

SECTION 23 81 43
AIR-SOURCE UNITARY HEAT PUMPS

SPEC WRITER NOTES:

1. Delete between //_____// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies electrically operated air-source unitary heat pumps.

B. Definitions:

1. Coefficient of Performance (COP) - Cooling: The ratio of the rate of 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 is 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 is Btu/h to total rate of electricity input in watts under designated operating conditions.
4. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.
5. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.
6. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

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 23 00, REFRIGERANT PIPING: Requirements for field refrigerant piping.
- 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.
- H. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
- I. Section 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS

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 Standard 90.1-2010, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI //210/240//AHRI 340/360// and UL 1995.
- D. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI //210/240//AHRI 340/360// and UL 1995.
- //E. Comply with requirements in Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

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. Air-Source Unitary Heat pump:
 - a. Packaged units
 - b. Split system
- 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.
- E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician

and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

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. Federal Specification (Fed. Spec.):
 A-A-50502-90 Air-conditioner (UNITARY HEAT PUMP), AIR TO AIR
 (3000 TO 300,000 BTUH)
- C. 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)
 340/360-07 Commercial and Industrial Unitary Air-
 Conditioning and Heat Pump Equipment
- D. 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
- E. 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)
- F. 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)
 90.1-07 Energy Standard for Buildings except Low-Rise
 Residential Buildings
 2008 Handbook HVAC Systems and Equipment
- G. American Society of Testing and Materials (ASTM):
 B117-09 Standard Practice for Operating Salt Spray (Fog)
 Apparatus
- H. National Electrical Manufacturer's Association (NEMA):

MG 1-09 (R2010) Motors and Generators (ANSI)
 ICS 1-00 (R2005) Industrial Controls and Systems: General
 Requirements

- I. National Fire Protection Association (NFPA):
 90A-09 Standard for the Installation of Air-
 Conditioning and Ventilating Systems
- J. Underwriters Laboratory (UL):
 1995-05 Heating and Cooling Equipment

PART II- PRODUCTS

2.1 UNITARY HEAT PUMPS, AIR TO AIR

- A. Units shall comply with Fed Spec A-A-50502//Type I, having factory assembled refrigerant circuit or circuits (Packaged Unit), // Type II, (Split System) having remote outdoor section separate from indoor Section, // Class 1, "Department of Energy" (DOE) covered products (units with cooling capacity up to 65000 Btu/hr// Class 2, Non-DOE covered products (units with cooling capacity up to 300,000 Btu/hr //.
1. Unitary heat pumps shall bear the United States Environmental Protection Agency, Energy Star label and shall have a minimum Heating Season Performance Factor (HSPF) of //8 (Type I - Packaged Unit), //8.2 (Type II - Split System), // and a minimum Seasonal Energy Efficiency Ratio (SEER) of //14 (Type I - Packaged Unit), //14.5 (Type II - Split System) //.
- B. Applicable AHRI Standards: Units shall be listed in the corresponding ARI Directory of Certified products shown in paragraph, APPLICABLE PUBLICATIONS:
1. Air Source Unitary heat pumps with capacity less than 19 KW (65,000 Btu/hr), Comply with AHRI 210/240.
 2. Air Source heat pump with capacity above 19KW (above 65,000 Btu/hr, Comply with AHRI 340/360.
- C. Casing: Unit shall be constructed of zinc coated, //heavy-gage // 14-gage minimum // galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit surfaces shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with // 13-mm (1/2-inch) // 25-mm (1-inch) // 50-mm (2-inch) // matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010. The base of the unit shall have provisions for forklift and crane lifting.

- D. Filters: One inch, MERV 7, throwaway filter shall be standard on all units below 19kW (6 Tons). Filter rack can be converted to two inch capability. Two inch, MERV 8, throwaway filters shall be factory supplied on all units above 19 kW (6 Tons).
- E. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors.
- F. Refrigerant Circuit: A minimum of two circuits is required. Each refrigerant circuit shall have independent fixed orifice or thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.

DESIGNER'S NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets. See Paragraph N below

- G. Evaporator and Condenser Coils: Internally finned, DN 10 (NPS 3/8) copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporated coil and condenser coil shall be leak tested at the factory to 1378 kPa (200 psig) and pressure tested to 2756 kPa (400 psig). All dual compressor units shall have intermingled evaporator coils. Sloped condensate drain pans shall be provided.
- H. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.
- I. Indoor Fan:
- //1. Forward-Curved, Centrifugal Fan: Provide V-belt driven with adjustable motor sheaves //adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves//. Motors shall be thermally protected. Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT).//
- //2. Plenum Fans // Provide direct-drive, Arrangement 4, plenum fan(s) equipped with variable-speed drives. Maximum fans in an array shall not exceed four.//
- J. Defrost Controls: A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 35- to 70-kW (10 to 20 tons).

Adaptive demand defrost shall be provided on units below 35 kW (10 Tons).

K. Unit Electrical

1. Provide single point unit power connection.
2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.
3. Safety Controls - High pressure, low temperature, and low pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically be interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.

DESIGNER'S NOTE: Select one of the two control configurations (stand-alone electric or DDC)

L. Operating Controls

1. Provide unit with //low voltage electric controls//factory supplied DDC control system.//
- //2. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch//(heat-off-cool)//(off-heat-auto-cool)//and fan control switch (auto-on)//.
- //3. Unit DDC Controller:
 - a. Unit controller shall include input, output and self-contained programming as needed for complete control of unit.
 - b. Unit controller shall be BAC net compliant and utilize BAC net operating protocol.
 - c. Control system shall seamlessly interface with temperature control system as specified in Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC without requiring gateways or any other interface devices.
 - d. All program sequences shall be stored on board in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of logic controller shall be completely modifiable in the field over installed BACnet LANs.

- e. Temperature Control System Interface: Points shall be available from the unit controller for service access and display and/or control.
- f. Space Temperature Sensor: The wall mounted sensor shall include occupied and unoccupied setpoint control, pushbutton unoccupied override, space temperature offset and space temperature indication. Refer to Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC for additional requirements.

M. Accessories:

1. Electric Heater: Constructed of heavy-duty nickel chromium elements. Staging shall be achieved through the unit control processor. Each heater shall have automatically reset high limit control. Heaters shall be individually fused from the factory and shall comply with NEC and CEC requirements. Power assemblies shall provide single point connection. Electric heat modules shall be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls shall confirm the supply fan is operating before electric elements are energized. Operate electric heater in //2//3// stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.
2. Economizer: // Down flow // Horizontal flow//;// field // factory // installed; and shall include fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting and fixed dry bulb.// Solid state enthalpy and differential enthalpy control shall be field-installed //.
3. Oversized Motors: // Factory // Field // installed over sized motor shall be available for high-static application.

2.2 CORROSION PROTECTION

A. Remote Outdoor Condenser Coils:

1. Epoxy Immersion Coating - Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating

thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:

- a. Salt Spray Resistance (Minimum 6,000 Hours)
 - b. Humidity Resistance (Minimum 1,000 Hours)
 - c. Water Immersion (Minimum 260 Hours)
 - d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
 - e. Impact Resistance (Up to 160 Inch/Pound)
- B. Exposed Outdoor Cabinet:
- 1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3- EXECUTION

3.1 INSTALLATION

- A. Install heat pumps according to manufacturers printed instructions.
- B. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with Division 26 Sections.
- C. Ductwork: Comply with requirements in Section 23 31 00, HVAC DUCTS AND CASINGS.
- D. Piping: Comply with requirements in Section 23 23 00, REFRIGERANT PIPING.

3.2 STARTUP AND TESTING:

- A. Perform startup checks according to manufacturer's written instructions.
- B. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the Resident Engineer.
- C. Furnish test reports to the Senior Resident Engineer in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

3.3 INSTRUCTIONS

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

3.4 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.

3.5 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.

3.6 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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