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SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 REFERENCE STANDARDS
- A AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- B ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- C ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- D SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2024.

1.2 SUBMITTALS
- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
- D Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- E Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- F Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.3 WARRANTY
- A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B Provide five year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.1 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS
- A General:
  1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
  2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- B Unit Casing:
  1. Minimum 22 gauge, 0.0299 inch galvanized steel.
  2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Acceptable Liners:
     a. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- C Damper Assembly:
  1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  3. Incorporate low leak damper blades for tight airflow shutoff.

D Controls:
1. DDC (Direct-Digital Controls):
   a. Include a field-installed, factory-tested, direct-digital controller.
   b. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
   c. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFMs.
      1) Occupied and unoccupied operating mode.
      2) Remote reset of temperature or CFM set points.
      3) Proportional, plus integral control of room temperature.
      4) Monitoring and adjusting with portable terminal.
   d. Room Sensor:
      1) Compatible with temperature controls specified.
      2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
   e. See Section 25 1400.

PART 3 EXECUTION

3.1 INSTALLATION
A Install in accordance with manufacturer's instructions.
B Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
C Provide ceiling access doors or locate units above easily removable ceiling components.
D Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
E Do not support from ductwork.
F Connect to ductwork in accordance with Section 23 31 00.

END OF SECTION 23 36 00

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 GENERAL

1.1 REFERENCE STANDARDS
- A AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- C ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2021).
- E ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2021.
- F NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- G NFPA 54 - National Fuel Gas Code; 2021.
- H SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.2 SUBMITTALS
- A See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- C Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.
- E Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- F Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- G Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.3 WARRANTY
- A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B Provide a five year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A Natural Gas, Propane, or Combination Natural Gas/Propane for Indoor Applications:
  1. Lochinvar LLC; _____: www.lochinvar.com/#sle.
  2. The Fulton Companies; _____: www.fulton.com/#sle.
  3. VIessman: www.viessmann-us.com.
  4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MANUFACTURED UNITS
- A Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.3 BOILER CONSTRUCTION

A Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
B Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
C Required Directory Listings:
1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
D Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
E Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
F Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
G Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.4 BOILER TRIM

A ASME rated pressure relief valve.
B Flow switch.
C Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
D Temperature and pressure gauge.
E Pressure Switches:
1. High gas pressure.
2. Low gas pressure.
3. Air pressure.
F Manual reset high limit.
G Boiler Pump (where required by boiler design):
1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
3. Pump time delay.

2.5 FUEL BURNING SYSTEM

A Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, propane, and No. 2 fuel oil, and maintain fuel-air ratios automatically.
1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
4. Combustion Air Filter: Protects fuel burning system from debris.
B Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
C Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.

D Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.6 FACTORY INSTALLED CONTROLS
A Option for internal or external (0-10) VDC control.
B Temperature Controls:
1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
3. Low-fire start time delay relay.
C Electronic PI setpoint/modulation control system.
D Microprocessor-based, fuel/air mixing controls.
E BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
1. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

PART 3 EXECUTION

3.1 INSTALLATION
A Install in accordance with manufacturer's instructions.
B Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
C Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 03 30 00.
D Coordinate provisions for water treatment in accordance with Section 23 25 00.
E Pipe relief valves to nearest floor drain.
F Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
G Install primary boiler pump in accordance with Section 23 21 23.
H Provide piping connection and accessories in accordance with Section 23 21 14.
I Provide for connection to electrical service in accordance with Section 26 05 83.
J Connect vent combustion generated fumes to breeching, chimney or exhaust stack; see Section 23 51 00.
K Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 15 00.

3.2 CLOSEOUT ACTIVITIES
A See Section 01 79 00 - Demonstration and Training for additional requirements.
B Demonstrate proper operation of equipment to Owner's designated representative.
C Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.
D Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.

END OF SECTION 23 52 16

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SECTION 23 65 33 - LIQUID COOLERS

PART 1 GENERAL

1.1 REFERENCE STANDARDS
- A ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
- B ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014 (Reaffirmed 2020).
- C ASME PTC 23 - Atmospheric Water Cooling Equipment; 2003 (Reaffirmed 2023).
- D NEMA MG 00001 - Motors and Generators; 2024.

1.2 SUBMITTALS
- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- C Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- D Certificates: Certify that liquid cooler performance, based on ASME PTC 23 meet or exceed specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- E Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- F Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include cleaning methods and cleaning materials recommended.
- G Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 60 00 - Product Requirements, for additional provisions.
  2. Extra Fan Belts: One set, matched, for each unit.

1.3 DELIVERY, STORAGE, AND HANDLING
- A Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- B Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.4 WARRANTY
- A See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B Provide a five year warranty to include coverage for liquid cooler package, labor.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A TowerTech: www.towertech-us.com (Preferred)
- B EVAPCO, Inc; _____: www.evapco.com/#sle.
- C SPX Cooling Technologies/Marley; _____: www.spxcooling.com/#sle.
- D Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MANUFACTURED UNITS
- A Provide outdoor units, factory assembled, sectional, counterflow, vertical discharge, forced draft design, with fan assemblies built into pan and casing.

2.3 COMPONENTS
- A Pan and Casing: Fiberglass or Stainless Steel

B Cooler Coil: Steel tubing, air tested under water to 350 psi, sloped to ensure drainage, encased in steel framework. Provide cleanable header unit with removable cover plates on header to access tubular coil.
C Fans: Multi blade, cast aluminum, axial type, with belt drive, bearings with ABMA STD 9 or ABMA STD 11, L-10 life expectancy at 30,000 hours, with extended grease fittings.
D Fan Motors: Variable speed (1800/900 rpm) mounted on adjustable steel base. See Section 23 05 13
E Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.
F Finish: Electrostatically sprayed thermosetting polymer.

2.4 INSIDE SUMP
A Pan and Casing: Galvanized steel, 12 gauge, 0.1046 inch for casing and 8 gauge, 0.1644 inch for reinforcing angles and channels with lift out steel strainer.
B Finish: Electrostatically sprayed thermosetting polymer.

2.5 CIRCULATING PUMP
A Pump: Close coupled, bronze fitted, centrifugal pump with mechanical seal, mounted on piping.
B Pump Control: Pan mounted immersion thermostat set at 140 degrees Fahrenheit.
C Pump Motor: Single speed (1800/900 rpm) open drip proof mounted on pump body. NEMA MG 1.

2.6 ACCESSORIES
A Electric Immersion Heaters: In pan suitable to maintain temperature of water in basin at 42 degrees Fahrenheit when outside temperature is 0 degrees Fahrenheit and wind velocity is 15 mph; immersion thermostat and float control to operate heaters on low temperature when pan is filled.

PART 3 EXECUTION

3.1 INSTALLATION
A Install in accordance with manufacturer's instructions.
B Install cooler on structural steel beams as instructed by manufacturer.
C Connect cooler water piping with flanged connections to cooler. See Section 23 21 13.
D Connect make-up water piping with flanged or union connections to cooler. Pitch to cooler. Pipe drain, overflow drain, and bleed lint to nearest floor drain. See Section 22 10 05.

END OF SECTION 23 65 33

SECTION 23 74 33 - DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
B AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
C ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
D ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
G UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
H UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.2 SUBMITTALS

A See Section 01 30 00 - Administrative Requirements for submittal procedures.
B Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
C Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
D Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
E Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
F Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
G Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
H Project Record Documents: Record actual locations of components.
I Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements for additional provisions.
    2. Extra Filters: One set of each type and size.

1.3 WARRANTY

A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B Provide five year manufacturers warranty for compressor/condenser unit.

PART 2 PRODUCTS

2.1 ROOF-MOUNTED DOAS

A Packaged Unit:
    1. Casing and Components:
        a. Fabrication: AHRI 210/240 and UL 207 construction, ASHRAE Std 23 tested.
        b. 18 gauge, 0.0478 inch steel panels reinforced with structural angles and channels to ensure rigidity.
        c. Provide bolted access panels to access each sections from either side of unit.
        d. Provide hinged door with lockable handle for serviceable sections.
        e. Drain Pan: Galvanized steel with corrosion-resistant coating.
    2. Performance Ratings: ASHRAE Std 90.1, EER and COP as applicable.

3. Regulatory Requirements: AHRI 270 (SI/I-P) rated, NFPA 70, and UL (DIR) listed.
4. Insulation: Minimum 1/2 inch thick acoustic duct liner for lining cabinet interior.
5. External Surface Finish: Heat resistant baked enamel.
6. Outdoor Installation: Weatherproofed casing, with intake louver or hood.
7. Outside Air Damper with Rain Hood and Screen:

B Filter Section:
1. Filter: Removable, 4 inches thick MERV-13.
2. Monitoring: Provide gauge with loaded setpoint-adjustable signal flag or external tag. Provide loaded filter alarm switch wired into unit controls with illuminated indicator on local control panel face.

C Cooling Section:
1. Water-Source Heat Pump:
   a. Packaged water-source heat pump with integrated or coordinated controls.
   b. Compressor Section:
      1) Hermetically sealed, direct-driven single-stage scroll or dual-stage scroll type with centrifugal type oil pumps.
      2) Motor: Suction gas-cooled with voltage utilization range of plus/minus 10 percent of unit nameplate voltage.
      3) Internal spring isolation and sound muffling to minimize vibration transmission and noise.
      4) External high-and low-pressure switches.
   c. Refrigerant Load Control: Provide hot-gas bypass and hot-gas reheat coil.
   d. Evaporator Section: Internally finned aluminum, copper, or cupro-nickel tubes mechanically bonded to aluminum plate fins.

D Energy Recovery Section: Provide wheel recovery device fully coordinated with return, exhaust, or return-exhaust fan section.

E Fan Section:
1. Provide direct or plenum mounted variable-speed fan motors; see Section 23 05 13.
2. Draw-through, forward-curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
3. Factory program for both soft start and constant flow output over static pressure range.
4. Provide preinstalled neutral wire protection when required to support specified fan type.
5. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
6. Belt-Driven Motor Requirements: Provide adjustable blower motor/sheave combination device based on indicated flow performance requirements. Statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy-duty, self-aligning, prelubricated ball bearings and V-belt drive with matching motor sheaves and belts.
7. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units; see Section 23 09 34.
8. Fan Turndown: Design control features to allow fan speed reduction to adjustable 50 percent of its capacity when the zone set point temperature is satisfied or when unit runs in fan-only mode.

F Unit Controls:
1. DDC:
   a. Application Specific Controller; see Section 25 14 00 unless factory-provided.
   b. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
   c. Coordination and Sequencing:
      1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
      2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, internal and remote contacts, and other devices required for operation.

3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.

2. Thermostat:
   a. Field mounted and wired, tied into prewired control-interface terminals.
   b. Smart Thermostat:
      1) BAS, SCADA, or Integrated Automation linked programmable thermostat; see Section 25 14 00.
   c. Programmable Thermostat:
      1) Electro-mechanical type with key- or pushbutton-operated display.
      2) Programmable occupied/unoccupied weekly and holiday schedule.
   d. Nonprogrammable Thermostat:
      1) Electro-mechanical type with key- or pushbutton-operated display.
      2) User-configurable, precoded options aligned with equipment functions.
   e. Thermostat: Single-gang-box-mounted platinum or thermistor.
      1) Local Interface to Include:
         (a) Filter maintenance indicating status.
3. Airflow Meter:
   a. Include integral airflow meter station or probe for ventilation, supply, or exhaust airflow in cfm as indicated on drawings.
4. Local Control Panel: Interface to include on-off-auto switch, heat-off-cool switch, indicating lights for supply fan, pilot operation, burner operation, lockout indication, and clogged filter indication.

G Electrical: 480 VAC, 3-phase, 60 Hz, single point to factory-mounted nonfused disconnect switch internally wired into motors and compressors, and other powered components including system safeties.

H Furnish dedicated outdoor air unit and associated components and accessories produced by a single manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A Install in accordance with manufacturer's instructions.

B Provide unit- or duct-mounted smoke detectors and other NFPA 90A provisions.

C Install unit on vibration isolator pad or roof curb; see Section 23 05 48.

D Provide flexible duct connections on inlet and outlet from unit; see Section 23 33 00.

E Connect drain pan outlet to nearest building drain system piping.

F Adjusting: Use plenum static pressure readings against manufacturer calibration chart to adjust primary airflow as other measuring methods will not work.

G Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 15 00.

END OF SECTION 23 74 33

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SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.

B ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2021).

D ASHRAE Std 13256-1 - Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps; 2021.

E ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

F UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

G UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

H UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

I UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.2 SUBMITTALS

A See Section 01 30 00 - Administrative Requirements for submittal procedures.

B Product Data: Provide drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements.

C Manufacturer's Instructions: Include assembly instructions, support details, connection requirements, and start-up instructions.

D Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

E Operation and Maintenance Data: Provide maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

F Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 GENERAL HEAT PUMP FABRICATION REQUIREMENTS

A Energy Efficiency: ASHRAE Std 90.1 I-P EER and COP ratings, minimum.

B ASHRAE Std 13256-1, factory-assembled unit including safety-controls, accessories, filters, piping, cables, wires, and precharged with R-454B refrigerant prior to testing.

C Include marked terminal strip to interface field-mounted components, accessories, and thermostat.

D Comply with UL 1995; place service and caution labels on unit.

E Cabinet Assembly:

1. Construct of zinc-coated, heavy-gauge, galvanized steel with exposed edges rounded.
2. Finish: Factory apply electrostatic powder paint or baked enamel finish. Coordinate with Engineer for specific color finish requirements of console units or other units installed within occupied spaces.
3. Provide access panels for inspection, cleaning, and servicing of refrigerant, controls, condensate drain pan, coil, and blower.
4. Furnish 1-inch or 3-inch duct flange on open-discharge selections.
5. Interior Insulation: Minimum 1/2 inch thick, dual density, bonded glass fiber.

6. Provide flame spread of less than 25, and smoke developed classification of less than 50 inch compliance with ASTM E84 and UL 723.
7. Sound and Noise Suppression:
   a. Mechanical Rooms: 18 gauge, 0.05 inch, minimum.
   b. Occupied Spaces: 16 gauge, 0.06 inch, minimum.
   c. Compressor enclosure lined with 1/2 inch thick insulation.
   d. Include vibration isolation between compressor and heat exchanger.
   e. Include length-wise, unit base stiffeners.
   f. Foam gasket sealant around compressor and end panel perimeter.

F Blower Section:
1. Draw-through, forward curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
2. Factory program for both soft start and constant flow output over static pressure range.
3. Provide preinstalled neutral wire protection when required to support specified fan type.
4. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
5. Belt-Driven Motor Requirements: Provide adjustable blower motor/sheave combination device based on indicated flow performance requirements.
6. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units.
7. Fan Turndown: Design control features to allow fan speed reduction to adjustable 50 percent of its capacity when the zone set point temperature is satisfied or when unit runs in fan-only mode.

G Evaporator Section:
1. Internally finned, aluminum or copper tubes mechanically bonded to configured aluminum plate fin, corrosion inhibitor coated as indicated.
2. Refrigerant Coil Distributor Assembly: Orifice style with round copper distributor tubes.
3. Thermostatic Expansion Valve: Factory select and install for wide control range.
4. Factory leak test to minimum 450 psi and pressure test to minimum 600 psi.
5. Tubes: Size tubes consistent with coil capacity. Fabricate suction header from rounded copper pipe.
6. Completely evacuate air and charge with proper column of refrigerant prior to shipment.
7. Drain Pan:
   a. Construct of ABS plastic, HDPE, stainless steel, or other corrosion-resistant material and flame rated in accordance with UL 94 when using polymers.
   b. Slope on two planes to pitch condensate to drain connection.
   c. Float Switch: UL 508, rated for protection against condensate overflow, controller connected.

H Compressor Section:
1. Provide rubber mounting devices located underneath compressor mounting base.
2. Safety Interlocked Devices:
   a. Thermal overload protection.
   b. High pressure switch for protection against excessive discharge pressure.
   c. Low pressure safety for protection against loss of refrigerant charge.

I Refrigerant Tubing Lines:
1. Tubing made of copper with service pressure ports on high- and low-pressure sides.
2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
3. Include drier, thermal expansion valve, and other related components.
4. Freeze Protection: 30 degrees Fahrenheit, thermistor based.
5. Insulation: Evaporator and heat exchanger sides; minimum 3/8 inch thick elastomeric insulation.

J Refrigerant Load Control:
1. Hot-Gas Bypass: Provide to increase heat transfer efficiency at low temperatures.
2. Hot-Gas Reheat Coil:

a. Humidity Control: Upgrade thermostat to include humidity sensor tied to unit controller for integral dehumidification control.
b. Coil Assembly: Aluminum or copper tubes mechanically expanded into evenly spaced aluminum fins.
c. Coil Testing: Proof test at minimum of 1.5 times maximum operating pressure, then leak test at maximum operating pressure.

3. Hot-Water Generator:
a. Secondary coil or heat exchanger, reversing valve, and accessories.
b. Storage: Interconnect to existing water heater or external storage tanks.

K Water-to-Refrigerant Heat Exchanger:
1. Coaxial Type: Provide aluminum or copper tube and fins.
2. Brazed-Plate Type: Stainless steel, with bidirectional liquid line filter drier.
3. Insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below 60 degrees Fahrenheit.
4. Provide rubber isolation to heat exchanging device for enhanced sound attenuation.
5. Freeze Protection: 35 degrees Fahrenheit by thermistor sensing.
6. Minimum Working Pressure: 400 psi water side, 600 psi DX side.
7. End Connections: Copper NPT. Provide flow shut-off ball valves.
8. Accessories:
a. Strainer, PT test plug, and flow regulator.
b. Unit-controlled, return-water-side solenoid valve.

L Filter Section:
1. ASHRAE Std 52.2, minimum efficiency reported value or MERV listing.
2. Filter Box: Provide field-installed return duct-mounted filter housing with side access.

M Electrical:
1. Provide factory-installed phase loss safety device for 3-phase units.
2. Configure unit for single point connection, include terminal for field-installed components.
3. Include separate holes and knockouts with plastic ferrules for respective electrical and controls wiring.

N Unit Controls:
1. DDC:
a. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
b. Coordination and Sequencing:
1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, load-pump contact, source pump contact, and other devices required for operation.
3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.

2. Thermostat:
a. Field mounted and wired, tied into prewired control-interface terminals.
b. Smart Thermostat:
1) BAS- or BMS-linked programmable thermostat; see Section 25 14 00.

2.2 CONSOLE, WATER-SOURCE HEAT PUMP

A Air Discharge Outlet: Locate on cabinet front side, top side, or sloped-top end.
B Compressor: Hermetically sealed, single-stage rotary type.
C Water-to-Refrigerant Heat Exchanger: Coaxial type.
D Blower Section: Provide 3-speed, electrically commutated motor (ECM) fan type.
E Filter Section: Include MERV 4 rated air filter.
F Electrical: 120 VAC, 1-phase, 60 Hz.

G Unit Controls: Factory-supplied DDC with thermostat.
1. BAS, SCADA, or other Integrated Automation Link: BACnet MS/TP in accordance with ASHRAE Std 135.
2. Control Valve: Return-installed, position-adjusted, ball type; see Section 25 35 19.

2.3 HORIZONTAL/VERTICAL WATER-SOURCE HEAT PUMP
A Manufacturers:
1. Trane Technologies, PLC; _____: www.trane.com/#sle.
2. Daikin Applied: www.DaikinApplied.com/#sle.
3. WaterFurnace International, Inc: www.waterfurnace.com/#sle.
4. ClimateMaster: www.climatemaster.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.
B Cabinet Air Discharge Configuration: As indicated on drawings.
C Compressor: Hermetically sealed, single-stage rotary or single-stage scroll type.
D Water-to-Refrigerant Heat Exchanger: Coaxial type.
E Blower Section: Provide high-static, permanent split capacitor (PSC) motor fan type.
F Filter Section: Include MERV 4 rated air filter.
G Unit Controls: Factory-supplied DDC with thermostat.
1. BAS, SCADA, or other Integrated Automation Link: BACnet MS/TP in accordance with ASHRAE Std 135.
2. Control Valve: Return-installed, position-adjusted, ball type; see Section 25 35 19.

2.4 HIGH-EFFICIENCY, DUAL-STAGE, HORIZONTAL/VERTICAL WATER-SOURCE HEAT PUMP
A Manufacturers:
1. Trane Technologies, PLC; _____: www.trane.com/#sle.
2. Daikin Applied: www.DaikinApplied.com/#sle.
3. WaterFurnace International, Inc: www.waterfurnace.com/#sle.
4. ClimateMaster: www.climatemaster.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.
B Cabinet Air Discharge Configuration: As indicated on drawings.
C Compressors: High-efficiency, hermetically sealed, dual-stage scroll type.
D Water-to-Refrigerant Heat Exchanger: Coaxial type with factory-supplied water economizer.
E Blower Section: Provide static or flow-controlled, variable-speed, belt-driven fan motor.
F Filter Section: Include MERV 13 rated air filter.
G Unit Controls: Factory-installed DDC with thermostat; see Section 25 14 00.
1. BAS, SCADA, or other Integrated Automation Link: BACnet MS/TP in accordance with ASHRAE Std 135.
2. Control Valve: Return-installed, modulating, pressure-independent ball type; see Section 25 35 19.

2.5 HOSE KITS, VALVES, FITTINGS, AND ACCESORIES
A Hoses:
1. Provide hoses for units for connection to main water supply and return headers.
2. Length: 2 feet.
3. Material: Braided stainless steel rated to minimum 400 psi at 265 degrees Fahrenheit.
B Automatic Balancing Valves:
1. Brass body for shutoff and hydronic balancing.
C Ball Valves:
1. Brass body for shutoff and hydronic balancing.
2. Provide pressure/temperature ports.

PART 3 EXECUTION

3.1 INSTALLATION
- A Install in accordance with manufacturer's instructions.
- B Ductwork:
  1. Provide as indicated on drawings; see Sections 23 31 00 and 23 33 00.
- C Source-Water:
  1. Connect water-side piping to respective piping source loop; see Sections 23 21 13 and 23 21 14 for related piping and hydronic specialties.
  2. Fit-in and install externally interconnected equipment and devices components such as pumps and heat exchanger(s) as applicable to specific selections.
  3. Flush and clean piping before placing in operation; take precautions to prevent introduction of debris into piping systems.
- D Coordinate installation of units with architectural, mechanical, and electrical work.
- E On water coils, provide shut-off valve on supply line and balancing valve on return line. Provide manual air vents at high points complete with stop valve.
- F Install wall-mounted thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls. Provide thermal break barrier for outdoor walls.

3.2 CONNECTIONS
- A Connect supply/return piping from heat pump to appropriate water source piping; see Section 23 21 13. Complete end connections with unions and shut-off valves; see Section 23 21 14.
- B Connect condensate drain pan to indirect waste connection with P-trap of adequate depth to seal against fan pressure; see Section 22 10 05.
- C Connect supply/return air ducts with flexible connectors; see Section 23 33 00.
- D Installation of piping adjacent to heat pump to allow for maintenance and service.
- E Field Install all electrical devices provided by the heat pump manufacturer not specified to be factory-installed.

3.3 SYSTEM STARTUP
- A Provide manufacturer's field representative to perform systems startup; see Section 23 05 93.
- B Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- C Adjust for proper operation within manufacturer's published tolerances.

3.4 FIELD QUALITY CONTROL
- A See Section 01 40 00 - Quality Requirements for additional requirements.
- B Test the heat pumps for performance compliance upon completion of the installation and energization of all electrical circuitry.
- C Operational Test: Start units to confirm unit operation and motor rotation.
- D Controls and Safety Switches: Test, adjust, and replace damaged/malfunctioning controls and equipment.
- E Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 15 00.
- F Malfunctioning Units: Remove, replace, and retest as specified above.

3.5 COMMISSIONING
- A See Section 01 91 13 - General Commissioning Requirements for additional requirements.

3.6 CLOSEOUT ACTIVITIES
- A Demonstration: Demonstrate operation of system to Owner personnel.
  1. Use operation and maintenance data as reference during demonstration.
  2. Briefly describe function, operation, and maintenance of each component.
- B Training: Train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.

END OF SECTION 23 81 46