

SECTION 23 81 46
WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the following configurations of electrically operated "Water-Source Unitary Heat Pumps"
1. Water source unitary heat pumps smaller than 21 KW (6 Tons).
 2. Concealed water source heat pumps larger than 21 kW (6 Tons).
 3. Vertical stack water source heat pumps.
- B. Definitions:
1. Coefficient of Performance (COP) - Cooling: The ratio of the rate of the heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
 2. Coefficient of Performance (COP) - Heating: The ratio of the rate of heat delivered to the rate of energy input in consistent units for a complete heat pump system, including the compressor and, if applicable, auxiliary heat under designated operating conditions.
 3. Energy Efficiency Ratio (EER): The ratio of net cooling capacity in Btu/h to total rate of electricity input in watts under designated operating conditions.
 4. Seasonal Energy Efficiency Ratio (SEER): The ratio of net cooling capacity in Btu/h to total rate of electricity input in watts over a typical cooling season.
 5. Heating Season Performance Factor (HSPF): The ratio of the net heating capacity in Btu/h to total rate of electricity input in watts over a typical heating season.
 6. Energy-Star Ratings: Energy-Star is a government-backed labeling program that helps people and organizations save money and reduce greenhouse gas emissions by identifying factories, office equipment, home appliances and electronics that have superior energy efficiency.
 7. Unitary Water-Cooled Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-water heat exchanger. These units provide both heating and cooling functions.
 8. FEMP: Federal Energy Management Program
 9. Extended Range Heat Pumps (Ground-Source/Ground-Coupled): Heat pumps designed to use with extended operating range of entering water temperature from -1 C (30 F) to 49 C (120 F)

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For pre-test requirements.

- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 21 13, HYDRONIC PIPING: Requirements for piping for split systems and expansion tanks.
- E. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for sheet metal ductwork.
- F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- G. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.

1.3 QUALITY ASSURANCE:

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.
- C. Comply with ASHRAE 90.1-2010.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data.
 - 1. Water Source Unitary Heat Pumps:
 - a. Less than 21 KW (6 Tons)
 - b. Larger than 21 KW (6 Tons) - Concealed
 - c. Vertical stack
 - d. Roof-top and unit ventilator types (Not specified below)
- C. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.
- D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:
 - AHRI-DCPP.....Directory of Certified Product Performance -
Applied Directory of Certified Products
 - 210/240-08.....Performance Rating of Unitary Air-Conditioning
and Air-Source Heat Pump Equipment

- 270-08.....Sound Rating of Outdoor Unitary Equipment
- 310/380-04.....Standard for Packaged Terminal Air-Conditioners
and Heat Pumps (CSA-C744-04)
- 320-98.....Water-Source Heat Pumps
- 330-98.....Ground Source Closed-Loop Heat Pumps
- 340/360-07.....Commercial and Industrial Unitary Air-
Conditioning and Heat Pump Equipment
- C. Air Movement and Control Association (AMCA):
 - 210-07.....Laboratory Methods of Testing Fans for
Aerodynamic Performance Rating (ANSI)
 - 410-96.....Recommended Safety Practices for Users and
Installers of Industrial and Commercial Fans
- D. American National Standards Institute (ANSI):
 - S12.51-02 (R2007).....Acoustics - Determination of Sound Power Levels
of Noise Sources Using Sound Pressure -
Precision Method for Reverberation Rooms (same
as ISO 3741:1999)
- E. American Society of Heating, Refrigerating and Air-Conditioning
Engineers Inc (ASHRAE):
 - 15-10.....Safety Standard for Refrigeration Systems (ANSI)
 - 62.1-10.....Ventilation for Acceptable Indoor Air Quality
(ANSI)
 - 90.1-10.....Energy Standard for Buildings except Low-Rise
Residential Buildings
 - 2008 Handbook HVAC Systems and Equipment
- F. American Society of Testing and Materials (ASTM):
 - B117-09.....Standard Practice for Operating Salt Spray (Fog)
Apparatus
- G. National Electrical Manufacturer's Association (NEMA):
 - MG 1-09 (R2010).....Motors and Generators (ANSI)
 - ICS 1-00 (R2005).....Industrial Controls and Systems: General
Requirements
- H. National Fire Protection Association (NFPA):
 - 90A-09.....Standard for the Installation of Air-
Conditioning and Ventilating Systems
- I. Underwriters Laboratory (UL):
 - 1995-05.....Heating and Cooling Equipment
- K. International Ground Source Heat Pump Association (IGSHPA)
 - 21010(1991).....Grouting Procedures for Ground-Source Heat Pump
Systems
 - 21015(2000).....Grouting for Vertical GHP Systems

21020(1988).....Closed-Loop/Ground-Source Heat Pump
System/Installation Guide

21060(1989).....Soil and Rock Classification Field Manual

PART 2- PRODUCTS

2.1 GENERAL REQUIREMENTS FOR WATER SOURCE HEAT PUMPS

- A. System Characteristics of a Ground Source Closed-Loop System: The system consists of multiple units connected to a 2-pipe, closed-loop hydronic system with continuous water circulation. The temperature of the water loop shall be maintained between approximately -1 and 49 degrees C (30-120 degrees F) by means of heat addition or heat rejection into the ground loop.
- B. Applicable AHRI Standards: Units shall be listed in the corresponding AHRI Directory of certified Products shown in paragraph APPLICABLE PUBLICATIONS.

2.2 WATER SOURCE UNITARY HEAT PUMP (WSHP) LESS THAN 21 KW (6 TONS)

- A. Description: Packaged water-source heat pump with temperature controls; and shall be factory assembled, tested, and rated according to AHRI-ISO-13256-1. Unit shall be floor mounted type or horizontal type, with inlet and outlet duct connections as indicated. Comply with AHRI 320.
- B. Cabinet: Manufacturer's standard galvanized steel for ducted models. Units shall have access panels, and ducted models shall have flanged duct connections. Cabinet shall be factory insulated with fiber glass duct liner, minimum 13 mm (1/2-inch) thick and complying with UL 181. Units shall have knockouts for electrical, piping, and condensate drain connections.
- C. Fan:
 - 1. Housed Centrifugal Fan Direct driven, centrifugal, with permanently lubricated multi-speed motor resiliently mounted in fan inlet
- D. Compressor: Hermetic, scroll compressor installed on vibration isolators; with a slide-out chassis and housed in an acoustically treated enclosure. Unit shall have factory-installed safeties, anti-recycle timer, high-pressure cutout, low-pressure cutout or loss-of-charge switch, internal thermal-overload protection, and freeze stat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 2 deg C (35 deg F). Condensate overflow switch shall stop compressor with high condensate level in condensate drain pan. Compressor lockout circuit shall be capable of being reset at either remote thermostat or circuit breaker.
- E. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

- F. Pipe Insulation: Refrigerant minimum 10-mm (3/8-inch) thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.
- G. Refrigerant Metering Device: Furnish with thermal expansion valve to allow specified operation with entering-water temperatures from minus 4 to plus 52 deg C (25 to 125 deg F).
- H. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2010.
- I. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.
- J. Sound Attenuation Package: Minimum 1-mm (0.06-inch) thick compressor enclosure and front panel. Minimum 2-mm (0.12-inch) thick foam gasket around the compressor and perimeter of end panel, sound attenuating blanket over compressor and hot-gas muffler.
- K. Water-to-Refrigerant Heat Exchanger:
 - 1. Coaxial heat exchangers with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube shall be leak tested to 3102 kPa (450 psig) on refrigerant side and 2758 kPa (400 psig) on water side. Heat exchanger shall be factory mounted in unit on resilient rubber vibration isolators.
 - 2. Stainless-Steel, Brazed-Plate Heat Exchanger: Factory mount heat exchanger in unit on resilient rubber vibration isolators and leak tested to 3102 kPa (450 psig) for refrigerant side and 2758 kPa (400 psig) for water side.
- L. Water Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.
- M. Hose Kits: Kits shall include metal braided hoses with swivel connectors on one end, flow control valve with test ports, two shut off ball valves with memory stops(one with test port), blow down ball valve and Y-strainer. Hoses shall be fire rated to meet UL94. Hoses shall have a minimum working pressure of 300psi.
- N. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 3102 kPa (450 psig).
- O. Refrigerant Circuit Components: Sealed refrigerant circuit charged with R-410A refrigerant
 - 1. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

2. Charging Connections: Service fittings on suction and liquid for charging and testing.
 3. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
 4. Refrigerant Metering: Extended temperature range device or a bi-directional thermal expansion valve.
- P. Filters: Disposable, pleated type, 25 mm (1 inch) thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a MERV rating of 7 according to ASHRAE 52.2.
- Q. Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for control equipment and sequence of operation.
- R. Controls:
1. Basic Unit Controls:
 - a. Low- and high-voltage protection.
 - b. Overcurrent protection for compressor and fan motor.
 - c. Random time delay, three to ten seconds, start on power up.
 - d. Time delay override for servicing.
 - e. Control voltage transformer.
 2. Thermostat: Wall-mounted thermostat heat-cool-off switch, fan on-auto switch, automatic changeover, exposed, temperature set point, Deg F indication.
 3. Terminal Controller:
 - a. Scheduled operation for occupied and unoccupied periods.
 - b. Compressor-disable relay shall stop compressor operation for demand limiting or switch to unoccupied operation.
 - c. Unit shall automatic restart after five minutes if fault clears and lockout after three attempts to restart following fault.
 - d. Indicate fault for service technician Return-air temperature high-limit (firestat).
 - e. Stop unit on high temperature.
 - f. Backup for volatile memory.
 - g. Differential pressure switch shall indicate fan status.
 - h. Fan failure alarm.
 - i. Differential pressure switch shall indicate filter status.
 - j. Dirty filter alarm.
 5. Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for BAS interface requirements. Interface relay for scheduled operation. Interface relay shall provide indication of fault at central workstation. Interface shall be BAC-net for central BAS workstation for the following functions. Set-point adjustment for set points identified in this Section start/stop and operating status

of heat-pump unit Data inquiry shall include supply air, room air temperature and humidity, and entering-water temperature. Occupied and unoccupied schedules

S. Electrical Connection: Control box with single electrical connection factory installed and tested.

T. Hangers shall have manufacturer's recommended vibration isolators for horizontal type heat pumps.

PART 3- EXECUTION

3.1 INSTALLATION

- A. Floor-Mounted Units: Support on neoprene pads with minimum 3.17-mm (0.125-inch) static deflection. Secure units to anchor bolts installed in concrete bases.
- B. Suspended Units: Suspend from structure with threaded steel rods and vibration isolators and seismic restraints.
- C. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

3.2 CONNECTIONS

- A. Connect supply and return hydronic piping to heat pump with hose kits.
- B. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- C. Connect supply- and return-air ducts to water-source heat pumps with flexible duct connectors. Comply with requirements in Section 23 31 00, HVAC DUCTS and CASINGS.
- D. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- E. Install piping adjacent to machine to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Test the heat pump units for the performance compliance after the installation is complete and electrical circuitry is energized.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 INSTRUCTIONS

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat pumps.

3.5 STARTUP AND TESTING

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.6 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.7 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

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