, CP20-LSH-651-01):
 - 1) Float style overflow switch.
 - 2) Stainless-steel attachment bracket.
 - 3) Manufacturer and Product: RectorSeal Safe-T-Switch, Model SS3.
- 4. Manufacturers:
 - a. AO Smith.
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.
- B. Electric Water Heater (For Emergency Safety Shower):
 - 1. Description:
 - a. Automatic, vertical, electric storage type.
 - b. Regulatory Compliance: UL Listed, ASME, ASHRAE 90.1, and NSF.
 - c. Designed to meet the requirements of ANSI Z358.1 for tepid water delivery to emergency equipment.
 - d. Tank: 120-gallon, steel, cement-lined, 150 psig working pressure, and ASME rate.
 - e. Insulation: 3-inch polyurethane foam.
 - f. Dip Tube: required on inlet connection down to bottom section of tank.
 - g. Anode: heavy-duty, tank mounted, screw-in type.
 - h. Pressure/Temperature Relief Valve: ASME rated.
 - i. Connections: inlet and outlet with factory-installed dielectric unions and brass drain valve with hose thread.
 - j. Heating Element: watt-density (maximum of 75 watts per square inch) incoloy sheath; immersion type.
 - k. Controls:
 - 1) Fully automatic, house in hinged control panel, and including the following:
 - a) Terminal block.
 - b) Close differential immersion-type thermostat.
 - c) Control transformer for 120-volt circuit and fusing.
 - d) Magnetic contactors for each stage.

PLUMBING EQUIPMENT 22 30 00 - 4

- e) Manual reset high-limit switch.
- f) Adjustable temperature range, 95 degrees F to 180 degrees F.
- g) Power circuit fusing as required by NEC and UL.
- 1. Guarantee: 3 years.
- 2. Accessories:
 - a. Mixing Valve: Providing 85 degrees F tepid water to emergency equipment.
- 3. Voltage: 480 volt, three-phase.
- 4. Capacity: 6 kW.
- 5. Manufacturer and Product: Hubbel; Model EMV-120-85-6-SL.

2.03 SUBMERSIBLE CENTRIFUGAL SUMP PUMPS

- A. Simplex, Submersible Water Sump Pump:
 - 1. Description:
 - a. Type: Simplex, heavy-duty, nonclog, close-coupled submersible centrifugal ejector pump.
 - b. Volute: Cast iron, foot mounted.
 - c. Impeller: Cast iron, vortex type.
 - d. Pump discharge: 1-1/2-inch NPT.
 - e. Motor Enclosure: Cast iron, carbon/ceramic seals with corrosion-resistant exterior finish.
 - f. Motor: 1,750 rpm, Oil-filled, continuous-duty, built-in auto reset thermal overload protection.
 - g. Shaft: AISI 1215 cold rolled steel.
 - h. Bearings: Permanently lubricated, sleeve bearing.
 - i. Hardware: Stainless steel bolts, screws, and guards.
 - j. Gaskets: Neoprene.
 - k. Electrical: 110 volts, single-phase with attached power cable (minimum 15 feet), with power requirements as indicated on data table at end of section.
 - l. Controls:
 - 1) Motor Starters: Magnetic with auto reset thermal overload protection device.
 - 2) Level Control: Integral float operated mechanical high-low switch. No external input required, auto-start, auto-stop.
 - 2. Capacity: See data table at end of section.
 - 3. Manufacturers and Products:
 - a. Zoeller Pumps; Model M137.
 - b. Or equal.

- B. Simplex, Submersible Chemically Resistant Sump Pump:
 - 1. Description:
 - a. Type: Simplex, heavy-duty, nonclog, close-coupled submersible centrifugal ejector pump.
 - b. Volute: Bronze, foot mounted.
 - c. Impeller: Bronze, vortex type.
 - d. Pump discharge: 1-1/2-inch NPT.
 - e. Motor Enclosure: Cast iron, carbon/ceramic seals with corrosionresistant exterior finish.
 - f. Motor: 1,750 rpm, Oil-filled, continuous-duty, built-in auto reset thermal overload protection.
 - g. Shaft: AISI 1215 cold rolled steel.
 - h. Bearings: Permanently lubricated, sleeve bearing.
 - i. Hardware: Stainless steel bolts, screws, and guards.
 - j. Gaskets: Neoprene.
 - k. Electrical: 110 volts, single-phase with attached power cable (minimum 15 feet), with power requirements as indicated on data table at end of section.
 - 1. Controls:
 - 1) Motor Starters: Magnetic with auto reset thermal overload protection device.
 - 2) Level Control: Integral float operated mechanical high-low switch. No external input required, auto-start, auto-stop.
 - 2. Capacity: See data table at end of section.
 - 3. Manufacturers and Products:
 - a. Zoeller Pumps; Model M139.
 - b. Or equal.

2.04 BACKFLOW PREVENTERS

- A. Double Check Backflow Preventer (3/4 Inch Through 2 Inches):
 - 1. Description:
 - a. Regulatory Compliance: AWWA C510, CSA B64.5, FCCHR of USC Section 10, ASSE 1015, ICC (IPC), NSF-61.
 - b. Valve Body: Cast copper silicon alloy..
 - c. End Connections: Threaded, NPT.
 - d. Maximum Working Pressure: 175 psi (350 psi test).
 - e. Temperature Range: 32 degrees to 140 degrees F.Shutoff Valve: Full port, resilient seated, bronze ball valve with bronze ball valve test cock.
 - f. Inlet Strainer: bronze wye strainer, 40-mesh perforated, Type 304 stainless steel.
 - 2. Sizes: See data sheet at end of section.

PLUMBING EQUIPMENT 22 30 00 - 6

- 3. Manufacturers and Products:
 - a. Febco; Model LF850.
 - b. Watts Regulator Company; Model LF719.
- B. Double Check Backflow Preventer (2-1/2 Inches Through 10 Inches):
 - 1. Description:
 - Regulatory Compliance: AWWA C510, CSA B64.5, FCCHR of USC Section 10, ASSE 1015, ICC (IPC), NSF-61, FM, UL, NSF-61G.
 - b. Housing: Type 304 stainless steel.
 - c. End Connections: Flanged.
 - d. Horizontal straight-through configuration.
 - e. Maximum Working Pressure: 175 psi (350 psi test).
 - f. Temperature Range: 32 degrees F to 140 degrees F.
 - g. Shutoff Valve: UL/FM Grooved gear operated butterfly valves with supervisory tamper switch.
 - h. Inlet Strainer: cast-iron wye strainer, Class 125 flanged, fusion epoxy AWWA C550 coated, perforated stainless steel screen (1/16-inch perforations on 2-1/2 inches to 4 inches; 1/8-inch perforation on 6 inches to 10 inches), threaded cap plug blowout opening.
 - i. UL Listed.
 - 2. Sizes: See data sheet at end of section.
 - 3. Manufacturer and Product: Watts, Colt C200NBFG.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install, arrange, and connect equipment as shown on the Drawings and in accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Pumps: Do not hydrostatic test pumps with mechanical seals.
- B. Startup:
 - 1. In accordance with Section 01 91 14, Equipment Testing and Facility Startup, and Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 2. Piping Systems: Verify that flushing, cleaning, and testing has been completed prior to startup.

3.03 **SUPPLEMENTS**

- Supplements listed below, following "End of Section," are a part of this A. Specification.
 - Electric Water Heater (Commercial) Data Sheet. Sump Pump (Commercial) Data Sheet. Backflow Preventers Data Sheet. 1.
 - 2.
 - 3.

END OF SECTION

Electric Water Heater (Commercial)								
Tag Number	Storage Capacity (gallons)	Upper Element (kW)	Lower Element (kW)	Simultaneous Element Operation	Voltage	Diameter (inches)	Height (inches)	Manufacturer, Model No.
IP15-WH-601-01	119	NA	6	NO	480V/3ph	30	69.25	Hubbel; Model EMV-120-85-6-SL
IP20-EWH-651-01	6	3	-	-	120V/1ph	15	16	AO Smith; DEL-6
CP20-EWH-651-01	6	3	-	-	120V/1ph	15	16	AO Smith; DEL-6
<u>Notes:</u> 1. Heating elements available are; 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, and 6.0 kW. 2. Voltages available are; 277V/3ph, and 480V/3ph.								

Sump Pumps (Commercial)									
Tag Number	Pump Location	Discharge Flow (GPM)	Discharge Head (TDH)	Motor Power (HP)	Voltage	Manufacturer	Model No.	Remarks	
CP11-PUMP-003-01	Caprock Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
CP19-PUMP-003-01	Caprock Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
CP20-PUMP-020-01	Caprock Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
CP22-PUMP-044-01	Caprock Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
CP24-PUMP-143-01	Caprock Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
CT11-PUMP-003-01	Caprock Tank	30	20 feet	1/2	110	Zoeller	M137	(1)	
CT32-PUMP-003-01	Caprock Tank	30	20 feet	1/2	110	Zoeller	M137	(1)	
IP24-PUMP-147-01	Intake Pump Station	30	20 feet	1/2	110	Zoeller	M137	(1)	
IP15-PUMP-009-01	Chemical Storage	30	20 feet	1/2	110	Zoeller	M139	(2)	
Notes: 1. Sump pump to run in auto, plug into continuously powered 110V outlet.									

2. Sump pump to be started manually from switched 110V outlet, with auto low-level stop.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS PLUMBING EQUIPMENT 22 30 00 SUPPLEMENT - 1

Backflow Preventers								
Tag Number	Valve Type ¹	Size (inches)	Flow Stream	Maximum Operating Flow (gpm)	Maximum Pressure Drop (psi)	Manufacturer, Model No.		
IP15-BFP-601-01	DC	3	FS	200	8	Febco, Model 850		
IP15-BFP-601-01	DC	1-1/2	W1	50	8	Febco, Model LF850		
Notes:								
1. Valve Type: RP - Reduced Pressure, DC - Double Check.								

2. Flow Streams: DIW - Deionized Water, FS - Fire Service, IRR - Irrigation Water, LCW - Laboratory Cold Water, TWS - Tempered Water Supply, W1 - Potable Water, W2 - Nonpotable Water, W3 - Plant Water.

SECTION 22 40 00 PLUMBING FIXTURES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Americans with Disabilities Act (ADA).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. American Society of Sanitary Engineering (ASSE): 1010, Performance Requirements for Water Hammer Arresters.
 - 4. ASTM International (ASTM): D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 5. Food and Drug Administration (FDA).
 - 6. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
 - 7. Plumbing and Drainage Institute (PDI):
 - a. Code Guide 302 and Glossary of Industry Terms.
 - b. WH-201, Water Hammer Arrester Standard.
 - 8. UL.

1.02 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.03 SUBMITTALS

- A. Action Submittals: Catalog information and rough-in dimensions for plumbing fixtures, products, and specialties.
- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.

1.04 REGULATORY REQUIREMENTS

A. Comply with the Americans with Disabilities Act (ADA), and local and state requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS

- A. Fixture Trim:
 - 1. Supply Stops and Traps:
 - a. McGuire.
 - b. American Standard.
 - c. Kohler.
 - d. Elkay.
 - 2. Water Closet Seats:
 - a. Bemis.
 - b. Church.
 - c. Olsonite.
 - 3. Lavatory Supply, Tailpiece, and Trap Insulation:
 - a. McGuire.
 - b. Trap Wrap.
 - c. Truebro.
 - d. Elkay.
- B. Plumbing Fixtures:
 - 1. Water Closets and Lavatories:
 - a. American Standard.
 - b. Kohler.
 - c. Eljer.

PLUMBING FIXTURES 22 40 00 - 2

- 2. Faucet Fittings:
 - a. Sinks:
 - 1) Chicago.
 - 2) T&S Brass.
 - 3) Elkay.
 - b. Lavatories:
 - 1) Chicago.
 - 2) Symmons.
- C. Emergency Showers and Eyewashes:
 - 1. Haws.
 - 2. Western.
 - 3. Guardian.
- D. Drainage Products:
 - 1. General:
 - a. Smith.
 - b. Wade.
 - c. Zurn.
- E. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Smith.
 - b. Sioux Chief.
 - c. Precision Plumbing Products.
 - 2. Pressure/Temperature Relief Valves:
 - a. Cash-Acme.
 - b. Kunkle Valve.
 - c. Watts.
 - 3. Pressure Gauges:
 - a. Ashcroft.
 - b. Marsh.
 - c. Marshalltown.
 - 4. Thermometers:
 - a. Trerice.
 - b. Weksler.

2.03 GENERAL

- A. Fixture Trim: Provide plumbing fixture trim where applicable on fixtures.
- B. Plumbing Fixtures: Indicated by fixture number as shown on the Drawings.
- C. Drainage Products: Indicated by fixture number as shown on the Drawings.

- D. Plumbing Specialties: Indicated by fixture number as shown on the Drawings.
- E. Exposed fixture connections shall be stainless steel.

2.04 MATERIALS

- A. Fixture Trim:
 - 1. Supply Stop:
 - a. Flexible supply with stainless steel, loose key, 1/2-inch IPS by 3/8-inch outside diameter tubing angle stop to wall with escutcheon plate.
 - b. Provide stop with stuffing box.
 - 2. Trap:
 - a. 17-gauge equivalent, P-trap with compression ring stainless steel waste and vent connection and cleanout.
 - b. 1-1/2 inches for lavatories and drinking fountains.
 - c. 1-1/2 inches for sinks.
- B. Plumbing Fixtures:
 - 1. LAV-1, Lavatory (Wall-Hung Type, ADA Compliant):
 - a. Fixture: 20 inches by 18 inches, vitreous china, for floor-mounted concealed arm carrier, three-hole punched on 4-inch centers for faucet. American Standard Companies, Inc.; Lucerne, Model 0355.012.
 - b. Faucet: Chicago Faucet Co.; Model 2200-4CP with 0.5-gpm flow restricter.
 - c. Trim: 3/8-inch supply stop with loose key, stainless steel P-trap.
 - d. Insulation: McGuire Manufacturing Company, Inc., Prowrap antimicrobial PVC resin seamless insulation for trap, tailpiece, and hot and cold water supply piping.
 - e. Strainer: McGuire Manufacturing Company, Inc.; Model 155A chrome-plated grid strainer with tailpiece.
 - f. Carrier: Jay R. Smith Mfg. Co.; 700 series concealed arm.
 - 2. SSK-1, Service Sink:
 - a. Fixture: Enameled cast iron with stainless steel rim guard and blank back. Kohler; Bannon, Model K-6718.
 - b. Faucet: Chicago Faucet Co.; Model 835-CP, exposed top supplies, with hose threads, vacuum breaker, and rod support.
 - c. Accessories: Kohler; Model K-6673, 3-inch trap standard with grid strainer.

- 3. WC-1, Water Closet (Floor Mounted, Flush Tank Type, ADA Compliant):
 - a. Elongated bowl, vitreous china, bolt caps, tank liner, 1.28 GPF as manufactured by:
 - 1) American Standard, Cadet 2467.100.
 - 2) Kohler, Highline K-3999.
 - b. Seat: White open-front, self-sustaining check hinges with stainless steel posts and pintles as manufactured by Olsonite, No. 10SSCT.
- C. Safety Equipment:
 - 1. SSH-1, Safety Shower/Eyewash Combination:
 - a. Model: Haws Co.; Model 8346.
 - b. Shower: ABS plastic deluge.
 - c. Eyewash: Stainless steel bowl with aerated eye/face wash.
 - d. Valve: Stay open.
 - e. Support: Freestanding, 1-1/4-inch galvanized pipe standard, stanchion, and floor flange.
 - f. Factory applied CRP (corrosive atmospheres coating).
 - g. Alarm System:
 - 1) Double pole, double throw flow switch.
 - 2) Power Requirements: 120V/1ph.
 - 3) Enclosure: Wall mounted, rated NEMA 4 or equivalent.
 - 4) Amber signal light and audible alarm.
 - 5) Automatic reset and silence switch.
 - 6) Manufacturer and Model: HAWS Co., Model 9001.
 - 2. SSH-2, Safety Shower/Eyewash Combination, Frost Proof, Through-Wall Type:
 - a. Model: Bradley Corp., Model S19-310TW
 - b. Shower: ABS plastic deluge.
 - c. Eyewash: Chrome-plated brass spray head.
 - d. Operator: Stainless steel push handle, hand operated.
 - e. Valve:
 - 1) Shower: 1 inch NPT stay-open valve.
 - 2) Eyewash: 1/2 inch NPT stay-open valve.
 - f. Support: Wall-mounted, through wall type, 1-1/4 inch coated galvanized steel.
 - g. Alarm System:
 - 1) Double pole, double throw flow switch.
 - 2) Power Requirements: 120V/1ph.
 - 3) Enclosure: Wall mounted, rated NEMA 4X.
 - 4) Amber signal light and audible alarm.
 - 5) Automatic reset and silence switch.
 - 6) Manufacturer and Model: Bradley Corp., Model S19-324D.

- D. Drainage Products:
 - 1. CO-1, Cleanout (Exterior):
 - a. Material: Taper thread, bronze plug, heavy-duty, scoriated castiron top.
 - b. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 4263.
 - 2. CO-2, Cleanout:
 - a. Material: Taper thread, bronze plug, scoriated nickel bronze top.
 - b. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 4023.
 - 3. FD-1, Floor Drain (Finished Areas):
 - a. Materials: Cast-iron body, adjustable nickel bronze strainer.
 - b. Options: Jay R. Smith Mfg. Co.; Model 2696, trap primer connection.
 - c. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 2005T-U- round.
 - 4. FD-2, Floor Drain (Unfinished Areas, General Drainage):
 - a. Materials: Stainless steel body and grate, Type 316 stainless steel equivalent.
 - b. Options: Sediment bucket, , trap primer connection, vandal-proof grate.
 - c. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 9710T-U.
 - d. Trap Seal: Sized to match floor drain.
 - 1) Manufacturer and Product: Jay R Smith Mfg. Co.; Model 2692.
 - 5. HD-1, Hub Drain:
 - a. Stainless steel reducing hub adapter with standard stainless-steel hub.
 - b. Hub: Two pipe sizes larger than outlet.
 - 6. WCO, Wall Cleanout:
 - a. Material: Stainless steel cover and screw.
 - b. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 4472.
 - 7. DB-1, Downspout Boot:
 - a. Material: Galvanized cast-iron body and strap.
 - b. Option: 2-inch cleanout.
 - c. Manufacturer and Product: Jay R. Smith Mfg. Co.; Model 1785 (4-inch by 3-inch) series.
- E. Hose Valves: Refer to Section 22 10 01, Plumbing Piping and Accessories.

- F. Plumbing Specialties:
 - 1. Water Hammer Arresters:
 - a. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
 - b. Manufacturer and Product: Sioux Chief Mfg. Co., Inc.; Series 650 and 660.
 - 2. Pressure/Temperature Relief Valve:
 - a. Materials: ASME/AGA rated, bronze body construction, vacuum relief valve vent in drain, backup emergency safety fuse plug, tamper-resistant bonnet screws, test lever, short thermostat, and automatic reseating.
 - b. Manufacturer and Product: Watts Industries, Inc.; Series 40.
 - 3. Pressure Gauge:
 - a. Materials: 3-1/2-inch gauge size, 0 psi to 160 psi range, steel case, glass crystal, brass movement, and 1/3-inch NPT lower connection.
 - b. Manufacturer and Product: Ashcroft Dresser Instrument Division, Dresser Industries, Inc.; Type 1008.
 - 4. Thermometer:
 - a. Materials: Adjustable angle, red reading mercury type with 9-inch case and 30 degrees F to 180 degrees F range, 3-1/2-inch aluminum stem, and separate NPT brass thermowell.
 - b. Manufacturer and Product: H.O. Trerice Co.; Model A005.
- G. Sealant: In accordance with Section 07 92 00, Joint Sealants.

PART 3 EXECUTION

- 3.01 PREPARATION
 - A. Drawings do not attempt to show exact details of fixtures. Changes in locations of fixtures, advisable in opinion of Contractor, shall be submitted to Engineer for review before proceeding with the Work.

3.02 INSTALLATION

- A. Fixture Trim: Install fixture trim where applicable on fixtures.
- B. Plumbing Fixtures, Mounting Heights:
 - 1. Standard rough-in catalogued heights, unless shown otherwise on the Drawings.
 - 2. Caulk fixtures in contact with finished walls with waterproof, white, nonhardening sealant which will not crack, shrink, or change color with age. See Section 07 92 00, Joint Sealants.

- C. Exact fixture location and mounting arrangement shall be as indicated on toilet room elevations and details as shown on the Drawings.
- D. Unless noted otherwise and as a minimum, fixtures shall be supported as indicated in PDI Code Guide 302.
- E. Safety Equipment:
 - 1. System Shutoff Valves:
 - a. Shutoff valves shall give visual indication of position (open or closed).
 - b. Shutoff valves shall be lockable valves and locked in open position.
 - 2. Each combination safety shower/eyewash shall have red safety signoff tag. After completing requirements listed below, Contractor and Owner shall sign red safety signoff tag. Requirements are as follows:
 - a. Visually check safety shower/eyewash piping for leaks.
 - b. Verify that upon operation, stay-open valves remain open.
 - c. Showerheads to be between 82 inches and 96 inches above standing surface.
 - d. Shower spray pattern, when valve is full open, shall be a minimum 20 inches in diameter at 60 inches above standing surface.
 - e. Water arcs from eyewash spray heads must cross. Test with eyewash gauge; Haws Drinking Faucet Co., Model 9015.
 - f. Minimum flow rates for safety showers shall be 20 gpm.
 - g. Minimum flow rates for eyewashes shall be 3 gpm.
 - h. Tempered water shall be temperature indicated on the Drawings.
- F. Drainage Products:
 - 1. Floor Drains: Set top flush with floor. Provide membrane clamps where required.
 - 2. Cleanouts: Install where shown or required for purposes intended. Set cover flush with finished floor.
 - 3. Hub Drains: Set top of hub 2 inches above finished floor.
 - 4. Downspout Boots: Install where shown on Architectural Drawings.
- G. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Install PDI-certified and rated shock arresters, sized and located in accordance with PDI WH-201 and as shown on the Drawings.
 - b. Install adjacent to equipment wherein quick closing valves are installed.

- c. Install at each combination safety shower/eyewash.
- d. Shock arresters to have access panels or to be otherwise accessible.
- 2. Thermometers and Pressure Gauges:
 - a. Arrange devices to facilitate use and observation.
 - b. Install in orientation that will allow clear observation from ground level.
 - c. Provide pressure gauges with block valves.
 - d. Install thermometers in thermowells.
- H. Caulk penetrations of exterior walls with weatherproof sealant in accordance with Section 07 92 00, Joint Sealants.

3.03 FIELD QUALITY CONTROL

- A. Perform visual inspection for physical damage, blocked access, cleanliness, and missing items.
- B. Notify Owner and Engineer 48 hours prior to shower testing. Owner and Engineer reserve the right to witness all tempered water and safety shower testing.
- C. Test safety shower and eyewash units. Water flow must be tested at both showerhead and eyewash/face ring.
 - 1. Shower Flow:
 - a. Test with tube-type water gauge (Haws Drinking Faucet Co., Model 9010) and 5-gallon container.
 - b. Container shall fill in 10 seconds or less, with a minimum 20-gpm flow.
 - 2. Eyewash Flow:
 - a. Test with tube-type water gauge (Haws Drinking Faucet Co., Model 9010) and 1-gallon container.
 - b. Container shall fill in 20 seconds or less.
 - 3. Contractor shall log, date, and initial inspection upon passing flow tests.
- D. Verify alarm operation both locally and systemwide. Notify security prior to test if alarm is connected systemwide.

END OF SECTION

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
 - 3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
 - 4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - b. Procedural Standards for Measuring Sound and Vibration.
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Documentation of experience record of testing authority.
 - 2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.
 - 3. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.
 - 4. Written verification of calibration of testing and balancing equipment.
 - 5. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.03 QUALITY ASSURANCE

- A. Air Balancing and Test Agency Qualifications:
 - 1. Certification by AABC of NEBB for testing, adjusting and balancing of HVAC systems.
 - 2. Corporately and financially independent organization functioning as an unbiased testing authority.
 - 3. Professionally independent of manufacturers, suppliers, and installers of HVAC equipment being tested.

- 4. Have a proven record of at least five similar projects.
- 5. Employer of engineers and technicians regularly engaged in testing, adjusting and balancing of HVAC equipment and systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.
- B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust and balance air systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.
- B. Adjust and balance the following systems:
 - 1. Supply, return and exhaust air systems.

3.02 ADJUSTING AND BALANCING AIR SIDE

- A. Preparation:
 - 1. Prior to beginning the Work, perform the following activities:
 - a. Review Shop Drawings and installed system for adequate and accessible balancing devices and test points.
 - b. Recommend to Engineer dampers that need to be added or replaced in order to obtain proper air control.
 - c. Verify proper startup procedures have been completed on the system.
 - d. Verify controls installation is complete and system is in stable operation under automatic control.
 - e. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.
- B. General:
 - 1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.

- 2. Lock and mark final positions of balancing dampers with permanent felt pen.
- 3. Correct fan and airflow measurements for an assumed Site elevation of 4,400 feet above mean sea level.
- C. Equipment Data:
 - 1. Collect the following data and included in final report:
 - a. Type of unit.
 - b. Equipment identification number.
 - c. Equipment nameplate data (including manufacturer, model, size, type, and serial number).
 - d. Motor data (frame, hp, volts, FLA rpm, and service factor).
 - e. Starter and motor overload protection data.
 - f. Include changes made during course of system balancing.
- D. Fan Systems:
 - 1. Measure fan system performance in accordance with AMCA 203.
 - 2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.
 - 3. Adjust Fan Air Volumes:
 - a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.
 - b. After final adjustments, do not operate motor above nameplate amperage on any phase.
 - c. After final adjustments, do not operate fan above maximum rated speed.
 - d. After final adjustments, record fan motor rpm at each fan speed setpoint.
 - e. Perform airflow test readings under simulated or actual conditions of full cooling, full heating, minimum outside air, full outside air and exhaust, and full return air.
 - 4. Adjust outside air dampers, return air dampers, relief air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.
 - 5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable-volume boxes, on every supply, return, and exhaust fan for each test condition.
 - 6. Read and record motor amperage on all phases for each test condition.

- E. Air Outlets and Inlets:
 - 1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
 - 2. Adjust air volumes on supply diffusers and grilles, and on return and exhaust grilles, to the quantity shown, with allowable variation of plus or minus 10 percent.
 - 3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.
 - 4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.

3.03 COMMISSIONING AND FACILITY STARTUP

- A. Commissioning and Facility Startup shall be in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. Facility startup specifies the order of and prerequisites for the following tests of the equipment:
 - 1. Component Testing.
 - 2. Functional Testing.
 - 3. Software Operational Testing.
 - 4. Performance Testing.
 - 5. Demonstration Testing.
- C. Commissioning and facility startup shall be performed using a qualified representative provided by the Manufacturer as specified in Section 01 91 14, Equipment Testing and Facility Startup, Section 01 43 33, Manufacturers' Field Services, and as elaborated upon in this section.

3.04 FIELD QUALITY CONTROL

- A. General: Perform functional tests as required by Section 01 91 14, Equipment Testing and Facility Startup.
- B. Performance Testing:
 - 1. Electric Heating Coil Testing:
 - a. Adjust system as required to achieve full output from coil.
 - b. Read and record amperages and voltages for all phases.
- C. Balancing Log Report Requirements:
 - 1. Include narrative description for each system explaining TAB methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.

- 2. Log and record operational information from every test for each system, as necessary to accomplish services described.
- 3. Include equipment data for units tested.
- 4. Include reduced set of HVAC Drawings or system schematic diagrams with each element uniquely identified and indexed to balance log.
- 5. Indicate recorded site values, and velocity and mass correction factors used to provide equivalent standard air quantities.
- 6. Include separate section in log, if necessary, describing operating difficulties in air systems that could not be eliminated by specified procedures. Identify these problems by system and location within building; include outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.
- D. Quality Control Verification:
 - 1. After adjustments have been completed and balance logs submitted, balancing and testing agency shall be available to demonstrate the following:
 - a. Air balancing procedures, vibration tests, and verification of test results.
 - b. Perform spot tests on a maximum of 20 percent of total diffusers and grilles, on two air handling fan devices per building, with measuring equipment used in original tests, at random points selected by Engineer.
 - c. Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of system as requested by Engineer.
 - d. At completion of rebalance procedures, perform another spot test if required to verify results.

END OF SECTION
SECTION 23 07 00 HVAC INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. Association of the Nonwoven Fabric Industry (INDA). IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 3. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - c. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - d. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - e. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - h. G22, Standard Practice for Determining Resistance of Plastics to Bacteria.
 - 4. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - b. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - c. 259, Standard Test Method for Potential Heat of Building Materials.
 - 5. UL.

DEFINITIONS 1.02

- Cold Air Ductwork: Designed to convey mechanically cooled air or return A. ducts in such systems.
- Warm Air Ductwork: Designed to convey mechanically heated air or return B. ducts in such systems.

1.03 **SUBMITTALS**

- Action Submittals: Product description, list of materials and thickness for each A. service or equipment scheduled, locations, and manufacturer's installation instructions.
- B. Informational Submittals:
 - Proof of compliance for test of products for fire rating, corrosiveness, 1. and compressive strength.
 - 2. Operation and maintenance data as specified in Section 01 78 23, Operation and Maintenance Data.
 - Certificate of compliance with the Build America, Buy America Act. 3. See Section 01 33 00, Submittal Procedures.
 - Certificate of compliance with American Iron and Steel. See 4. Section 01 33 00, Submittal Procedures.

QUALITY ASSURANCE 1.04

- Materials furnished under this specification shall be standard, cataloged A. products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- Provide materials by firms engaged in the manufacture of insulation products B. of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
- C. UL listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

DECEMBER 2024

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Every package or standard container of insulation, jackets, cements, adhesives and coatings delivered to Project Site for use must have manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Marked "asbestos-free."

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
 - B. Insulation: Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
 - C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
 - D. Fire Resistance:
 - 1. Insulation, Adhesives, Vapor Barrier Materials and Other Accessories, Except as Specified Herein: Noncombustible.
 - 2. Do not use fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration resulting from the effects of moisture or high humidity are not acceptable.
 - 4. Provide materials including facings, mastics, and adhesives, with fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with ASTM E84 (NFPA 255) methods.
 - E. Materials exempt from fire-resistant rating:
 - 1. Nylon anchors.
 - 2. Treated wood inserts.
 - F. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - 1. Polyurethane insulation.
 - 2. PVC casing.
 - 3. Fiberglass-reinforced plastic casing.

2.02 DUCT INSULATION

- A. Type D2—Board:
 - 1. Fiberglass, minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 0 degree F to 450 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Knauf; Duct Slab.
 - c. Owens/Corning Fiberglass; TIW.
 - d. Johns Manville; 1000 Series Spin-Glass.
- B. Type D3—Liner (ASTM C1071, Type 1):
 - 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean, black composite coated surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
 - 2. Liquid water repellency rating not less than 4 when tested in accordance with INDA IST 80.6.
 - 3. Potential heat value not exceeding 3,500 Btu/lb when tested in accordance with NFPA 259 and meeting the classification of "Limited Combustible" as defined by NFPA 90A.
 - 4. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
 - 5. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139, ASTM G21, and ASTM G22.
 - 6. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. Johns Manville; Linacoustic (rectangular), Spinacoustic (Round).
 - c. Knauf; Acoustic Duct Liner.

PART 3 EXECUTION

3.01 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with the manufacturer's written instructions and in accordance with recognized industry practices.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulation. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage. Tape all punctures.

- E. Seal longitudinal and circumferential joints with FSK tape, and finish with fiberglass mesh fabric embedded in vapor barrier mastic.
- F. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.
- G. Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- H. Refer to Section 23 31 13, Metal Ducts and Accessories, for installation of internal duct liner.

3.02 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal all exterior joints to make watertight.

3.03 DUCTWORK INSULATION REQUIREMENTS

- A. Mechanically Cooled and Heated Supply and Return Air, and Outside Air (Exposed to View):
 - 1. Type D2, board.
 - 2. Thickness as required to achieve R-values as required in the New Mexico Energy Code.
- B. Mechanically Cooled and Heated Supply Air, Return Air, and Outside Air (outdoors):
 - 1. Type D3, liner.
 - 2. Thickness as required to achieve R-values as required in the New Mexico Energy Code.
- C. Air Distribution Devices: Refer to Section 23 37 00, Air Outlets and Inlets, for requirements.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS HVAC INSULATION 23 07 00 - 5

3.04 INSULATION FINISH REQUIREMENTS

- A. Ductwork Insulation (Exposed to View, Indoors): Factory finish.
- B. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.05 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 23 09 00 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): INCITS 4, Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - a. Handbook Fundamentals.
 - b. Guideline 3, Reducing Emission of Fully Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems.
 - c. 135, Data Communication Protocol for Building Automation and Control Networks.
 - 3. American Society of Mechanical Engineers (ASME): B19.3, Safety Standard for Compressors for Process Industries.
 - 4. American Water Works Association (AWWA): C704, Propeller-Type Meters for Waterworks Applications.
 - 5. Electronic Industries Alliance (EIA):
 - a. TIA-232-F, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485, Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi-point Systems.
 - 6. Federal Communications Commission (FCC).
 - International Organization for Standardization (ISO): 8802-3, Information Technology - Telecommunication and Information Exchange Between Systems - Local and Metropolitan Area Networks -Specific Requirements - Carrier Sense Multiple Access with Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - 8. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code.
 - b. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 10. UL: 916, Standard for Safety Energy Management Equipment.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

1.02 DEFINITIONS

- A. The terms "HVAC Control System," "Automatic Temperature Control System," "Building Automation System," and "Environmental Management and Control System" shall be considered equivalent and used interchangeably for the purposes of this Contract.
- B. Algorithm: A software procedure for solving a recurrent mathematical or logical problem.
- C. Analog: A continuously varying signal or value (temperature, current, velocity, etc.).
- D. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.
- E. Control Wiring:
 - 1. Wiring, high or low voltage other than power wiring required for proper operation of mechanical systems.
 - 2. Includes conduit, wire and wiring devices to install complete control system including motor control circuits, interlocks, thermostats, PE and EP switches and like devices.
 - 3. Includes wiring from DDC cabinet to all sensors and points defined in the Points List summary or specified herein and required to execute sequence of operation.
 - 4. Includes necessary power wiring to HVAC control devices, digital controllers including terminal units and actuators.
- F. Control Process: Software required to complete control loop from input signal to interlock logic and process calculation to final output signal control.
- G. Deadband: Temperature range over which no heating or cooling energy is supplied, such as 72 degrees F to 78 degrees F; as opposed to single point changeover or overlap, or a range from set point over which no control action is taken.
- H. Direct Digital Control (DDC): Consists of microprocessor-based controllers with control logic performed by software. Analog-to-digital (A/D) converters transform analog values into digital signals that microprocessor can use.
- I. Power Wiring: Line voltage wiring to mechanical equipment. Line voltage wiring that also serves as control circuit, such as line voltage thermostat or involves interlocking with damper shall be considered control wiring.

- J. Abbreviations that may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. ATC: Automatic Temperature Control.
 - 3. BAS: Building Automation System.
 - 4. CHWS/R: Chilled/Hot Water Supply/Return.
 - 5. CMOS: Complementary Metal Oxide Semiconductor.
 - 6. DDC: Direct Digital Control.
 - 7. DX: Direct Expansion.
 - 8. EP: Electro-Pneumatic
 - 9. EEPROM: Electronic Erasable Programmable Read Only Memory.
 - 10. EMCS: Environmental Management and Control System.
 - 11. HCP: HVAC Control Panel.
 - 12. HGS/R: Hot Glycol Supply/Return.
 - 13. HMI: Human-Machine Interface.
 - 14. HOA: Hand-Off-Auto (Switch).
 - 15. HVAC: Heating, Ventilation, and Air Conditioning.
 - 16. IP: Current (I) Pressure (P), as in IP transducer.
 - 17. LCD: Liquid Crystal Display.
 - 18. LED: Light Emitting Diode.
 - 19. PE: Pneumatic-Electric
 - 20. PLC: Programmable Logic Controller.
 - 21. RAM: Random Access Memory.
 - 22. RTD: Resistance Temperature Detectors.
 - 23. VAV: Variable Air Volume.
 - 24. W3: Nonpotable Water.

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SYSTEM DESCRIPTION

- A. General Requirements:
 - 1. Provide control wiring, power wiring, conduit, hardware, and electrical work associated with the HVAC control system.
 - 2. Provide control wiring between HVAC control panel contacts and field control devices, such as duct smoke detectors and motor starter control coil contacts.
 - 3. Provide controls necessary for entire system to have fail-safe operation.

- 4. Control sequences and functions including alarms, monitoring and resetting functions, and operational sequences shall not be limited to point schedules and sequences of operation.
- 5. Provide sequences and functions as required to deliver a fully functioning HVAC system.
- B. Control System Types:
 - 1. The following control system types may be used in this Project:
 - a. Electric/Electronic Control System (ELECTRIC):
 - 1) System using simple electric or electronic control devices.
 - 2) User interface at control device.
 - b. Standalone DDC Control System (STANDALONE DDC):
 - 1) Microprocessor-based DDC Control System utilizing standalone DDC controllers.
 - 2) No information sharing between controllers.
 - 3) User interface at DDC controller.
 - 4) Refer to Section 23 09 23, Direct-Digital Control System for HVAC, for additional requirements.
 - 2. Provide control system(s) of architecture defined in Control Type Schedule, below:

Control Type Schedule					
Location	System	Control Type			
All	Where operating sequences call for simple thermostatic or interlock control	ELECTRIC			
Process Areas	All	STANDALONE DDC			

- C. Performance Requirements: Design control system and equipment to perform under the following conditions:
 - 1. Temperature, Ambient:
 - a. Summer maximum 110 DB/72.2 WB degrees F.
 - b. Winter minimum 12.1 DB degrees F.
 - c. Based on ASHRAE Handbook fundamentals weather data for the City of Tucumcari, New Mexico.
 - 2. Temperature, Indoor:
 - a. Heated and Ventilated Process Areas: Summer maximum 90 degrees F; winter minimum 50 degrees F.
- D. Refer to Section 01 61 00, Common Product Requirements, for additional environmental performance requirements.

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC 23 09 00 - 4

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that includes make, model, dimensions, weight of equipment, and electrical schematics, for all control system components.
 - 2. Complete system power, interlock, control, and data transmission wiring diagrams no smaller than 11 inches by 17 inches.
 - 3. Complete drawings and schematics of proposed control system, including panel power requirements.
 - 4. System operating sequences to be programmed, in exact English language.
 - 5. Complete points list.
 - 6. Interfaces with HVAC equipment.
 - a. Schematic diagram of each equipment item.
 - b. Indicate location of each control item in equipment.
 - c. Show equipment manufacturer controls where installed.
 - 7. Panel face layout dimensional drawings.
- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.
 - 3. Table identifying which member of Contractor's team is responsible for furnishing and setting in-place power wiring and control wiring of each item or component of HVAC equipment.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
 - 6. Confirmation that control system Supplier has received, and coordinated with all approved HVAC equipment submittals.
 - 7. Experience and qualifications of control system Supplier's proposed representative who will supervise installation, adjustment, and calibration of control systems.
 - 8. Performance test plan and schedule.
 - 9. Test Results:
 - a. Functional and performance test documentation.
 - b. Component calibration sheets for each instrument and panel component as described in Section 40 90 00, Process Instrumentation and Control Systems.

- 10. Operation and maintenance data: In accordance with Section 01 78 23, Operation and Maintenance Data. In addition, include the following detailed information:
 - a. Operation and maintenance instructions for control system as furnished and installed, including control of associated mechanical and electrical equipment.
 - b. Record of system adjustments and calibration methods.
 - c. Performance test results.

1.06 QUALITY ASSURANCE

- A. Materials, devices, appliances, and equipment used shall be indicated as acceptable by established standards of UL.
- B. Codes and Standards: Meet requirements of applicable standards and codes, except when more detailed or stringent requirements are indicated by Contract Documents, including requirements of this section.
 - 1. Underwriters Laboratories: Products shall be UL 916-PAZX listed.
 - 2. National Electrical Code NFPA 70.
 - 3. Federal Communications Commission Part J.
- C. Qualifications of HVAC Controls System Supplier:
 - 1. Minimum of 15 years' experience in design, installation, and maintenance of fully electronic building automation systems.
 - 2. Minimum of 10 years' experience in design, installation, and maintenance of computer based, direct digital control, facility automation systems.
 - 3. Minimum of 5 years' experience as manufacturer's authorized representative in design, installation, and maintenance of manufacturer's system and products.
 - 4. Capable of furnishing factory-trained technicians, competent to provide instruction, routine maintenance, and emergency service onsite within 4 hours after receipt of request.
 - 5. Factory trained certified engineering and commissioning staff, and complete offsite training facilities.
 - 6. Necessary facilities to provide Owner with complete maintenance, periodic inspection, and service contract. Refer to Paragraph Maintenance.
- D. FCC Regulation: Electronic equipment shall conform to requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

- E. Compatibility:
 - 1. System shall have documented history of compatibility by design for minimum of 15 years. Future compatibility shall be supported for no less than 10 years.
 - 2. Compatibility shall be defined as:
 - a. Ability to upgrade existing field panels to current level of technology, and extend new field panels on previously installed network.
 - b. Ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers, or protocol converters.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 61 00, Common Product Requirements.
- B. Corrosion Protection:
 - 1. Control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through use of corrosion-inhibiting vapor capsules.
 - 2. Prior to shipment, capsules shall be provided within shipping containers and equipment as recommended by capsule manufacturer.
 - 3. During construction period, capsules shall be replaced in accordance with capsule manufacturer's recommendations.

1.08 EXTRA MATERIALS

- A. Tools:
 - 1. For each building, furnish one complete set of special tools recommended by manufacturer for maintenance, dismantling, or repair of each separate type of equipment item.
 - 2. Furnish toolbox for storage of special tools. Identify purpose by means of stainless steel or solid plastic nametag attached to box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified shall be products of the following manufacturers, unless indicated otherwise:
 - 1. Allen Bradley.
 - 2. Siemens Building Technologies.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 3. Johnson Controls.
- 4. The Trane Company.
- 5. Honeywell.
- 6. Invensys.
- 7. Alerton Technologies.
- 8. Delta Controls.
- 9. Automated Logic Corporation.
- 10. Andover.

2.02 MATERIALS

- A. General:
 - 1. Products used in this installation shall be new, currently under manufacture, and shall have been applied in similar installations for minimum of 2 years.
 - 2. System shall not be used as test Site for new products, unless explicitly approved by Owner's representative, in writing.
- B. Control Components:
 - 1. Control range to obtain specified capacities.
 - 2. Sensitivity to maintain control points close enough to set point for acceptable offset, without cycling equipment more frequently than recommended by manufacturer.
 - 3. Field or computer adjustable to actual set point, ranges. Adjustable to other settings that will provide proper operation of entire control system.
- C. Controls Interfacing:
 - 1. Interface controls properly with factory supplied components of mechanical systems. Coordinate special control interfacing requirements.
 - 2. For equipment that requires special interfacing with control system, provide equipment with integral controls or provide accessory devices required for operation of total mechanical system.
 - 3. Coordinate interfaces with electrical work as necessary.
 - 4. Provide electric, electronic, and mechanical devices as required to properly interface with prewired control panels furnished with HVAC equipment and with other mechanical and electrical components.

2.03 LABELING

A. All products, namely electrical materials, devices, appliances, and equipment used, shall be indicated as acceptable by established standards of UL and Factory Mutual (FM).

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC 23 09 00 - 8

- B. Valid label affixed to item shall provide indication of product acceptance by required agencies.
- C. HVAC control panels and control components that consist of multiple components shall bear UL listing mark on unit.

2.04 SERVICE CONDITIONS

- A. Refer to Section 01 61 00, Common Product Requirements, Section 26 05 02, Basic Electrical Requirements, and Electrical Drawings for classification of areas as hazardous, corrosive, wet, indoor dry, and dust-tight.
- B. Use materials and methods, and enclose devices in NEMA enclosure types suitable for classification indicated, and as required by NFPA 70.
- C. Exhaust ductwork shall be considered same classification as area served.
- D. Instruments within 3 feet of ducts conveying air from spaces classified as Class I, Division 1 or Division 2 (in accordance with NFPA 70) shall be suitable for same area classification as space exhausted.

2.05 ELECTRICAL COMPONENTS AND ACCESSORIES

- A. Electrical components shall be provided in accordance with requirements of Division 26, Electrical.
- B. Wiring:
 - 1. In accordance with Section 26 05 05, Conductors, and NFPA 70.
 - 2. Insulation shall be rated 600 volts, minimum.
- C. Electrical Raceways: In accordance with Section 26 05 33, Raceway and Boxes, and NFPA 70.
- D. Provide surge suppressors on each power connection, meeting applicable requirements of Section 40 90 00, Instrumentation and Control for Process Systems.

2.06 FIELD COMPONENTS AND INSTRUMENTS

A. Refer to HVAC controls detailed specification, Section 23 09 13, HVAC Controls, Field Components, and Instruments.

2.07 MICROELECTRONIC CONTROL COMPONENTS

A. Refer to HVAC controls detailed specification, Section 23 09 23, Direct-Digital Control System for HVAC.

2.08 ACCESSORIES

- A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.
- B. Equipment Identification Plates:
 - 1. Provide 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear block type equipment tag numbers as shown on the Drawings.
 - 2. Provide adjacent to the following control devices, and for equipment whose function is not readily apparent.
 - a. Manual override timers.
 - b. START/STOP switches.
 - c. Emergency STOP switches.
 - d. Special purpose devices.
 - e. HVAC control panels.
- C. Anchor Bolts: Provide as specified in Section 05 50 00, Metal Fabrications. Refer to Section 01 88 15, Anchorage and Bracing, for additional requirements.

2.09 EQUIPMENT FINISH

- A. Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated.
- B. If manufacturer has no standard color, provide gray finish as approved by Engineer.

PART 3 EXECUTION

- 3.01 SEQUENCES OF OPERATION
 - A. Reference Contract Drawings.

3.02 INSTALLATION

- A. General:
 - 1. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings, and equipment details.
 - 2. Changes in location or installation of control devices or equipment shall be approved by Engineer before proceeding with the Work.

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC 23 09 00 - 10

- 3. Mount devices requiring manual reset and all other user serviceable control devices in readily accessible locations.
- B. Wiring:
 - 1. General:
 - a. Install electric wire, cable, fittings, and conduit associated with systems specified in this section, in accordance with requirements of NFPA 70.
 - b. Install control and interlock wiring separate from power wiring.
 - c. Number code or color code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.
 - d. Provide wire markers on each conductor in panel and at load connections. Identify circuit with control wire number.
 - e. Restrain wiring in control panels by plastic ties or ducts.
 - f. Hinge wiring shall be secured at each end so that any bending or twisting will be around longitudinal axis of wire and bend area shall be protected with sleeve.
 - g. Arrange wiring neatly, cut to length, and remove surplus wiring. Provide abrasion protection for any wire bundles that pass through holes or across edges of sheet metal.
 - h. Use manufacturer's recommended tool with proper sized anvil for crimp terminations. No more than two wires may be terminated in single crimp lug and no more than two lugs may be installed on single screw terminal.
 - i. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.
 - j. Properly support and run wiring in a neat manner.
 - k. Run wiring parallel or at right angles to building structure.
 - 2. Concealment:
 - a. Generally conceal wiring from view, except in mechanical rooms and areas where other conduit and piping are exposed; install exposed wiring and conduit to be as unobtrusive as possible.
 - b. Install line voltage control wiring, wiring exposed to view, surface-mounted wiring, and wiring concealed within walls in conduit, in accordance with Division 26, Electrical.
 - c. Install exposed and concealed low voltage control wiring systems in conduit.
 - d. Wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.
 - e. Conduit shall be sized to suit the number, type, and size of conductors as specified in Section 26 05 05, Conductors.

- C. End-User Accessible Control Components:
 - 1. Do not mark room thermostats.
 - 2. Mount user adjustable control components (room thermostats, humidistats, temperature sensors, humidity sensors, etc.) level and in accordance with applicable accessibility requirements of local Building Code.
- D. Control Dampers:
 - 1. Verify correctness of installation.
 - 2. For pneumatic systems, calibrate and adjust positioners and IP transducers.
 - 3. Verify proper control action.
 - 4. Adjust limit switch settings.
 - 5. Adjust opening and closing speeds, and travel stops.
 - 6. Stroke control dampers by means of associated control output.
- E. Adjustable Frequency Drives:
 - 1. Verify control wiring installed to adjustable frequency drive.
 - 2. Calibrate and adjust remote speed control loop and feedback loop.
 - 3. Verify control actions and interlocks.
 - 4. Adjust minimum and maximum speed settings.
 - 5. Ramp adjustable frequency drive by simulation of associated controller output.
- F. DDC Controllers:
 - 1. Verify control wiring for correctness.
 - 2. Verify power wiring.
 - 3. Calibrate and adjust manual and auto control actions of controllers.
 - 4. Tune control loop.
 - 5. Stroke associated final element through controller output.
 - 6. Verify set points and alarm functions.
- G. HVAC Control Panel (HCP) Equipment:
 - 1. Mount HCPs level, plumb, and securely to wall or column. Verify that adequate clearance is provided to allow for full front panel swing.
 - 2. Provide field terminations and conduit knockouts for control/instrumentation wiring.
 - 3. Field termination wiring shall have designated instrument tag.
 - 4. Panel cutouts shall be cut, punched, or drilled and smoothly finished with round edges.
 - 5. Provide separate conduit entry for each power feeder circuit.
 - 6. Signals requiring grounding shall be grounded within panel.

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC 23 09 00 - 12 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 7. Field end of conductor shield/drain wires shall be folded back and placed under heat-shrink tubing without being grounded.
- 8. Panel end of conductor shield/drain wires shall be covered with clear tubing at panel and grounded.
- 9. Calibrate instrumentation provided on control panels.
- 10. Provide labels for internal panel material (such as, terminal blocks, power supplies, relays, PLC racks).

3.03 FIELD QUALITY CONTROL

- A. Performance and Functional Testing:
 - 1. Tests and certification shall be as specified in Section 01 91 14, Equipment Testing and Facility Startup, and Section 01 43 33, Manufacturers' Field Services.
 - 2. HVAC controls interface with process control system shall be coordinated with the Work of Section 40 90 00, Instrumentation and Control for Process Systems.

3.04 MANUFACTURER'S SERVICES

A. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

3.05 TRAINING

- A. Provide training of Owner's personnel to enable them to operate HVAC equipment in available modes, to adjust set points, and to interpret alarm signals.
- B. Training sessions shall be prepared in advance, and arranged for clear, effective transfer of information in minimum time.
- C. Provide training to operations and maintenance personnel per Section 01 43 33, Manufacturers' Field Services

3.06 ADJUSTING AND CALIBRATING

- A. Control system shall be adjusted and calibrated by qualified manufacturer's representative.
- B. Calibrate control devices at time of installation to ensure measuring and reading accuracy.

- C. Adjustment Record:
 - 1. Prepare complete record of system adjustments for each control system.
 - 2. Indicate deviations from specified temperatures.
 - 3. Include copy of completed record in each copy of Operation and Maintenance Manual.

3.07 CLEANING AND TOUCHUP PAINTING

A. Touchup scratches, scrapes, or chips in exterior surfaces with finish matching type, color, consistency, and type of surface of original finish.

END OF SECTION

SECTION 23 09 13 HVAC CONTROLS, FIELD COMPONENTS, AND INSTRUMENTS

PART 1 GENERAL

1.01 GENERAL

- A. This section is a supplement to Section 23 09 00, Instrumentation and Control Devices for HVAC.
- B. The requirements of this section shall be provided in addition to those listed in Section 23 09 00, Instrumentation and Control Devices for HVAC.

1.02 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.
- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.
 - 3. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.04 EXTRA MATERIALS

A. HVAC Control Panel (HCP) Spare Lamps: Furnish spare lamps for each type and color of pilot light used, a minimum of one per HCP, stored inside HCP in dummy light sockets secured to back panel surface.

PART 2 PRODUCTS

2.01 HVAC CONTROL PANELS (HCP)

- A. Provide at locations shown on the Drawings for convenient operator interface with control system.
- B. A single 120-volt, 20-amp feeder shall serve each HCP, unless otherwise indicated.
- C. HCP Contents: Set point adjustment dials, gauges, receiver controllers, manual timers, time clocks, microprocessor control modules, electronic indication relays, control switches, transformers, pilot lights, alarm lights, display screens, keypads, and other devices necessary for particular system.
- D. HCP Construction:
 - 1. Construct each HCP to NEMA 250 rating as indicated in Schedule below, except where indicated otherwise:

Construction Schedule		
Location	NEMA 250 Type	
Pump Rooms	4X	
Chemical Facility	4X	
Electrical Rooms	12	

HVAC Control Panel (HCP) NEMA 250 Construction Schedule

- 2. Metal enclosure to accommodate secure conduit fittings and protect against electrical transients.
- 3. Hinged front door with locking handle.
- 4. Flush-mount manual switches, pilot lights, and direct-reading gauges on front panel face.
- 5. Identify front panel mounted devices and HCP with labeling in accordance with Section 23 09 00, Instrumentation and Control Devices for HVAC.
- E. Panel Listing: Panels shall bear UL or ETL listing mark stating "LISTED ENCLOSED INDUSTRIAL CONTROL PANEL."
- F. Control Devices:
 - 1. Mount inside HCP.
 - 2. Prewired internally.
 - 3. Terminate wires leaving HCP at separately numbered terminal strips (one terminal pair per circuit).

- 4. Furnish individual connectors for every item of mechanical equipment, integral and remote pilot lights, and other devices described for each panel.
- 5. Refer to the Drawings for power and control circuit requirements.
- 6. Identify wires by color coding or numerical tags at both ends.
- 7. Wire control devices without splices to the terminal strip.
- 8. Furnish integral circuit protection for panel mounted control devices.
- G. Terminal Blocks:
 - 1. One-piece molded plastic blocks with screw type terminals and barriers rated for 600 volts.
 - 2. Double sided and supplied with removable covers to prevent accidental contact with live circuits.
 - 3. Furnish permanent, legible identification, clearly visible with protective cover removed.
 - 4. Terminate wires at terminal blocks with crimp type, preinsulated, ringtongue lugs.
 - 5. Size lugs for terminal block screws and for the number and size of wires terminated.
 - 6. Provide screwdriver access for blade width of a minimum of 3/16 inch or Klein 601 Series screwdrivers. Terminals requiring use of special screwdrivers are not acceptable.
- H. Miscellaneous Accessories:
 - 1. Furnish panel as-built electrical wiring diagrams and schematics, secured to inside of panel door, or enclosed in plastic jackets placed inside each panel.
 - 2. Install plastic or stick-on labels on interior control devices to identify them in conjunction with control schematics.

2.02 CONTROL DAMPERS

- A. General:
 - 1. Specification applies to control dampers, except those specified to be furnished with equipment.
 - 2. Furnish opposed-blade type for proportional action and parallel-blade type for two-position action, except where indicated otherwise.
- B. Standard Duty Control Dampers (M):
 - 1. Frame:
 - a. Nominal 5 inches deep, minimum 16-gauge (127 mm by minimum 1.6 mm) roll formed, hat-shaped channel, reinforced at

corners. (Structurally equivalent to 13 gauge (2.3 mm) U-channel.)

- b. Material: Type 304 stainless steel.
- 2. Blades:
 - a. Style: Single skin with three longitudinal grooves, minimum.
 - b. Orientation: Horizontal or vertical with thrust washers, as indicated on the Drawings.
 - c. Minimum 14 gauge (2 mm) equivalent thickness.
 - d. Material: Type 304 stainless steel.
 - e. Width: Nominal 6 inches (152 mm).
- 3. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
- 4. Seals:
 - a. Blade Seals: Inflatable PVC-coated fiberglass material and galvanized steel. Mechanically attached to blade edge.
 - b. Jamb Seals: Flexible metal compression type.
- 5. Linkage: Concealed in frame.
- 6. Axles:
 - a. Minimum 1/2 inch (13 mm) diameter, hex-shaped, mechanically attached to blade.
 - b. Material: Plated steel.
- 7. Performance Data:
 - a. As follows:
 - 1) Temperature Rating: Withstand minus 76 degrees F to 350 degrees F (minus 60 degrees C to 177 degrees C).
 - CLOSED Position: Maximum pressure of 13 inches w.g. (3.2 kPa) at a 12-inch blade length.
 - 3) OPEN Position: Maximum air velocity of 6,000 feet per minute (1,829 meters per minute).
 - Leakage: Maximum 2 cubic feet per minute per square foot (0.6 cubic meter per minute per square meter) at 1 inch w.g. (0.25 kPa) for all sizes 24 inches (610 mm) wide and above.
 - 5) Pressure Drop: Maximum 0.05 inch w.g. (0.01 kPa) at 1,500 feet per minute (457 meters per minute) across 24-inch by 24-inch (610-mm by 610-mm) damper.
- 8. Accessories:
 - a. As follows:
 - 1) Actuator: Refer to Article Control Damper Operators, for requirements.
 - 2) Switch Package: Two-position indicator switches linked directly to damper blade to remotely indicate damper blade position.
 - 3) Duct Transition Connection: Configuration to suit ductwork cross-section, as shown on the Drawings.

- 9. Manufacturers and Products:
 - a. Ruskin; Model CD-35.
 - b. American Warming and Ventilating.
 - c. TAMCO.

2.03 CONTROL DAMPER OPERATORS

- A. General:
 - 1. Drawings and Control Diagrams indicate only one damper motor for each motorized damper (M).
 - 2. Select actual quantity of motors required to operate each damper in accordance with size of damper provided.
 - 3. Coordinate exact quantity of damper motors with electrical work to ensure that necessary wiring and conduit is provided for installation.
 - 4. Provide operators for motorized dampers and motorized louvers.
- B. Electric Damper Operators:
 - 1. Performance: As scheduled on the Drawings.
 - 2. Mounting: External side plate.
 - 3. Ample power to overcome friction of damper linkage and air pressure acting on damper blades.
 - 4. Furnished with external adjustable stops to limit stroke.
 - 5. Operators on modulating dampers that are to be sequenced with other control devices shall have full relay type pilot positioner and interconnecting linkage to provide mechanical feedback that will accurately position and control damper.
 - 6. Intake, relief, and exhaust dampers shall close and return dampers shall open on control failure, unless indicated otherwise.
 - 7. Operating Torque:
 - a. Provide multiple independent damper sections, each with separate actuator, as needed to provide minimum of 120 percent of operating torque required by damper(s).
 - b. Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 1-inch WC air pressure on damper blades:
 - Opposed-Blade Dampers: Minimum 5 inch-pounds per square foot of damper area, unless higher values are recommended by damper manufacturer.
 - 2) Parallel-Blade Dampers: Minimum 7 inch-pounds per square foot of damper area, unless higher values are recommended by damper manufacturer.
 - 8. Manufacturers:
 - a. Belimo.
 - b. Neptronic.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS HVAC CONTROLS, FIELD COMPONENTS, AND INSTRUMENTS 23 09 13 - 5

- c. Siemens Building Technologies.
- d. Johnson Controls.
- e. Honeywell.

2.04 ELECTRONIC SENSORS

- A. Temperature (TS):
 - 1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in input/output summary and sequence of operations.
 - b. Temperature sensor shall resistance type, and shall be either twowire 1,000-ohm nickel RTD or two-wire 1,000-ohm platinum RTD.
 - c. The following point types (and accuracy of each) are required, and their associated accuracy values include errors associated with sensor, lead wire, and A to D conversion:

Point Type	Accuracy	
Room Temperature	$\pm 0.5^{\circ}F$	
Duct Temperature	$\pm 0.5^{\circ}\mathrm{F}$	
All Others	$\pm 0.75^{\circ}\mathrm{F}$	

- 2. Room Temperature (TS-1):
 - a. Constructed for either surface or wall box mounting.
 - b. Nonlocking wire protective guards for room temperature sensors installed in process areas.
 - c. Shall have the following options when specified:
 - Set point reset slide switch providing plus or minus
 3 degrees F (adjustable) range.
 - 2) Individual heating/cooling set point slide switches.
 - 3) Momentary override request pushbutton for activation of after-hours operation.
 - 4) Analog thermometer.
- 3. Outdoor Temperature (TS-2):
 - a. Accuracy: Plus or minus 1 degree F.
 - b. Range: Minus 40 degrees F to 140 degrees F.
 - c. Cover: Weathertight, with sealed conduit connection and sun shield.
- B. Position Indicator:
 - 1. 0 percent to 100 percent open, for damper, inlet vane, or similar.
 - 2. Potentiometer, 0 ohm to 2,000 ohm equals 0 percent to 100 percent.

- C. Current Sensors (CS):
 - 1. Fixed Setpoint, Digital Output Current Switch:
 - a. Application: Monitoring status of direct drive equipment.
 - b. Current-operated solid state relay.
 - c. Split core design.
 - d. Trip Setpoint: Fixed.
 - e. Output: Digital switch.
 - f. Sensor Power: Induced from line.
 - g. Manufacturer and Product: Veris; Hawkeye 600/800.

2.05 ELECTRIC THERMOSTATS (ET)

- A. Process Area Room Thermostat (ET-1)
 - 1. Modulating electric type, except where two-position action is required.
 - 2. Temperature Scale: Furnish 50 degrees F to 90 degrees F dial.
 - 3. External adjustments.
 - 4. Adjustable sensitivity.
 - 5. Insulating back where exterior wall mounting is indicated.
 - 6. Nonlocking wire protective guard.

2.06 MISCELLANEOUS DEVICES

- A. General:
 - 1. RTD to voltage (0-volt to 5-volt) converters with zero span adjustments for use with analog inputs.
 - 2. Limited range thermistors are acceptable provided they sense expected range for point at specified accuracy with 0-volt to 5-volt output.
 - 3. Auxiliary contacts in each motor starter, Work of Division 26, Electrical.
 - 4. START/STOP relay module for either momentary or maintained switch action as indicated.
- B. Pilot Relays:
 - 1. Plug-in type.
 - 2. Interchangeable.
 - 3. Mounted on a circuit board.
 - 4. Wired to numbered terminal strips.
- C. Electronic Indication:
 - 1. Furnish temperature-indicating dials or digital read-outs on HCP.
 - 2. 2-1/2-inch minimum rectangular.
 - 3. Temperature sensing dc bridge circuit.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- D. Duct Mounted Smoke Detection (I):
 - 1. Refer to Section 28 31 00, Fire Detection and Alarm, for requirements.
 - 2. Furnish duct smoke detectors for air handling systems with weatherproof enclosure, number and location as shown on the Drawings.
 - 3. Type: Duct mounted housing with prealigned sampling and exhaust tubes, analog sensing, solid state circuitry, plug-in, twist-lock base for photoelectric detector in accordance with UL 286A, NFPA 72, NFPA 90A, and NFPA 101 type.
 - 4. Voltage: 24V ac.
 - 5. Detector:
 - a. Type: Photoelectric.
 - b. Ambient Temperature Range: 32 degrees F to 140 degrees F.
 - c. Humidity Range: 10 percent to 93 percent relative humidity, noncondensing.
 - d. Velocity Range: 100 fpm to 4,000 fpm.
 - 6. Furnish with integral reset button or key switch and front mounted LED with pulsed indication for alarm condition.
 - 7. Include mounting bracket for installation on the ductwork.
 - 8. Coordinate with other trades to accomplish specified Automatic Smoke Detection shutoff control sequence. Refer to the Drawings.
 - 9. Manufacturers and Products:
 - a. Apollo America; Model RT-3000-P, NEMA 4X rated.
 - b. Siemens.
- E. HVAC System Emergency Shutdown Switch (ESS):
 - 1. Wall-mounted, break-glass type, yellow manual pull switches for HVAC system emergency shutdown.
 - 2. Noncoded, single action, single pole.
 - 3. Surface mounting type.
 - 4. Signage: Coordinate signage requirements with the requirements of Section 10 14 00, Signage. Wall mount directly above each switch. Refer to the Architectural Drawings for signage locations.
 - 5. Manufacturers and Products:
 - a. Simplex; 2099 Series.
 - b. Edwards; 270 Series.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Control Dampers:
 - 1. Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.

- 2. Install square and free from racking with blades running horizontally.
- 3. Operate opposed blade dampers from a power blade or drive axle.
- 4. Bracing:
 - a. Install for multiple section assemblies to support assembly weight and to hold against system pressure.
 - b. Install at every horizontal and vertical mullion.

END OF SECTION

SECTION 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 GENERAL

- A. This section is a supplement to Section 23 09 00, Instrumentation and Control Devices for HVAC.
- B. The requirements of this Section shall be provided in addition to those listed in Section 23 09 00, Instrumentation and Control Devices for HVAC.
- C. Design, furnish, and install a complete Direct Digital Control (DDC) system as required to accomplish the specified sequences of operation for control of heating, cooling, ventilating, air-conditioning, and other building equipment and systems as described herein.
- D. The requirements of this Section shall be provided in addition to those listed in Section 40 99 90, Package Control Systems.

1.02 DEFINITIONS

- A. ASCII: ANSI X3.4, Information Systems—Coded Character Sets—7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).
- B. BACnet: ASHRAE 135, BACnet, Data Communication Protocol for Building Automation and Control Networks.
- C. Distributed Control: System whereby control processing is decentralized and independent of central computer. Control system is built up of standalone controllers. Single controller failure shall not impact more than one system.
- D. Ethernet: ISO/IEC 8802-3. The most common high performance peer-to-peer LAN protocol.
- E. Integration:
 - 1. Ability of control system components from different manufacturers to connect together and provide coordinated control via real-time data exchange through common communications data exchange protocol.
 - 2. Integration shall extend to operator's workstation software, which shall support user interaction with control system components.
 - 3. Methods of integration include industry standard protocols, such as: BACnet, LonMark/LonTalk, OLE for Process Control (OPC), or integrator interfaces between manufacturer's systems.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 1

- F. Interoperability: Ability of equipment to communicate mutually.
- G. Input/Output (I/O): Connections between computer and sensors and actuators.
- H. Human-Machine Interface (HMI): Method by which operator communicates with HVAC Control System. Allows operator to command, monitor, and program control system.
- I. Internet Protocol (IP): Network layer protocol originally created by Defense Advanced Research Project Agency to facilitate data communication between U.S. Defense Department and defense contractors, including universities and manufacturers.
- J. Local Area Network (LAN): Network in which devices can communicate directly without going through intervening routers. LANs commonly used by DDC system Suppliers include Ethernet (ISO 8802-3), ARCNET, Echelon LonTalk, and EIA 485.
- K. Master-Slave/Token-Passing (MS/TP): One of the data link layers created specifically for use with BACnet messages.
- L. Network:
 - 1. System of distributed control units that are linked together on communication highway.
 - 2. Allows sharing of point information between control units.
 - 3. Provides central monitoring and control of entire system from any distributed control unit location.
 - 4. Primary networks provide peer-to-peer communications.
 - 5. Secondary networks provide either peer-to-peer, master-slave, or supervised token-passing communications.
- M. Peripheral: Input/Output equipment used to communicate with computer and make copies of system outputs. Peripherals include CRT, printer, tape deck, diskette.
- N. PID (Proportional, Integral, Derivative) Control Loop: Mathematical calculation used to evaluate control input and determine control output value required to maintain input value at set point. Shall have operator adjustable maximum rate of change, P and D gains, and loop response time delay. Loop shall be self-integrating so no integral constant is required and not be subject to integral windup.
- O. Transmission Control Protocol (TCP): Connection-oriented protocol used to convey multiple related messages (e.g., file transfers, Web pages, etc.).

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 2 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

P. Abbreviations that may be used in this section:

- 1. BIOS: Basic Input Output System.
- 2. DDC: Direct Digital Control.
- 3. IBM: International Business Machines, Inc.
- 4. LCD: Liquid Crystal Display.
- 5. PC: Personal Computer.
- 6. PID: Process Instrumentation Diagram.
- 7. PI: Pressure Indicator.

1.03 QUALITY ASSURANCE

- A. Compatibility:
 - 1. System shall have documented history of compatibility by design for minimum of 15 years.
 - 2. Future compatibility shall be supported for no less than 10 years.
 - 3. Compatibility shall be defined as:
 - a. Ability to upgrade existing microelectronic controllers to current level of technology, and extend new microelectronic controllers on previously installed network.
 - b. Ability for any existing microelectronic controller microprocessor to be connected and directly communicate with new microelectronic controllers without bridges, routers, or protocol converters.

1.04 SYSTEM PERFORMANCE

- A. System shall conform to the following performance standards:
 - 1. Graphic Display:
 - a. Minimum of 20 dynamic points.
 - b. Current data displayed within 20 seconds of request.
 - 2. Graphic Refresh: System shall update dynamic points with current data within 30 seconds.
 - 3. Object Command:

b.

- a. Maximum time between command of binary object by operator and reaction by device shall be 10 seconds.
 - Analog objects shall start to adjust within 10 seconds.
- 4. Object Scan: Changes of state and change of analog values shall be transmitted over high-speed network such that any data used or displayed at controller or workstation will be current, within prior 60 seconds.
- 5. Alarm Response Time: Maximum time from when object goes into alarm to when it is annunciated at workstation shall not exceed 45 seconds.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 3

- 6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with mechanical process under control.
- Performance: Programmable Controllers shall be able to execute DDC PID control loops at selectable frequency from at least once every 5 seconds. Controller shall scan and update process value and output generated by this calculation at this same frequency.
- 8. Multiple Alarm Annunciation: Workstations on network shall receive alarms within 5 seconds of each other.
- 9. Reporting Accuracy: Table 1 lists minimum acceptable reporting accuracies for values reported by specified system.

Table 1 Reporting Accuracy				
Measured Variable	Reported Accuracy			
Space temperature	±0.5°C [±1°F]			
Ducted air	±1.0°C [±2°F]			
Outside air	±1.0°C [±2°F]			
Delta-T	±0.15°C [±0.25°F]			
Air flow (measuring stations)	±5% of reading			
Air pressure (ducts)	±25 Pa [±0.1" WC]			
Air pressure (space)	±3 Pa [±0.01" WC]			
Electrical Power	5% of reading ³			
¹ (10%-100% of scale) (cannot read accurately below 10%). ² For both absolute and differential pressure. ³ Not including utility supplied meters.				

PART 2 PRODUCTS

2.01 STANDALONE DDC CONTROL SYSTEM

A. Standalone Custom Controllers:

- 1. General:
 - a. Provide adequate number of controllers to provide performance specified in Article System Performance and as indicated on the Drawings.
 - b. Microprocessor based true no-host system; no PC or "host" computer required to perform control functions or communications, capable of standalone operation, providing control functions without being connected to a network.

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 4 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS **Commented [LL1]:** Spec is missing general information on smoke detection and fire dampers. I think this should be coordinated coordinated with electro and described herein

- 2. Performance:
 - a. Set points, controller operating system, and programming shall be resident in EEPROM, within controller.
 - b. Capable of executing DDC loops and custom control routines.
 - c. DDC loop control programming with editable proportional, integral, and derivative control parameters.
 - d. DDC loops shall have editable high and low output limits as well as editable failure output values.
 - e. Software control reaction time shall be programmable to be no slower than 5 seconds.
 - f. DDC loops shall be programmable to operate at user defined intervals with maximum frequency of 1 second.
 - g. Sufficient memory to support its operating system, database, and programming requirements.
- 3. Environment: Controller hardware shall be suitable for anticipated ambient conditions.
 - Controller shall be mounted in locking enclosure. Refer to Section 23 09 13, HVAC Controls, Field Components, and Instruments, for enclosure details.
 - Controller used outdoors or in wet ambient conditions shall be mounted within waterproof enclosure and rated for operation at minus 40 degrees C to 65 degrees C (minus 40 to 150 degrees F).
 - c. Controller used in conditioned ambient shall be mounted in dustproof enclosure and shall be rated for operation at 0 degrees C to 50 degrees C (32 degrees F to 120 degrees F).
- 4. Clock:
 - a. Real time clock that shall remain active during power failure for up to 7 days under normal operating conditions.
 - b. When controller is used with higher level system, time clock shall be automatically synchronized with system controller.
- 5. Software:
 - a. Software for controller setup, programming, and editing of database.
 - b. In English language.
 - c. IBM/Windows PC compatible.
 - d. PI and PID control loops.
 - e. Programming subroutine blocks available to be used in any combination for program modifications.
 - f. As a minimum, routines shall include:
 - 1) Time- or event-based scheduling.
 - 2) Offline, fill-in-the-blank programming of controller.
 - 3) Operating and programming error messages and diagnostics.
 - 4) Database save and restore.
 - 5) Adaptive optimum start/stop.
 - 6) Run time totalization.
 - 7) Alarm detection and dial out.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 5

- 8) Historical Trending: Trend data shall be fully compatible with Microsoft Access and Excel.
- g. Documentation: Provide to Owner, before completion of Project:
 - 1) Electronic copy of programming tool software.
 - 2) Electronic copy of control logic program used in controller.
 - 3) User's manual for software operation.
 - 4) Include appropriate cable for interconnection between PC serial port and controller.
- 6. Diagnostics:
 - a. Controller shall contain the following diagnostic information:
 - 1) LEDs indicating status of main board, communications Transmit and Receive, and Binary Output ON/OFF.
 - 2) Information regarding failure of analog or change of state of any binary point. Controller must then capture an image of all points at value or state at time of event/alarm. This data must be able to be viewed from a set of screens that are labeled with alarm point, date and time of occurrence, and cause of failure.
 - 3) Self test procedure for checking communications and verifying functionality of memory and database.
 - 4) Upon detection of communication loss, retransmission shall be attempted.
 - 5) Continuing failure shall cause trouble signal to be annunciated at HCP.
- 7. External Communication:
 - a. Allow service tool editing of programming while controller is in total standalone operation.
 - b. Include USB or RJ45 port for connection to portable operator interface device for commissioning, adjustment, diagnosis, upload, download, and editing of data.
 - c. Provide port for connection to LAN.
- 8. Digital Interface with SCADA:
 - a. Type: Monitoring with limited remote-control functionality
 - b. Physical: Ethernet, Cat 6 cable
 - c. Communication Protocol:
 - 1) BACnet IP, or
 - 2) Modbus TCP/IP, or
 - 3) EtherNet/IP
 - d. Signals from DDC to SCADA, As minimum:
 - 1) Discrete:
 - a) Critical Alarms:
 - (1) Power Fail.
 - (2) Fail to Start.
 - (3) Communication fail, if appliable

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 6 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS Commented [LL2]: RS232 changed int USB or RJ45 port

			 b) Faults: Dirty filter Frost. Broken belt, if appliable. c) Major Equipment Status: Remote/Auto/Manual. Running. Stopped. Fail. d) Smoke Detector Alarm, if applicable. 	
		2)	 e) Fire Damper Status, if applicable. Analog: a) Setpoints. b) Temperatures. c) Pressures 	
	e.	Signa	 d) VFD Speeds, if appliable. e) Damper/Valve Position, if applicable. ls from SCADA to DDC: 	
		1) 2)	Setpoint setting	Commented [LL3]: Added
9.	Hard	wire In	terface with SCADA:	
	a.	Type:	Discreate Output, Dry Contact.	
	b.	Sourc	e and Signal:	
		1)	IP20-HCP-601-01 HVAC Control Panel.	
			a) Signal: Smoke detection in Pump Room.	
		2)	IP20-HCP-602-02 HVAC Control Panel.	
			a) Signal: Smoke detection in Electrical Room.	
		3)	CP20-HCP-601-01 HVAC Control Panel.	
			a) Signal: Smoke detection in Pump Room.	
		4)	CP20-HCP-602-01 HVAC Control Panel.	
10	Floot	trical	a) Signal: Smoke detection in Electrical Room.	Commented [LL4]: Added
10.	PICCI	Power		
	a.	1)	On/Off switch inside cabinet	
		2)	Controller Power: 24V, 50/60 Hz.	
		3)	On-board isolation transformer or dedicated transformer,	
		-	rated at minimum of 125 percent of maximum power	
		4)	consumption, and shall be fused or current limiting type. Battery Backup: Local controller must provide backup of all memory for period of 7 days under normal operating conditions if commercial power to controller is interrupted	
	b.	Conne	ections:	
	0.	1)	Plug-in terminal blocks, in accordance with requirements of Section 23 09 13, HVAC Controls, Field Components, and Instruments.	
PW\JA\ENMRW\D DECEMBER 2024 ©COPYRIGHT 202	032993 24 JAC	318\4\4 COBS	2 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 7	
- Logic card containing active electrical components shall be easily removable from wiring base without use of tools.
- 3) Provide quick disconnect interconnection with electrical wiring.
- c. Immunity to Power and Noise:
 - Controller shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform orderly shutdown below 80 percent nominal voltage.
 - Operation shall be protected against electrical noise of 5 Hz to 120 Hz and from keyed radios up to 5W at 1 meter (3 feet).
 - 3) Provide filters, as required to comply with applicable FCC regulations.
- d. Power Loss/Restart:
 - 1) Tolerant of power failures.
 - Memory shall be nonvolatile or unit shall hold memory up to 30 days minimum on backup batteries.
 - 3) When power failure has occurred and power is restored, controller shall restart automatically and without operator intervention.
 - 4) Restart Procedures:
 - a) Come online.
 - b) Update monitored functions.
 - c) Implement special facility startup strategies as required.
 - Resume operation based on current time and status.
- 11. Input/Output:

5)

- a. Controller shall be configurable using modular Input/Output points to allow for system customization and expansion.
- b. Each controller shall monitor analog inputs and analog outputs, and perform minimum 10 bit A-to-D and 8 bit D-to-A conversion.
- c. Local controller shall receive signals from industry standard sensors and input devices and directly control actuators and control devices.
- d. Controller shall have capability to monitor and control the following types of inputs and outputs:
 - 1) Analog Inputs:
 - a) Current: 4 mA to 20 mA.
 - b) Voltage: 0V dc to 10V dc.
 - c) Thermistor.
 - d) 1,000 ohm RTD.
 - 2) Binary Inputs:
 - a) Isolated dry contact closure.
 - b) Pulse.

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 8 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 3) Analog Outputs:
 - a) Current: 4 mA to 20 mA.
 - b) Voltage: 0V dc to 10V dc.
- 4) Binary Outputs: 24V ac, Triac switch.
- e. Output points must be available with manual software and hardware overrides with feedback indication that an output is presently overridden.
- f. Port Isolation:
 - 1) Individually, electrically isolated to protect against transients, spikes, and power surges.
 - 2) Optically isolated from each other, controller circuit board, and from power wiring.
 - Optical isolation either as integral component to controller or as a separate interface device between controller and field wiring.
- g. Quantity of I/O Points: As required to provide equipment function as described in Sequences of Operation on the Drawings.
- 12. Expansion Capability:
 - a. Capable of accepting expansion modules for addition of:
 - 1) Memory.
 - 2) Input/Output points.
- 13. Trending:
 - a. Minimum of eight user selectable points shall be able to be logged, with a minimum of 24 samples per log.
 - b. Start and stop times for each trend log shall be definable or continuous.
- 14. User Interface:
 - a. Local keypad and display shall be provided for each controller for interrogating and editing data.
 - b. Keypad and display shall be built-in to controller, with minimum one line by 20 character LCD display.
- B. Remote Communications:
 - 1. Provide functionality and hardware for complete access for system monitoring, control, and programming through VPN tunnel provided and configured by Owner.
 - 2. Possible to retrieve and save system panel's database and to download that database from remote location

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 9

PART 3 EXECUTION

3.01 GENERAL

A. Refer to Section 23 09 00, Instrumentation and Control Devices for HVAC, for requirements.

END OF SECTION

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC 23 09 23 - 10 PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

SECTION 23 31 13 METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.
 - 3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.
 - A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 1. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- o. C916, Standard Specification for Adhesives for Duct Thermal Insulation.
- p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
- r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
- 6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems.
- 7. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - e. 259, Standard Test Method for Potential Heat of Building Materials.
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- 8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Duct Construction Standards.
 - b. Guidelines for Seismic Restraints of Mechanical Systems.
 - c. Fibrous Glass Duct Construction Standards.
 - d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
 - e. HVAC Air Duct Leakage Test Manual.

- 9. UL:
 - a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films.
 - c. 555, Standard for Safety Fire Dampers.
 - d. 555S, Standard for Safety Smoke Dampers.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. CFM: cubic feet per minute.
 - 2. FPM: feet per minute.
 - 3. PCF: pounds per cubic foot.
 - 4. WC: water column.
- B. Sealing Requirements:
 - 1. For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
 - a. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - b. Joints, duct surface connections including:
 - 1) Girth joints.
 - 2) Branch and subbranch intersections.
 - 3) Duct collar tap-ins.
 - 4) Fitting subsections.
 - 5) Louver and air terminal connections to ducts.
 - 6) Access door, and access panel frames and jambs.
 - 7) Duct, plenum, and casing abutments to building structures.

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Rectangular and Rigid Round Ductwork:
 - 1) Schedules of duct systems, materials, joints, sealing, gage and reinforcement.
 - 2) SMACNA Figure Numbers for each shop fabricated item.
 - 3) Reinforcing details and spacing.
 - 4) Seam and joint construction details.
 - 5) Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
 - b. Ductwork Accessories:
 - 1) Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes, including the following items:
 - a) Fittings and volume control damper installation (both manual and automatic) details.
 - b) Duct liner.
 - c) Sealing materials.
 - d) Dampers; include leakage, pressure drop, and maximum back pressure data.
 - e) Duct-mounted access panels and doors.
 - f) Flexible ducts.
 - g) Sheet metal fasteners.
 - 2. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures .
 - 3. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 4. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
 - 5. Manufacturers Certificate of American Iron and Steel (AIS) compliance in accordance with Section 01 33 00, Submittal Procedures.
 - 6. Record Drawings: Include duct systems routing, fittings details, and installed accessories and devices.

1.05 QUALITY ASSURANCE

- A. Industry Standards:
 - 1. Unless otherwise indicated or specified, sheet metal ductwork shall be constructed and installed in accordance with SMACNA Duct Construction Standards relevant to ductwork system being provided. These standards are herein referenced as the SMACNA Manual, unless otherwise indicated.
 - 2. Comply with ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated.
 - 3. NFPA Compliance: NFPA 90A and NFPA 90B.
- B. Manufacturers: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.
- C. Suppliers of duct and fitting components shall provide on request the following information:
 - 1. Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.
 - 2. Laboratory performance data for fittings, including zero-length dynamic losses.
- D. Installer shall be a firm with at least 3 years' experience of successful installation on ductwork systems similar to that required for this Project.
- E. Changes or alterations to layout or configuration of duct system shall be:
 - 1. Specifically approved in writing by Engineer.
 - 2. Proposed layout shall provide original design results, without increasing system total pressure.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect ductwork from dirt, water, and debris. During storage on Job Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.
- B. Deliver sealant materials to Site in original unopened containers labeled with manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

- C. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- D. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 PRODUCTS

2.01 SCHEDULES

A. Ductwork Schedule: Refer to the Drawings.

2.02 GENERAL

- A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- B. Internally Lined Ductwork: Duct sizes indicated for internally lined ducts are the clear inside dimensions, and shall be increased in both dimensions by twice the thickness of the liner.
- C. Ductwork thinner than 26-gauge will not be allowed.
- D. Ductwork Interior Surfaces:
 - 1. Smooth.
 - 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 - 3. Seams and joints shall be external.
 - 4. For ductwork that is required to be reinforced, Contractor may use either external or internal reinforcing.

2.03 SHEET METAL MATERIALS

- A. Construct metal duct systems from materials as indicated on the Material Classification Schedule on the Drawings.
- B. Galvanized Steel Ductwork:
 - 1. Comply with ASTM A653/A653M and ASTM A924/924M.
 - 2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel).
 - 3. Sheet Designation: CS Type B.
 - 4. Applicable Specification: ASTM A653/A653M.
 - 5. (Zinc) Coating Designation: G90.

- 6. Coating designation in accordance with Test Method A, ASTM A90/A90M. and ASTM A924/A924M.
- 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
- 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- C. Aluminum Ductwork:
 - 1. Comply with ASTM B209.
 - 2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
 - 3. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or equivalent.
- D. Exposed Ductwork: 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, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.
- E. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.04 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
 - 1. Ultraviolet light resistant.
 - 2. Mildew resistant.
 - 3. Flashpoint: Greater than 70 degrees F, SETA CC.
 - 4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102.
 - b. Rectorseal; AT-33.
 - c. Childers CP-140.
- D. Water-Based Sealants:
 - 1. Listed by manufacturer as nonflammable in wet and dry state.
 - 2. Manufacturers and Products:
 - a. Foster; Series 32.
 - b. Childers; CP-145A, 146.
 - c. Rectorseal; Airlok 181.

2.05 DUCTWORK FASTENERS

- A. General:
 - 1. Rivets, bolts, or sheet metal screws.
 - 2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.
- B. Self-Drilling Screws:
 - 1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.
 - 2. Aluminum Ductwork System:
 - a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Marutex® stainless steel with strength of Type 410 stainless steel and corrosion resistance of Type 304 stainless steel, complete with bonded metal and fiber washer for dielectric separation.
 - b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA.
 - 2) Clark Craft Fasteners, Tonawanda, NY.

2.06 DUCTWORK PRESSURE CLASS

- A. Construct duct systems to pressure classifications indicated in Ductwork Schedule.
- B. Where no specific duct pressure designations are indicated in Specifications or on the Drawings, 2-inch WC pressure class shall be basis of Contract.

2.07 RECTANGULAR DUCTWORK

- A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise. Fabricate rectangular ducts in accordance with SMACNA Rectangular Industrial Duct Construction Standards where specified on the Drawings.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.08 RECTANGULAR DUCTWORK FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction

Standards, Metal and Flexible. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA Industrial Duct Construction Standards where specified on the Drawings.

- B. Elbows:
 - 1. Fit square-turn elbows with vane side rails.
 - 2. Shop fabricate double-blade turning vanes of same material as ductwork.
 - 3. Fabricate with equal inlet and outlet.
 - 4. Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.
 - 5. Manufacturers and Products:
 - a. Elgen.
 - b. Duro-Dyne.

2.09 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.10 RECTANGULAR DUCTWORK INSULATION LINER

- A. Location: Provide ductwork with internal insulation liner where indicated on the Drawings or in Ductwork Schedule.
- B. Material:
 - 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean.
 - 2. Black composite coating on surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
 - 3. Liquid water repellency rating not less than 4.0 when tested in accordance with INDA IST 80.6.
 - 4. Potential heat value not exceeding 3,500 Btu per hour per pound when tested in accordance with NFPA 259 and meeting classification of "Limited Combustible" as defined by NFPA 90A.
 - 5. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
 - 6. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139.

- 7. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. JohnsManville; Linacoustic RC.
 - c. Knauf; Duct Liner M.
- C. R-Value: Minimum 4.2 hours foot squared degrees F per Btu or greater, where indicated on the Drawings or Ductwork Schedule.
- D. Liner Adhesive: In accordance with NFPA 90A and ASTM C916.
- E. Mechanical Fasteners:
 - 1. Same material as ductwork, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
 - 2. Provide fasteners that do not damage liner when applied as recommended by manufacturer, that do not cause leakage in duct, and will indefinitely sustain 50-pound tensile dead load test perpendicular to duct wall.
 - 3. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 4. Adhesive for Attachment of Mechanical Fasteners: In accordance with Fire Hazard Classification of duct liner system.
- F. Liner Application:
 - 1. Ductwork liner shall be applied at time of ductwork manufacture in an approved sheet metal workshop.
 - 2. Adhere single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
 - 3. Apply coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
 - 4. Butt transverse joints without gaps and coat joint with adhesive.
 - 5. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
 - 6. Longitudinal Joints:
 - a. Shall not occur except at corners of ducts, unless size of duct and standard liner product dimensions make longitudinal joints necessary.
 - b. Apply adhesive coating on longitudinal seams in ducts exceeding 2,500 fpm air velocity.
 - Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter, at 3 inches from transverse joints, and at intervals not exceeding 18 inches longitudinally.

- 8. Secure transversely oriented liner edges facing airstream with metal nosing that are either channel or "Z" profile or are integrally formed from duct wall at the following locations:
 - a. Fan discharge.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts.
- 9. Seal insulation edges.
- 10. Repair abrasions or tears with mastic.

2.11 RIGID ROUND DUCTWORK

- A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.
- B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.
- C. Where space limitations prevent use of round duct or where shown on the Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.
- D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.
- E. Ductwork seams of Snaplock type shall not be used.

2.12 RIGID ROUND DUCTWORK FITTINGS

- A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless otherwise specified.
- B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.
- C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- D. Elbows:
 - 1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1.5 times elbow diameter. Two piece segment elbows are not allowed, except with turning vanes.
 - 2. Segmented Elbows: Fabricate with welded construction.

- 3. Round Elbows 8 Inches and Smaller:
 - a. Stamped elbows for 45-degree and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.
- 4. Round Elbows 9 Inches Through 14 Inches:
 - a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.13 ROUND DUCTWORK BRANCH CONNECTIONS

A. Branch duct connections (taps) to round duct mains shall be made using factory fabricated fittings.

2.14 DUCTWORK HANGERS AND SUPPORTS

- A. General:
 - 1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
 - 2. Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.
 - 3. Wire hangers are not acceptable.
 - 4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.
- B. Construction Materials:
 - 1. Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:
 - a. Galvanized Steel Ductwork:
 - 1) Indoors: Carbon steel, zinc electroplated.
 - 2) Outdoors: Carbon steel, hot-dipped galvanized after fabrication.
 - b. Aluminum Ductwork Indoors and Outdoors:
 - 1) Carbon steel, hot-dipped galvanized after fabrication.
 - 2) Non-metallic pad between lower attachment and ductwork, to achieve dielectric separation.

- C. Building Attachments:
 - 1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
 - 2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
 - 3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.
 - b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
 - c. Concrete attachments shall be made of steel.
- D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.
- E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.15 DUCTWORK FLEXIBLE CONNECTIONS

- A. General:
 - 1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.
 - 2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
 - 3. Comply with NFPA 90A and NFPA 90B requirements.
 - 4. Airtight and waterproof.
- B. Materials:
 - 1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - 2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
 - 3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except teflon coated).
 - b. Woven polyester or nylon for most applications.
 - c. Woven fiberglass for high temperature applications.
 - d. Coating: Vinyl.

- C. Construction:
 - 1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
 - 2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.
 - 3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
 - 4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.
- D. Manufacturers:
 - 1. Ductmate; PROflex, Commercial.
 - 2. Ventfabrics.
 - 3. Duro-Dyne.

2.16 DUCT INSPECTION DOORS

- A. General:
 - 1. Insulated, gasketed, and at least 15 inches by 15 inches when duct dimensions are large enough.
 - 2. On ductwork where largest side dimension is less than 16 inches, furnish inspection doors at least 8 inches by 8 inches.
 - 3. Complete with necessary hardware and either Amerlock 10 or Ventlock No. 100 latches, and Ventlock Series No. 100 hinges.
 - 4. Fabricated of same material as ductwork.
- B. Round Spin-in Type Access Doors:
 - 1. Size: 18-inch and 24-inch diameter will be acceptable in lieu of comparable size square or rectangular access doors specified herein.
 - 2. Complete with insulation, spin-in frame, inner door, attachment cable, gaskets, three latches, and pull ring.
 - 3. Manufacturer and Product: Flexmaster; Inspector Series.
- C. Manufacturers:
 - 1. Ventlok.
 - 2. Duro-Dyne.
 - 3. Flexmaster.

2.17 MANUAL DAMPERS

- A. Butterfly Manual Dampers:
 - 1. Fabricate from two gauges heavier than duct in which installed, of same material as ductwork.
 - 2. Align operating handle with damper blade.
 - 3. Provide 2-inch standoff bracket for insulated duct systems.
 - 4. Damper Manufacturers:
 - a. Ruskin.
 - b. American Warming and Ventilating.
 - 5. Operator Manufacturers:
 - a. Accessible Ductwork: Ventlok; Type 620 or Type 635.
 - b. Accessible Insulated Ductwork: Ventlok; Type 639.
- B. Manual Opposed-Blade Balancing Dampers:
 - 1. Externally operated gang airfoil, damper blades.
 - 2. Fabricate from same material as ductwork.
 - 3. Stainless steel or nylon sleeve bearings.
 - 4. Construction shall have interlocking edges and maximum 10-inch blade width.
 - 5. Manufacturers and Products:
 - a. Ruskin; CD102.
 - b. American Warming and Ventilating; Model VC-31.

2.18 BACK DRAFT DAMPERS

- A. General: Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA 500.
- B. Steel Frame, Nonmetallic Blades:
 - 1. Fabrication:
 - a. Frame: 2 inches by minimum 18-gauge (51 mm by minimum 1.6 mm) galvanized steel with windstops to reduce backflow.
 - b. Blades:
 - 1) Style: Single piece, independent.
 - 2) Action: Parallel.
 - 3) Material: Noncombustible, neoprene coated fiberglass.
 - 4) Orientation: Horizontal.
 - 5) Width: Maximum 6 inches (152 mm).
 - c. Rear Bird Screen: Galvanized expanded metal.

- d. Mounting:
 - 1) Suitable for mounting in vertical or horizontal airflow up positions.
 - 2) Configured for positions as shown on the Drawings.
- e. Finish: Mill galvanized.
- 2. Performance Data:
 - a. Temperature Rating: Withstand minus 30 degrees to 200 degrees F (minus 34 degrees to 93 degrees C).
 - b. Maximum Back Pressure: 4-inch WC (1.0 kPa).
 - c. Maximum System Air Velocity: 1,000 fpm (5.1 m/s).
 - d. Maximum Spot Air Velocity: 1,200 fpm (6.1 m/s).
- 3. Accessories:
 - a. Duct Transition Connection: Rectangular.
- 4. Manufacturers and Products:
 - a. Ruskin; Model NMS2.
 - b. Vent Products, Co.

2.19 CONTROL DAMPERS

- A. Refer Section 23 09 13, HVAC Controls, Field Components, and Instruments, for requirements.
- 2.20 EXTERNAL DUCT INSULATION
 - A. Refer to Section 23 07 00, HVAC Insulation.
- 2.21 MISCELLANEOUS ACCESSORIES
 - A. Accessories Hardware:
 - 1. Instrument Test Holes:
 - a. Cast metal, material to suit duct material, including screw cap and gasket and flat mounting gasket.
 - b. Size to allow insertion of pitot tube and other testing instruments.
 - c. Provide in length to suit duct insulation thickness.
 - 2. Flexible Duct Clamps:
 - a. Stainless steel band with cadmium-plated hex screw to tighten band with worm-gear action.
 - b. Provide in sizes from 3 inches to 18 inches to suit duct size.
 - 3. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline, and grease.

2.22 DUCTWORK IDENTIFICATION

- A. Painted Identification Materials:
 - 1. Stencils: Standard metal stencils, prepared for required applications with letter sizes generally comply with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4-inch-high letters for access door signs and similar operational instructions.
 - 2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray can form and grade.
 - 3. Identification Paint: Standard identification enamel of colors indicated or in accordance with ASME A13.1 for colors for systems not identified herein.
- B. Nomenclature: Include the following:
 - 1. Direction of air flow.
 - 2. Duct service (supply, return, exhaust).
- C. Manufacturers:
 - 1. W.H. Brady, Co.
 - 2. Seton Identification Products.
 - 3. Craftmark.
 - 4. Brimar Industries, Inc.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Miscellaneous:
 - 1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
 - 2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
 - 3. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
 - 4. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

- B. Ductwork Location:
 - 1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
 - 2. Avoid diagonal runs wherever possible.
 - 3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
 - 4. In general, install as close to bottom of structure as possible.
 - 5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
 - 6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - 7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.
- C. Penetrations:
 - 1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.
 - 2. Clearances:
 - a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
 - b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.
 - 3. Closure Collars:
 - a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.
 - b. Fit collars snugly around ducts and insulation.
 - c. Same gauge and material as duct.
 - d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.
 - e. Use fasteners with maximum 6-inch centers on collars.
 - 4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.
- D. Concealment:
 - 1. Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above suspended ceiling.
 - 2. Do not encase horizontal runs in solid partitions, except as specifically shown.
 - 3. Limit clearance to 1 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.

- E. Coordination with Other Trades:
 - 1. Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.
 - 2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on the Drawings.
 - 3. Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.
 - 4. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.
- F. Restroom Exhaust Ductwork:
 - 1. Joints and Seams: Seal watertight.
 - 2. Slope branch ducts downward to grille.

3.02 RECTANGULAR DUCTWORK

- A. General:
 - 1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.
 - 2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.
- B. Low Pressure Taps:
 - 1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
 - 2. Determine location of spin-in after outlet location is determined.
 - 3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.
- C. Fittings:
 - 1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.
 - 2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.
 - 3. Make offsets with maximum angle of 45 degrees.
 - 4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.

- D. Rectangular Ductwork Transverse Joints:
 - 1. Install each run with a minimum of joints.
 - 2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
 - 3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

3.03 RIGID ROUND DUCTWORK

- A. General: Except where interrupted by fittings, install round ducts in lengths as long as possible to minimize joints.
- B. Rigid Round Ductwork Joints:
 - 1. Rigid round ductwork joints shall be in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless otherwise specified.
 - 2. Single and Double Wall Supply and Return System Joints:
 - a. Less than 36 Inches: Slip coupling.
 - b. 36 Inches and Larger: Flanged connector, Van Stone, or welded companion flange type.
 - 3. Single and Double Wall Exhaust and Return System Joints:
 - a. Spiral Seam Duct: Welded flanged connector.
 - b. Longitudinal Seam Duct: Van Stone flange connector.

3.04 DUCTWORK HANGERS AND SUPPORTS

- A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.
- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.

- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Support vertical ducts at maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load, but are not limited to specific methods indicated.
- G. In new construction, install concrete insert prior to placing concrete.

3.05 FLEXIBLE CONNECTIONS

- A. Flexible Collars and Connections:
 - 1. Use between fans and ducts.
 - 2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type draw bands.
 - 3. For rectangular ducts, lock flexible connections to metal collars.

3.06 DAMPERS

- A. General:
 - 1. Inspection:
 - a. Inspect areas to receive dampers.
 - b. Notify Engineer of conditions that would adversely affect installation or subsequent utilization of dampers.
 - c. Do not proceed with installation until unsatisfactory conditions are corrected.
 - 2. Install dampers at locations indicated on the Drawings and in accordance with manufacturer's installation instructions.
 - 3. Install square and level.
 - 4. Handle damper using sleeve or frame. Do not lift damper using blades or jack-shaft.
 - 5. Damper blades and hardware shall operate freely without obstruction.
 - 6. Damper blades and hardware that bind within frame or obstructed by adjacent construction will not be acceptable.
 - 7. When installed, damper frames shall be gasketed or caulked to eliminate leakage between duct and damper frames.
 - 8. Head and sill shall have stops.
 - 9. Suitable for installation in mounting arrangement shown.
 - 10. Do not compress or stretch damper frame into duct or opening.

- B. Manual Dampers:
 - 1. Provide balancing dampers for grilles and diffusers as indicated on the Drawings in branch duct as near main as possible.
 - 2. Add or remove balancing dampers as requested by air balancing firm for necessary control of air.
- C. Back Draft Dampers:
 - 1. Install dampers square and free from racking with blades running horizontally.
 - 2. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.07 ACCESS DOORS

- A. Ductwork:
 - 1. Install access doors in ductwork, in accordance with manufacturer's instructions, at each:
 - a. Duct mounted smoke or ionization detector.
 - b. Motorized damper.
 - c. Turning vane.
 - d. Volume damper.

3.08 EXTERNAL DUCT INSULATION

A. Refer to Section 23 07 00, HVAC Insulation.

3.09 MISCELLANEOUS ACCESSORIES

- A. Auxiliary Drain Pans:
 - 1. Under equipment for which pan is shown on the Drawings and under all horizontal air handling units located above ceilings and piping located in ceiling space directly above computer facility areas; furnish and install auxiliary drain pans.
 - 2. Route drain lines to nearest floor or hub drain independent of any other drain.
 - 3. Slope drain pans toward drain connection to promote drainage.
- B. Louver and Grille Blank-Off Sections: Attach airtight to louver or grille and install to allow for easy removal.

- C. Inspection Plates and Test Holes:
 - 1. Where required in ductwork for balance measurements.
 - 2. Test holes shall be airtight and noncorrosive with screw cap and gasket.
 - 3. Extend cap through insulation.

3.10 DUCT SEALING

- A. Seal duct seams and joints as follows:
 - 1. In accordance with SMACNA requirements as indicated on Ductwork Schedule.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.
- C. Seal externally insulated ducts prior to insulation installation.
- D. Seal all audible leaks.
- 3.11 BALANCING OF AIR SYSTEMS
 - A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- 3.12 PROTECTION OF INSTALLED WORK
 - A. Open ends of installed ductwork systems shall be covered to prevent dust, foreign objects and water from entering ductwork.
 - B. Ductwork systems shall not be used for air conveyance until adequate air filtration devices are installed in air handling equipment, to prevent ingress of construction dust.

3.13 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.
- C. If duct systems are found to contain construction debris at time of construction completion Contractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

SECTION 23 34 00 HVAC FANS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration— Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
 - 2. Air Movement and Control Association International (AMCA):
 - a. 99, Standards Handbook.
 - b. 201, Fans and Systems.
 - c. 203, Field Performance Measurement of Fan Systems.
 - d. 204, Balance Quality and Vibration Levels for Fans.
 - e. 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - f. 300, Reverberant Room Method for Sound Testing of Fans.
 - g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - d. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. National Fire Protection Association (NFPA): 45, Standard on Fire Protection for Laboratories Using Chemicals.
 - 8. Occupational Safety and Health Act (OSHA).

- 9. Society for Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 10. UL: 507, Safety Standard for Electric Fans.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. DWDI: Double Width, Double Inlet.
 - 5. FRP: Fiberglass Reinforced Plastic.
 - 6. hp: Horsepower.
 - 7. ODP: Open Drip Proof.
 - 8. SWSI: Single Width, Single Inlet.
 - 9. TEFC: Totally Enclosed, Fan Cooled.
 - 10. UV: Ultra Violet
 - 11. XP: Explosion Proof.

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Provide following for specified products:
 - a. Identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.
 - c. Descriptive specifications, literature, and drawings.
 - d. Dimensions and weights.
 - e. Fan sound power level data (reference 10 to power minus 12 watts) at design operating point.
 - f. Fan Curves:
 - 1) Performance Curves Indicating:
 - a) Relationship of flow rate to static pressure for various fan speeds.
 - b) Brake horsepower curves.

- c) Acceptable selection range (surge curves, maximum revolutions per minute).
- d) Static pressure, capacity, horsepower demand and overall efficiency required at duty point, including drive losses.
- g. Capacities and ratings.
- h. Construction materials.
- i. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
- j. Wheel type, diameter, maximum revolutions per minute for fan class, operating revolutions per minute, and tip speed.
- k. Motor data, including service factor and operating horsepower, as specified in Section 26 20 00, Low-Voltage AC Induction Motors.
- 1. Power and control wiring diagrams, including terminals and numbers.
- m. Vibration isolation.
- n. Factory finish system.
- o. Color selection charts where applicable.
- p. Corrosion protection coating product data.
- 2. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
- 3. "Or Equal" Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.
- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures .
 - 3. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
 a. Motors specified to be premium efficient type.
 - 5. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

- 6. Test reports.
- 7. Operation and maintenance data in conformance with Section 01 78 23, Operation and Maintenance Data. Include as-built version of equipment schedules.
- 8. Manufacturers Certificate of American Iron and Steel (AIS) compliance in accordance with Section 01 33 00, Submittal Procedures.

1.05 QUALITY ASSURANCE

- A. Performance Ratings: Tested in accordance with AMCA 210.
- B. Sound Ratings: Tested in accordance with AMCA 300.
- C. Fabrication: In accordance with AMCA 99.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULES

A. Some specific equipment requirements are listed in Equipment Schedule. Refer to the Drawings.

2.02 GENERAL

- A. Spark Resistant Construction: Fans required to be spark resistant shall comply with requirements of AMCA 99-0401.
- B. Operating Limits: Fans designated to meet a specified fan class shall comply with requirements of AMCA 99-2408.
- C. Acoustical Levels: Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.
- D. Fan Drives:
 - 1. Fan Shafts: First critical speed of at least 125 percent of fan maximum operating speed.
 - 2. Provide speed test openings at shaft locations.
 - 3. Weather Cover: For outdoor applications, factory fabricated drive assembly of same material as fan housing, unless specified otherwise.
- E. Finishes:
 - 1. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
 - a. Parts cleaned and chemically pretreated with phosphatizing process.

- b. Alkyd enamel primer.
- c. Air dry enamel topcoat.
- 2. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- 3. Stainless Steel Parts: Finished smooth and left unpainted.

2.03 CABINET FAN

- A. General:
 - 1. Factory-assembled, ceiling, wall, or inline mounted, centrifugal cabinet fan; including housing, fan wheel, drive assembly, motor, and accessories. Refer to drawings for duct connection configuration.
 - 2. Bearing AMCA Certified Ratings Seal for sound and air performance.
- B. Housing:
 - 1. Material: Minimum 20-gauge galvanized steel.
 - 2. Construction:
 - a. Minimum 14-gauge blower and motor support frame.
 - b. Lined with minimum 1/2-inch acoustical insulation.
 - c. Outlet duct collar. Rectangular.
 - d. Motor mounted on resilient vibration isolators.
 - e. Motor and blower removable from unit without cabinet disassembly.
 - f. Removable cabinet access panels.
 - g. Air Inlet: End air inlet configuration.
 - h. Predrilled universal mounting brackets, adjustable.
- C. Wheel: Centrifugal forward curved type, galvanized steel or plastic construction.
- D. Shaft, Bearings, Drive:
 - 1. Shafts: Turned, ground and polished carbon steel.
 - 2. Bearings: Grease lubricated, precision antifriction ball, sealed type.
 - 3. Drives:
 - a. In accordance with Paragraph Fan Drives.
 - b. Factory set to specified fan revolutions per minute.
 - c. Type: Direct.
- E. Electrical:
 - 1. Integral wiring box.
 - 2. Factory-installed disconnect receptacle.

- F. Accessories:
 - 1. Provide as follows:
 - a. Speed Controller:
 - 1) Integral mount.
 - 2) Solid state electronics.
 - 3) Dial type combination ON/OFF switch and SPEED selector.
 - b. Rectangular duct connections.
- G. Manufacturers and Products:
 - 1. Greenheck; CSP Series.
 - 2. Loren Cook.

2.04 CENTRIFUGAL FAN, UPBLAST

- A. General:
 - 1. Factory-assembled centrifugal upblast sidewall fan; including housing, fan wheel, drive assembly, motor and accessories.
 - 2. Bearing AMCA Certified Ratings Seal for sound and air performance.
- B. Housing:
 - 1. Construction: Spun-formed aluminum, minimum 16-gauge marine alloy.
 - 2. Windband: Finish with rolled bead.
 - 3. Top Cap: Motor access via quick release latches.
 - 4. Motor completely sealed from exhaust air stream.
 - 5. Motor cooling via air breather tubes.
 - 6. Integral conduit chase for wiring.
 - 7. Drain trough at lowest point of housing.
 - 8. Fan Inlet:
 - a. Full inlet cone of aluminum construction.
 - b. Match inlet shroud.
- C. Wheel:
 - 1. Aluminum construction, backward inclined centrifugal, nonoverloading type.
 - 2. Machined, cast aluminum hub.
 - 3. Matched to deep spun inlet venturi.

- D. Shaft, Bearings, Drive:
 - 1. Shaft:
 - a. Turned, ground, and polished carbon steel.
 - b. Keyed for sheave installation.
 - c. Zinc-phosphate coated and oil emulsion-dipped.
 - 2. Bearings:
 - a. Grease lubricated, precision antifriction ball, self-aligning, pillow block style.
 - b. Selected for average life (ABMA 9 L₅₀) of not less than 200,000 hours operation at maximum cataloged operating speed.
 - c. Terminate with zerk fittings.
 - 3. Drives:
 - a. In accordance with Paragraph Fan Drives.
 - b. Factory set to specified fan revolutions per minute.
 - c. Type: Direct. Refer to Equipment Schedule for additional requirements.
- E. Accessories: Provide as scheduled on Equipment Schedule and as follows:
 - 1. Bearing Lubrication Lines:
 - a. Extended to outside of fan housing.
 - b. Type 316 stainless steel construction.
 - c. Terminate with zerk fittings.
 - 2. Sidewall Mounting Kit, as required for installation.
 - 3. Corrosion Protection Coating:
 - a. Provide factory-applied corrosion protection coating on these fan components:
 - 1) Wheel.
 - 2) Housing.
 - 3) Accessories.
 - 4) Interior surfaces in contact with airstream.
 - b. Coating system shall be baked polyester and shall be in accordance with Article Corrosion Protection Coating.
- F. Manufacturers and Products:
 - 1. Greenheck; Model CUE (Direct Drive).
 - 2. Cook; Model ACRUD (Direct Drive).

2.05 CORROSION PROTECTION COATING

- A. General:
 - 1. Factory-applied corrosion protection coating for application to fan components and accessories, where required by this section.

- 2. Quality Control:
 - a. Verify dry film thickness before final baking.
 - b. Finished coating system shall be free from voids, checks, cracks, and blisters.
- 3. Surface Cleaning: Clean parts to be coated as follows:
 - a. Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - b. Follow with immersion in potable water bath to neutralize and remove cleaning solution.
 - c. Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.
- B. Baked Polyester:
 - 1. Material: Polyester.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Electrostatic spray.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 1.5-mil to 2.5-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 230 degrees F, continuous.

2.06 MOTORS

- A. General AC Induction Type:
 - 1. Fan motors shall comply with provisions of Section 26 20 00, Low-Voltage AC Induction Motors.
 - 2. Provide integral self-resetting overload protection on single-phase motors.
 - 3. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
 - 4. Motors shall not operate into service factor in any case.
 - 5. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
 - a. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - b. Winding Thermal Protection: None.
 - c. Space Heater: No.

- d. Number of Speeds: Single.
- e. Number of Windings: One.
- f. Motor Efficiency: Premium efficient.
- g. Shaft Type: Solid, carbon steel.
- h. Mounting: As required for fan arrangement.
- i. Service Factor: 1.15.
- B. General Electronically Commutated Type:
 - 1. Motors shall not operate into service factor in any case.
 - 2. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
 - a. Electronically commutated motor with integral dial speed control potentiometer.
 - b. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - c. Winding Thermal Protection: None.
 - d. Space Heater: No.
 - e. Number of Windings: One.
 - f. Shaft Type: Solid, carbon steel.
 - g. Mounting: As required for fan arrangement.
 - h. Service Factor: 1.15.

2.07 ACCESSORIES

- A. Equipment Identification Plates: Furnish stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear block type equipment tag numbers indicated on the Drawings.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.08 SOURCE QUALITY CONTROL

- A. General:
 - 1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.
 - 2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure. Motor shall not operate into motor service factor in any listed case.
 - Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA 203, Appendix L.

- B. Testing Provisions:
 - 1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
 - 2. Center punch fan shaft to accommodate tachometer readings.
- C. Acoustical Levels:
 - 1. Perform noise tests in accordance with AMCA 300 and AMCA 301.
 - 2. Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- D. Balancing:
 - 1. Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.
 - 2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design revolutions per minute.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install fans level and plumb.
 - B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
 - C. Labeling:
 - 1. Label fans in accordance with Article Accessories.
 - 2. Mark exhaust fans serving fume hoods with arrows to indicate proper direction of rotation, in accordance with NFPA 45.
 - D. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
 - E. Equipment Support and Restraints: Secure controls to concrete bases using anchor bolts cast in concrete base.
 - F. Connections:
 - 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 - 2. Isolate duct connections to fans.
 - 3. Install ductwork adjacent to fans to allow proper service and maintenance.
3.02 FIELD QUALITY CONTROL

A. Functional Tests:

- 1. Verify blocking and bracing used during shipping are removed.
- 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
- 3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
- 4. Verify cleaning and adjusting are complete.
- 5. Verify lubrication for bearings and other moving parts.
- 6. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.03 MANUFACTURER'S SERVICES

- A. Refer Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Equipment Testing and Facility Startup.
- B. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.
- C. Balancing: Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.05 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 37 00 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 880, Air Terminals.
 - 2. ASTM International (ASTM): C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 3. UL.

1.02 DEFINITIONS

- A. NC: Noise Criteria; background sound rating method for indoor sound.
- B. VAV: Variable air volume.
- C. WC: Water column.

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's data and descriptive literature for products specified.
 - b. Furnish the following information for each type of grille furnished.
 - 1) NC sound data.
 - 2) Static pressure loss data.
 - 3) Throw data.

- B. Informational Submittals:
 - 1. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 2. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures .

PART 2 PRODUCTS

- 2.01 SUPPLY GRILLES
 - A. Supply Grilles (SG1):
 - 1. Construction:
 - a. As follows:
 - 1) Material: Aluminum.
 - 2) Finish: Aluminum face finish.
 - 2. Adjustable front horizontal and rear vertical vanes on 3/4-inch centers.
 - 3. Continuous sponge rubber gasket at face flange.
 - 4. 1-inch minimum flat rectangular frame.
 - 5. Performance:
 - a. As follows:
 - 1) Maximum Pressure Drop: 0.1 inches WC.
 - 2) Sound: Maximum NC 30.
 - 6. Manufacturers and Products:
 - a. Krueger; 880/5880 Series.
 - b. Titus; 300 Series.

2.02 RETURN, EXHAUST AND TRANSFER GRILLES

- A. Louvered Return, Exhaust and Transfer Grilles (RG1, EG1, TG1):
 - 1. Construction:
 - a. As follows:
 - 1) Material: Aluminum.
 - 2) Finish: Aluminum face finish.
 - 2. Fixed horizontal louvers set at 35 degrees to 45 degrees.
 - 3. 1-inch minimum flat, rectangular frame.
 - 4. Manufacturers and Products:
 - a. Krueger; S80/S580H Series.
 - b. Carnes; Type RAAAH.
 - c. Titus; 350 Series.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to architectural reflected ceiling plans for coordination of locations of ceiling-mounted air outlets and inlets with ceiling grids and lighting. Where locations of devices shown on mechanical drawings do not agree with locations that are shown on architectural reflected ceiling plans, reflected ceiling plans shall take precedence. If air outlets or inlets are shown on mechanical drawings, but are not shown on architectural reflected ceiling plans, devices shall be located as near as possible to locations shown on mechanical drawings when coordinating with ceiling.
- B. Install diffusers and grilles, tight on their respective mounting surfaces, level, plumb, and true with room dimensions.
- C. Support air inlets and outlets where installed in metal suspension systems for acoustical tile and lay-in panel ceilings as specified in applicable building code.

END OF SECTION

SECTION 23 81 00 UNITARY AIR-CONDITIONING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. Air Moving and Conditioning Association (AMCA): Bulletin 300, Setup No. 1.
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - b. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 4. American Society of Mechanical Engineers (ASME): BPVC Section IX, Welding and Brazing Qualifications.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2370, Standard Test Method for Tensile Properties of Organic Coatings.
 - c. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - e. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
 - 6. Canadian Standards Association (CSA).
 - 7. ETL Testing Laboratories (ETL).
 - 8. International Organization for Standardization (ISO):
 - a. 9001, Quality Management Systems Requirements.
 - b. 13256-1, Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-Air and Brine-to-Air Heat Pumps.
 - 9. National Electrical Manufacturers Association (NEMA).
 - 10. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
 - 11. UL: 94, Safety Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. COP: Coefficient of Performance.
 - 3. DX: Direct Expansion.
 - 4. EER: Energy Efficiency Ratio.
 - 5. HP: Heat Pump.
 - 6. IR: Infra Red.
 - 7. LED: Light Emitting Diode.
 - 8. PSC: Permanent Split Capacitor.
 - 9. PTAC: Packaged Terminal Air Conditioner.
 - 10. SPST: Single Pole, Single Throw.
 - 11. TXV: Thermostatic Expansion Valve.
 - 12. UV: Ultraviolet.

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.
 - b. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature which shall include make, model, dimensions, weight of equipment, and electrical schematics for all products specified.
 - c. Manufacturer's standard finish color selection for enclosure finishes.
 - d. Complete performance data that will indicate full compliance with Specification:
 - Include fan sound power level data (ref. 10 to 12 watts) at design operating point, based on AMCA Bulletin 300, Setup No. 1.
 - 2) Include heating and cooling performance data at design operating conditions.
 - e. Factory dip-applied protective coating product data.

- f. During Shop Drawing Action Submittal Phase: Contractor shall submit for engineer approval alternate layout of air conditioning equipment and attached ductwork system if an approved substitution requires modification from the basis of design air conditioning equipment and ductwork configuration shown on the Drawings.
- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 3. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for air-conditioning units, and motors.
 - 5. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
 - 6. Test reports.
 - 7. Operation and Maintenance Data in conformance with Section 01 78 23, Operation and Maintenance Data.
 - a. Include wiring and control diagrams for equipment.
 - b. Include as-built version of equipment schedules.

1.05 QUALITY ASSURANCE

- A. Heating and Cooling Equipment: Minimum operating efficiencies, defined as COP and EER, as specified in ASHRAE 90.1.
- B. Unit shall be rated (when matched with appropriate outdoor unit) per AHRI 210/240.
- C. Units shall be certified by UL and CSA, and shall be UL or ETL listed and labeled.
- D. Cooling performance rated in accordance with AHRI testing procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

- B. Protection of Equipment:
 - 1. Box, crate, or otherwise protect from damage and moisture during shipment, handling, and storage.
 - 2. Protect from exposure to corrosive fumes and keep thoroughly dry at all times.
 - 3. Store motors, drives, electrical equipment, and other equipment with antifriction or sleeve bearings in weathertight and heated storage facilities prior to installation.
 - 4. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

1.07 SPECIAL GUARANTEE

A. Refrigerant Compressors: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of compressors specified in this Specification found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the Contract Documents.

1.08 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following materials:

Item	Quantity
Fan Belts	One complete set for each belt-driven fan.
Filters	One complete set per unit.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Specified components of this section, including insulation, facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

- B. Multiple Compressor Units:
 - 1. Provide completely independent refrigeration circuits and controls.
 - 2. Indoor unit air coils shall have intermingled circuits, unless specified otherwise.

2.02 EQUIPMENT SCHEDULES

A. Refer to the Drawings.

2.03 PACKAGED AC UNITS

- A. General:
 - 1. Factory assembled, packaged, pad-mounted, air-cooled air-conditioning unit.
 - 2. Contained within unit enclosure shall be factory wiring, piping, controls, compressor, holding charge of refrigerant.
 - 3. Unit Configuration: Packaged, configuration as indicated on the Drawings.
 - 4. Units shall operate as single zone variable air volume (SZVAV) units as indicated in the Sequence of Operations and Equipment Schedules on the Drawings.
- B. Unit Cabinet:
 - 1. Constructed of galvanized steel, phosphatized and coated with baked enamel finish.
 - 2. Removable access panels with access to internal components.
 - 3. Outdoor Compartment: Isolated with minimum 1/2-inch thick acoustic lining to ensure quiet operation.
 - 4. Knockouts for unit electrical power and condensate piping connections.
 - 5. Supported on steel full-length mounting rails.
 - 6. Indoor compartment interior insulated with 1-inch thick, 1 pound per cubic foot density, coated glass fiber insulation, attached with adhesive material.
 - 7. Duct flanges for connection of supply and return ductwork.
 - 8. Weatherproof indoor section.
- C. Evaporator Fan:
 - 1. Double-inlet, double-width, forward-curved fan.
 - 2. Direct-drive or belt-drive as standard with unit.
 - 3. Motor:
 - a. Totally enclosed and permanently lubricated, with integral overload protection.
 - b. Variable speed.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS UNITARY AIR-CONDITIONING EQUIPMENT 23 81 00 - 5

- D. DX Evaporator Coil:
 - 1. Coil: Constructed of aluminum fins mechanically bonded to internally enhanced seamless copper tubes, with galvanized steel tube sheets.
 - 2. Condensate Drain Pan: Plastic or stainless steel, insulated, with primary and secondary drain fittings. Provide condensate overflow switch.
- E. Condenser Fan:
 - 1. Direct-drive propeller type.
 - 2. Motors:
 - a. Totally enclosed, single-phase motors with Class B insulation and permanently lubricated sleeve bearings.
 - b. Protected by internal thermal overload protection.
 - 3. Shaft: Inherent corrosion resistance.
 - 4. Fan Blades: Corrosion-resistant and statically and dynamically balanced.
 - 5. Equip openings with PVC-coated protection grille over fan and coil.
- F. Compressor:
 - 1. Fully hermetic reciprocating or scroll type.
 - 2. Equipped with oil system, operating oil charge, and motor.
 - 3. Internal overloads shall protect compressor from over-temperature and over-current.
 - 4. Motor: NEMA rated, Class F, suitable for operation in a refrigerant atmosphere.
 - 5. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.
 - 6. Scroll compressors shall have high discharge gas temperature protection, if required.
 - 7. Compressor assembly shall be installed on rubber vibration isolators and have internal spring isolation.
- G. Condenser Coil: Constructed of aluminum fins mechanically bonded to internally enhanced seamless copper or aluminum allow tubes, with galvanized steel tube sheets.
- H. Refrigeration Components:
 - 1. Brass external liquid line service valve with service gauge port connections.
 - 2. Suction line service valve with service gauge connection port.
 - 3. Service gauge port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps.
 - 4. Accumulator.

- 5. Filter drier.
- 6. Pressure relief.
- 7. Sight glass.
- I. Electric Heating Coil as follows:
 - 1. Heavy-duty nickel-chromium elements.
 - 2. Individual line-break HIGH limit control for each stage.
 - 3. HIGH limit control operating through heating element contactors equipped with automatic reset.
 - 4. Internally factory-wired to provide single-point power connection with unit.
 - 5. UL listed.
 - 6. Capacity as listed in Equipment Schedule.
- J. Controls:
 - 1. Factory selected, assembled, and tested.
 - 2. Refrigerant Metering: Factory installed refrigerant metering device.
 - 3. Time delay restart to prevent compressor reverse rotation on singlephase scroll compressors.
 - 4. Automatic restart on power failure.
 - 5. Three-pole contactors.
 - 6. Safety lockout if outdoor unit safety is open.
 - 7. Time delay control sequence shall be provided standard through control board.
 - 8. High pressure and liquid line low pressure switches.
 - 9. Automatic outdoor fan motor protection.
 - 10. Start capacitor and relay (single-phase units without scroll compressors).
 - 11. Automatic demand-type defrost start and termination.
 - 12. BACnet MS/TP Communication Card.
 - 13. Safeties:
 - a. High condensing temperature protection.
 - b. System diagnostics.
 - c. Compressor motor current and temperature overload protection.
 - d. High pressure relief.
 - e. Outdoor fan failure protection.
- K. Air Filters:
 - 1. Rack mounted.
 - 2. Differential pressure gauge and tubing.
 - 3. UL 900 listed, 2-inch thick with pleated nonwoven fabric media.
 - 4. MERV 8 rating.
 - 5. Manufacturer and Product: Farr, 30/30.

- L. Accessories:
 - 1. Provide as scheduled in Equipment Schedule and as follows:
 - a. Low-Ambient Cooling Kit:
 - 1) Solid state condenser fan motor controller; responds to saturated condensing pressure/temperature of unit.
 - Maintains a saturated condensing temperature of 100 degrees F plus or minus 10 degrees F with outdoor temperatures down to minus 20 degrees F.
 - 3) Includes winter start control package, to bypass lowpressure switch temporarily to allow compressor start during low load conditions.
 - 4) Includes ball bearing condenser fan motor.
 - b. Compressor Cycle Delay: Compressor prevented from restarting for a minimum of 5 minutes after shutdown.
 - c. Filter Drier: Liquid line mounted.
 - d. Economizer: Modulating outside air and return air dampers, barometric relief, inlet hood, enthalpy controller and motorized electric damper actuator. Damper assemblies shall be ultra lowleak design per ASHRAE 90.1.
 - e. Power Exhaust Kit: Exhaust fan sized for 100 percent of supply airflow. Room pressure control type. Modulating exhaust air damper.
 - f. Electric Multistage Unit Controller: Refer to Article Unitary Equipment Controls.
 - g. Single zone variable air volume controls and associated integral control components.
- M. Manufacturers (Up to 10 Nominal Tons):
 - 1. Valent.
 - 2. Aaon.
- N. Manufacturers (Up to 50 Nominal Tons)
 - 1. Aaon.
 - 2. Valent.
- O. Manufacturers (Over 50 Nominal Tons)
 - 1. Tempmaster.
 - 2. Aaon.

2.04 WALL MOUNT AC UNITS

A. General:

- 1. Self-contained, exterior wall-mounted air conditioner suitable for outdoor use, specifically designed for electrical enclosure climate control.
- 2. Completely factory assembled and tested; includes compressor, indoor and outdoor coils, fans, motors, prewired controls, thermostats, interconnecting refrigerant tubing, wiring, circuit breaker, and other necessary components mounted in corrosion resistant cabinet.
- 3. Unit shall be shipped from factory with full operating refrigerant and oil charge.
- 4. Outside air, return air, and barometric relief control dampers.
- 5. Cooling performance rated and certified in accordance with AHRI 390 testing procedures.
- B. Unit Cabinet:
 - 1. Constructed of Type 304 stainless steel sheet metal.
 - 2. Sloped top with built-in mounting flanges.
 - 3. Unit Mounting Brackets: Full-length bracket shall be factory provided.
 - 4. Conditioned air section shall be insulated with 1-inch, 2-pound dual density fiberglass.
 - 5. Economizer Hood: Construction to match unit cabinet.
 - 6. Drain Pan: Constructed of stainless steel. Finished with manufacturer's standard corrosion-resistance coating system.
 - 7. Supply Grille: Adjustable aluminum double deflection type, factory installed.
 - 8. Return Grille: Aluminum, fixed blade type, factory installed.
- C. Compressor:
 - 1. Hermetic type, equipped with immersion type self-regulating crankcase heater.
 - 2. Motor shall be protected by internal line-break thermostat.
 - 3. Electrical wiring connections at compressor shall be protected by receptacle housing.
- D. Refrigeration Components:
 - 1. Refrigeration Circuit:
 - a. Liquid filter dryer.
 - b. Suction and liquid access valves.

- E. Condenser Section:
 - 1. Condenser Coil: Constructed of aluminum plate fins mechanically bonded to seamless copper tubes.
 - 2. Fan:
 - a. Direct driven, slow speed propeller type for quiet operation.
 - b. Motor: Equipped with thermal protector.
 - c. Sealed condenser fan motors.
 - d. Heavy-duty coil guard integrated with cabinet.
- F. Evaporator Section:
 - 1. Evaporator Coil: Constructed of aluminum plate fins mechanically bonded to seamless copper tubes.
 - 2. Two direct driven evaporator blowers shall be of centrifugal type, forward curved.
 - 3. Indoor Motor: Equipped with thermal protector.
 - 4. Evaporator drain pan sloped for drainage.
- G. Electric Heat Coil:
 - 1. UL listed.
 - 2. Heavy-duty nickel-chromium elements.
 - 3. Individual line-break HIGH limit control for each stage.
 - 4. HIGH limit control operating through heating element contactors, equipped with automatic reset.
 - 5. Internally factory-wired to provide single-point power connection with unit.
- H. Controls:
 - 1. Refrigerant Metering: Factory installed refrigerant metering device.
 - 2. Internal control circuit of a current limiting type transformer to generate 24V ac, switching devices to operate compressor, indoor fan motor, and electrical heater(s).
 - 3. Access to electrical control box, including low voltage compartment, shall be from front of air conditioner. Side mounted control boxes shall not be permitted.
 - 4. Provide automatic resetting adjustable time delay circuit to prevent rapid compressor cycling and to delay startup of compressor on call for cooling.
 - 5. Economizer temperature controls with adjustable operating setpoints.
 - 6. Temperature sensors.
 - 7. When the unit is OFF, all dampers are closed.
 - 8. Internal control board with LEDs to indicate operational and power status and safety pressure lockout status.
 - 9. Option to prevent simultaneous heating and cooling.

UNITARY AIR-CONDITIONING EQUIPMENT 23 81 00 - 10

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

- 10. Safeties:
 - a. Control circuit shall incorporate manual reset safety circuit to render refrigerant system (compressor and outdoor fan motor) inoperative should there be a loss of airflow or refrigerant.
 - b. System lockout condition shall be indicated by contact closure available at low voltage terminal block.
 - c. Safety circuit shall be resettable at wall thermostat.
 - d. Refrigeration circuit shall include high and low pressure switches with lockout relay.
 - e. Compressor time delay circuit.
 - f. Compressor low pressure bypass.
 - g. Phase rotation and phase failure protection.
- I. Air Filters: 2-inch deep, mounted internally, factory supplied, and accessible through external access panel.
- J. Accessories:
 - 1. Provide as follows:
 - a. Fresh Air Economizer Damper:
 - 1) Factory provided.
 - 2) 100 percent Modulating, full airside type.
 - b. Electric Multistage Unit Controller: Refer to Article Unitary Equipment Controls.
 - c. Wall mount brackets.
 - d. Dirty filter indicator with LED.
- K. Manufacturers and Products:
 - 1. Bard.
 - 2. Marvair.

2.05 UNITARY EQUIPMENT CONTROLS

- A. Electric Thermostat:
 - 1. Two-position electric type.
 - 2. Temperature Scale: Furnish 50 degrees F to 90 degrees F scale.
 - 3. Adjustments external to units.
 - 4. Adjustable sensitivity.
 - 5. Nonlocking cover.
 - 6. Insulating back, where exterior mounting is indicated.

- B. Electronic Multistage AC Unit Controller:
 - 1. Heating and Cooling Stages:
 - a. Four-stage cooling and four-stage heating electronic control.
 - b. Staging delay between each cycle.
 - c. Visual indication of activation of each stage.
 - 2. Integrated thermostat.
 - 3. Temperature Scale: Manually adjustable, 55 degrees F to 90 degrees F scale.
 - 4. Duty Cycle:
 - a. Automatic duty cycling of equipment.
 - b. Manual adjustment for 1-day to 24-day cycle time.
 - c. Manual cycle advance.
 - d. Visual indication of lead unit.
 - 5. Enclosure:
 - a. Single wall-mounted enclosure with operator interface on outside of panel door.
 - b. NEMA rating per the Material Classification Schedule on the General section of the Drawings.
 - 6. Operator interface to consist of temperature adjustment, LCD room temperature display, and visual indication of lead unit and each cooling and heating stage activation.
 - 7. Adjustments external to controller.
 - 8. Adjustable "dead band" between heating and cooling to be between 4 degrees F and 20 degrees F.
 - 9. Power loss memory for restoration of sequence of operation in event of power loss.
 - 10. Refer to Section 23 09 00, Instrumentation and Control Devices for HVAC, for additional controller operation options.
 - 11. Manufacturer and Model: Bard; TEC40.

2.06 ELECTRICAL

- A. General:
 - 1. Units shall include high and low voltage terminal block connections.
 - 2. Control voltage to indoor unit fan shall be 24 volts.
 - 3. Motor Starters/Contactors: Factory installed with unitary equipment, unless otherwise noted.
 - 4. Disconnects: Factory installed nonfused disconnects or circuit breakers on each unit, unless otherwise noted.

- B. Motors:
 - 1. Refer to Section 26 20 00, Low-Voltage AC Induction Motors, for general requirements.
 - 2. Unless otherwise stated, electric motors shall comply with the following:
 - a. Voltage, Phase, Horsepower, Synchronous Speed: Refer to Equipment Schedule for motor driven equipment.
 - b. Enclosure: ODP, unless specified otherwise.
 - c. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - d. Winding Thermal Protection: Manufacturer's standard.
 - e. Space Heater: Manufacturer's standard.
 - f. Multispeed Motors, Synchronous Speed, Number of Windings: Manufacturer's standard.
 - g. Efficiency: Minimum efficiency per Section 26 20 00, Low-Voltage AC Induction Motors.

2.07 ACCESSORIES

- A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.
- B. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear block type equipment tag numbers indicated on the Drawings.
- C. Anchor Bolts: Sized by equipment manufacturer, as specified in Section 05 50 00, Metal Fabrications and Section 01 81 01, Equipment Anchorage. Quantity as recommended by manufacturer.

2.08 SOURCE QUALITY CONTROL

- A. Factory Tests:
 - 1. Direct expansion coils leak tested underwater with 200-psig air. Pressure tested to 450 psig.
 - 2. Electric heating coils tested with 2,000-volt dielectric test.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install equipment in accordance with manufacturer's recommendations, and these Specifications.
 - 2. Set and install equipment so equipment is level and properly supported.
 - 3. Ensure piping connections to equipment do not cause strain on equipment.
 - 4. Ensure vibration isolation has been installed per manufacturer's instructions and isolation devices are performing satisfactorily.
 - 5. Install safety devices as recommended by manufacturer and required by code.
- B. Seal outside air intake watertight to roof curb.
- C. Isolate sheet metal duct connections from portions of unit not internally spring-isolated from fans, or other vibrating or rotating equipment.
- D. Inspect internal casing insulation, seal exposed edges, and butt joints with mastic to ensure insulation will not be loosened during operation.
- E. Filters:
 - 1. Install set of filters in each unit before operating and leave in place during startup and testing to keep equipment and ductwork clean.
 - 2. Do not operate units until filters are installed. If operated without filters, completely clean ductwork, coils, and interior of units.
- F. Lubricate unsealed bearings prior to startup.

3.02 FIELD QUALITY CONTROL

- A. Initial equipment testing and startup shall be made by authorized representative of unit manufacturer.
- B. Air-cooled outdoor unit shall not be started without complete prestart checkout of entire refrigerant piping system and charging of system with refrigerant as recommended by equipment manufacturer.
- C. Field Testing: Manufacturer shall provide factory-trained representative employed by equipment manufacturer to perform the following services. Supervision only, of Contractor personnel, will not be acceptable.
 - 1. Leak test.
 - 2. Refrigerant pressure test.

- 3. Evacuate (if required).
- 4. Dehydrate (if required).
- 5. Charge condensing unit with refrigerant and oil (if required).

3.03 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for the following:
 - 1. Inspect installation including external interlock, power connections; supervise initial operation, calibration of operating and safety controls and supervise electrical testing including insulation resistance of motors and voltage balance between phases during starting and running.
 - 2. Test Report:
 - a. Submit test reports unit is in safe and proper operating condition.
 - b. Contain pressure and control settings, meg readings, voltage readings per phase during START and RUN, suction temperature and pressure, liquid temperature and pressure.
 - c. List minor discrepancies to be corrected which do not affect safe and reliable operation.
 - d. One copy of report shall be left in unit control panel.
 - 3. One copy of bound installation operation and maintenance service, and parts brochures, including applicable serial numbers, full unit description, parts ordering sources, shall be placed in unit control panel at time of starting.
 - 4. Training of Owner's personnel for specified equipment. Provide training to operations and maintenance personnel per Section 01 43 33, Manufacturers' Field Services.
- B. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

3.04 ADJUSTING AND CLEANING

- A. Air System Balancing: As specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Install set of filters at time of final cleaning as defined in Section 01 77 00, Closeout Procedures.

END OF SECTION

SECTION 23 82 00 TERMINAL HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Moving and Conditioning Association (AMCA): 300, Reverberant Room Method for Sound Testing of Fans
 - 2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 90.1 IP/SI, Energy Standard for Buildings, Except Low-Rise Residential Buildings.
 - 3. ASTM International (ASTM):
 - a. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - b. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 4. Electrical Test Laboratories (ETL).
 - 5. National Electrical Manufacturer's Association (NEMA).
 - 6. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 70, National Electrical Code (NEC).
 - c. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 7. Sheet Metal and Air Conditioning Contractors' National Assoc., Inc. (SMACNA): Ducted Electric Heat Guide for Air Handling Systems.
 - 8. UL: Product Directories.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. DWDI: Double Width, Double Inlet.
 - 5. FRP: Fiberglass Reinforced Plastic.
 - 6. hp: Horsepower.
 - 7. ODP: Open Drip Proof.
 - 8. PSC: Permanent Split Capacitor.
 - 9. SWSI: Single Width, Single Inlet.
 - 10. TEFC: Totally Enclosed, Fan Cooled.
 - 11. UV: Ultraviolet.
 - 12. XP: Explosion Proof.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS TERMINAL HEATING AND COOLING UNITS 23 82 00 - 1

1.03 MATERIAL SELECTION

A. Unless specifically mentioned otherwise herein, materials such as; mounting hardware materials, pipe supports, ductwork and supports, electrical framing channel, supports for electrical conduits and cable trays, electrical boxes and fittings, electrical conduit, and enclosure types used in specific areas shall be in accordance with the Material Classification Schedule on the Drawings.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature which shall include make, model, dimensions, weight of equipment, and electrical schematics for products specified.
 - 3. Manufacturer's standard finish color selection for cabinet finishes.
 - 4. Performance data, including sound power level data (reference 10 to minus 12 power watts) at design operating point, shall be based on AMCA 300.
- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - Manufacturer's test reports for the following:
 a. Electric duct heater.
 - 3. Certificate of compliance with the Build America, Buy America Act. See Section 01 33 00, Submittal Procedures.
 - 4. Certificate of compliance with American Iron and Steel. See Section 01 33 00, Submittal Procedures.
 - 5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data. Include as-built version of equipment schedules.

1.05 QUALITY ASSURANCE

A. Heating Equipment: Minimum operating efficiencies, specified in the State of New Mexico Energy Code.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Equipment Schedules: Refer to the Drawings.

2.02 UNIT HEATER, ELECTRIC, WALL

- A. Characteristics:
 - 1. Horizontal air delivery, wall-mounted electric unit heater.
 - 2. UL listed and CSA certified.
 - 3. Cabinet Casing:
 - a. Corrosion-resistant drawn-formed steel finished with baked on polyester powder paint finish.
 - b. Top: Two threaded holes for threaded rod suspension.
 - c. Bottom: Hinged panel for service access to wiring and controls.
 - 4. Elements:
 - a. Nickel-chromium resistance wire surrounded with magnesium oxide and sheathed in steel spiral-finned tubes.
 - b. Kilowatt rating as specified.
 - 5. Motor and Propeller Fan:
 - a. Single motor and propeller.
 - b. Motor shall be totally enclosed, continuous-duty, with automatic resetting, thermal overload protection.
 - c. Propeller fan shall be directly connected to motor shaft and be statically balanced.
 - d. Mount motor to unit with rubber vibration absorbing material.
 - 6. Electrical:
 - a. Built-in control circuit transformer (where required) to provide a single-source power connection.
 - b. Provide built-in transformers and built-in fuse blocks with factory-supplied fuses on models with 480-volt, three-phase power supply to permit 240-volt motor operation.
 - c. Enclose electrical control components in separate junction box.
 - 7. Controls: Operated by unit mounted line-voltage thermostat.
- B. Manufacturers:
 - 1. Reddi.
 - 2. Modine.
 - 3. Chromalox.
 - 4. Markel.

PW\JA\ENMRW\D3299318\4\42 DECEMBER 2024 ©COPYRIGHT 2024 JACOBS

2.03 UNIT HEATER, ELECTRIC, SUSPENDED

- A. Characteristics:
 - 1. Factory assembled including casing, heater elements, fan wheel, drive assembly, motor, controls and accessories.
 - 2. UL listed.
 - 3. Meet requirements of National Electrical Code.
 - 4. Three phase heaters shall have balanced phases.
 - 5. Casing:
 - a. Heavy gauge steel casing.
 - b. Baked enamel finish.
 - c. Individual adjustable discharge louvers.
 - d. Protective air inlet louvers or fan guards.
 - 6. Heating elements shall be one of the following types:
 - a. Aluminum finned, copper clad, steel sheath.
 - b. High mass, all steel tubular finned type, copper brazed, in fixed element banks.
 - c. Nickel-chromium wire elements enclosed in powder filled aluminum coated steel tubes with permanently fused fins.
 - d. Steel tubes with nickel chromium resistance wire embedded in a dielectric with steel fins crimped and brazed to the tube.
 - e. Corrosion-resistant steel fins brazed to tubular heating elements.
 - 7. Fan and Motor:
 - a. Totally enclosed motor.
 - b. Direct drive fan.
 - c. Sealed bearings. Permanently lubricated.
 - 8. Controls:
 - a. Thermal overload protection with automatic reset.
 - b. Controls, transformers, and contactors shall be factory assembled, except wall mounted thermostats when indicated.
- B. Accessories and Features:
 - 1. Provide as follows:
 - a. Airflow discharge shall be horizontal.
 - b. Voltage: 480-volt, three-phase.
 - c. Wall mounting bracket.
 - d. Fan delay feature that starts fan after element warmup and stops fan after element cool down.
 - e. Independent summer fan operation with unit mounted switch.
 - f. Thermostat: Adjustable, wall mounted, low voltage with a minimum temperature range of 40 degrees F to 85 degrees F.
 - g. Control transformer.
 - h. Two-stage heating operation.

TERMINAL HEATING AND COOLING UNITS 23 82 00 - 4

- C. Manufacturers and Products:
 - 1. Qmark; Type MUH.
 - 2. Trane; Type UHEC.
 - 3. Modine: Type HER (horizontal discharge).
 - 4. Markel; Series 5100.
 - 5. Chromolox; Series LUH (horizontal discharge).

2.04 ELECTRICAL

- A. General:
 - 1. Units shall include high and low voltage terminal block connections.
 - 2. Control voltage to indoor unit fan shall be 24 volts.
 - 3. Motor Starters/Contactors: Factory installed with unitary equipment, unless otherwise noted.
 - 4. Disconnects: Factory installed nonfused disconnects or circuit breakers on each unit, unless otherwise noted.
- B. Motors:
 - 1. Refer to Section 26 20 00, Low-Voltage AC Induction Motors, for general requirements.
 - 2. Unless otherwise stated, electric motors shall comply with the following:
 - a. Voltage, Phase, Horsepower, Synchronous Speed: Refer to Equipment Schedule for motor driven equipment.
 - b. Enclosure: ODP, unless specified otherwise.
 - c. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - d. Winding Thermal Protection: Manufacturer's standard.
 - e. Space Heater: Manufacturer's standard.
 - f. Multispeed Motors, Synchronous Speed, Number of Windings: Manufacturer's standard.
 - g. Efficiency: Minimum efficiency per Section 26 20 00, Low-Voltage AC Induction Motors.

2.05 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear block type equipment tag numbers as indicated on the Drawings.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.06 SOURCE QUALITY CONTROL

- A. Functional Test:
 - 1. Perform manufacturer's standard factory test on equipment.
 - 2. Equipment with Electric Resistance Heating Coils: Test with 2,000-volt dielectric test.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install in strict compliance with manufacturer's instructions. Maintain clearances around unit as listed in manufacturer's recommendations.
- B. Electric Unit Heaters, All Types:
 - 1. Bottom of unit shall be a minimum of 8 feet above finish floor, unless indicated otherwise.
 - 2. Heater shall be permanently mounted in position indicated with a fixed power supply.
 - 3. Install so obstructions do not block heater air inlet or outlet.

3.02 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation, equipment testing, startup assistance, and training of Owner's personnel for specified equipment.
- B. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

END OF SECTION