SECTION 23 81 46
WATER-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.
2. This section may not include every possible type of heat pump. Edit and add to the section equipment, as required, to meet the specific-project needs.

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.
   4. Roof-top and unit ventilator types (Not specified below)

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 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 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 23 00, REFRIGERANT PIPING: Requirements for field refrigerant piping.
E. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING: Requirements for piping for split systems and expansion tanks.
F. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for sheet metal ductwork.
G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.
I. Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
J. 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 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.

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)
320-98	Water-Source Heat Pumps
325-98	Ground 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

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)
90.1-10	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 2- PRODUCTS

SPEC WRITER NOTE: Provide "Extended Range" units ground source heat pumps.

2.1 GENERAL REQUIREMENTS FOR WATER SOURCE HEAT PUMPS

A. System Characteristics of a 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 at approximately 18-35 degrees C (65-95 degrees F) by means of addition of heat and heat rejection when needed.

//B. 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.

//C. System Characteristics of a Ground Source Open-Loop System: The system consists of multiple units connected to a 2-pipe, open-loop hydronic system with continuous water circulation. The temperature of the water loop shall be operating over an extended range, -1 and 49 degrees C (30-120 degrees F), by means of heat addition or heat rejection directly into the ground water.

D. Applicable AHRI Standards: Units shall be listed in the corresponding AHRI Directory of certified Products shown in paragraph APPLICABLE PUBLICATIONS.

E. The water-source heat pumps are available in different configurations, such as, console type, horizontal or vertical stacked type), roof-top, and unit ventilator type. Refer to DESIGNER NOTE 2 above to edit and make changes as required.

SPEC WRITER NOTE: For high-humidity locations (VA HVAC Design Manual), provide E-coated aluminum fins and corrosion-resistant cabinets.

F. Corrosion Protection:

1. Remote Outdoor Condenser Coils:
   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)
2. Exposed Outdoor Cabinet: 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)

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 console type with integral inlet

and discharge grilles for free air delivery // or// horizontal ~~//~~ type, with inlet and outlet duct connections. Comply with AHRI 320.

B. Cabinet: Manufacturer's standard galvanized steel //for ducted models //and //galvanized steel with baked enamel finish for console 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 //

//2. Plenum Fan(s) // Direct-driven, aluminum wheel, plenum fans mounted in Arrangement 4, and equipped with variable speed drives. Maximum number of fans in a single array shall not exceed four. //

D. Compressor: Hermetic, // rotary // 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.

SPEC WRITER NOTE: Choose from the following two paragraphs.

//G. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 18 to 38 deg C (65 to 100 deg F). Capillary tubes may be used only when unit is furnished with water-regulating valve. //

//H. 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). //

I. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2010.

J. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

K. 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 //.

L. General Motor Requirements: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT. Motor shall be multispeed, permanently lubricated, // permanent split capacitor // ECM //.

SPEC WRITER NOTES: The standard heat exchanger is copper with the optional cupronickel for open loop type systems or projects where superior corrosion protection is desired (i.e.; poor local water quality). Stainless steel should only be used where extremely poor water conditions exist or superior corrosion protection is required.

M. Water-to-Refrigerant Heat Exchanger:

//1. Coaxial heat exchangers with // copper // cupronickel // 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.

//3. Domestic Water Heat Exchanger: Refrigerant-to-domestic water heat exchanger shall be double-wall-vented type with factory-mounted pump and controls. Pump shall be energized when domestic-water temperature in heat exchanger is more than // 63 deg C (145 deg F) // and temperature in water heater is less than 52 deg C (125 deg F).

SPEC WRITER NOTE: Verify availability of water-side economizer with manufacturer. Water-side economizer may be field installed on this type of water-source heat pump. Partial free cooling is available at 55 deg F (13 deg C).

//N. Water-Side Economizer: Copper tube and aluminum fin coil with three-way valve and entering-water temperature sensor and controller. Valve

diverts water to water-side economizer coil ahead of refrigerant-to-water heat exchanger when entering-water temperature falls to 13 deg C (55 deg F).//

SPEC WRITER NOTE: Choose one of the following two paragraphs for variable flow systems. Typically the water regulating valves provide a more stable system flow and are more common.

//O. 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.//

//P. Motorized Water Valve: Stop water flow through the unit when compressor is off. //

Q. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 3102 kPa (450 psig).

R. Refrigerant Circuit Components: Sealed refrigerant circuit charged with // R-407C // 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.

S. Electric Heating Coil: Helix-wound, nickel-chromium wire-heating elements in ceramic insulators mounted on steel supports. Energize on call for heating when entering-water-loop temperature is less than // minus 4 deg C (25 deg F) // 5 deg C (40 deg F) // 15 deg C (60 deg F)//.

T. Hot-Gas Reheat: Reheat valve shall be a pilot-operated, sliding-type valve with replaceable magnetic coil to divert refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

U. Hot-Gas Bypass: Include constant pressure expansion valve, solenoid valve, and controls to maintain continuous refrigeration system operation at 10 percent of full load on lead compressor.

V. Filters: // Disposable, glass-fiber, flat type, 25 mm (1 inch) thick, treated with adhesive, and having a minimum of 80 percent arrestance according to ASHRAE 52.1 and a MERV rating of 5 according to ASHRAE 52.2. // 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.

W. // Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for control equipment and sequence of operation.//

X. 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, // manual // automatic // changeover, // concealed, // exposed, // temperature set point, Deg// C // F // indication.
3. Terminal Controller:
   a. Scheduled operation for occupied and unoccupied periods on // 7 // 365 //-day clock with minimum 4 programmable periods per day, // two- // _____- // hour unoccupied period override period Remote control panel to contain programmable timer and LED for fault condition.
   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.

SPEC WRITER NOTE: Provide interface with DDC control system if present.

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

Y. Electrical Connection: Control box with single electrical connection factory installed and tested // with fused disconnect //.

SPEC WRITER NOTE: Show a list of Input/ Output Point Summary on drawings for maintenance of controls and alarms.

//Z. Hangers shall have manufacturer's recommended vibration isolators for horizontal type heat pumps. //

2.3 CONCEALED WATER SOURCE HEAT PUMPS LARGER THAN 21 KW (6 TONS)

A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to AHRI-ISO-13256-1.

B. Cabinet: Manufacturer’s standard galvanized steel. Units shall have access panels and 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(s) // Belt driven, centrifugal, with permanently lubricated single-speed motor installed on an adjustable fan base resiliently mounted in chassis. //
2. // Plenum Fan(s) // Direct-driven, aluminum wheel, plenum fans mounted in Arrangement 4, and equipped with variable speed drives. Maximum number of fans in a single array shall not exceed four. //

D. Compressor: Hermetic // rotary // 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 to 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.

SPEC WRITER NOTE: Choose from the following two paragraphs.

//G. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 18 to 38 deg C (65 to

100 deg F). Capillary tubes may be used only when unit is furnished with water-regulating valve. //

//H. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from minus 4 to plus 52 deg C (25 to 125 deg F).

I. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2010.

J. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

K. 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.

L. General Motor Requirements: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT. Motor shall be multispeed, permanently lubricated, // permanent split capacitor // ECM //.

SPEC WRITER NOTES: The standard heat exchanger is copper with the optional cupronickel for open loop type systems or projects where superior corrosion protection is desired (i.e.; poor local water quality). Stainless steel should only be used where extremely poor water conditions exist or superior corrosion protection is required.

M. Water-to-Refrigerant Heat Exchanger:

//1. Coaxial heat exchangers with // copper // cupronickel // 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 mounted 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.

SPEC WRITER NOTE: Verify availability of water-side economizer with manufacturer. Water-side economizer may be field installed on this type of water-source heat pump. Partial free cooling is available at 55 deg F (13 deg C).

N. Water-Side Economizer: Copper tube and aluminum fin coil with three-way valve and entering-water temperature sensor and controller. Valve

diverts water to water-side economizer coil ahead of refrigerant-to-water heat exchanger when entering-water temperature falls to 13 deg C (55 deg F).

SPEC WRITER NOTE: Choose one of the following two paragraphs for variable flow systems. Typically the water regulating valves provide a more stable system flow and are more common.

//O. 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. //

//P. Motorized Water Valve: Stop water flow through the unit when compressor is off. //

Q. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 3102 kPa (450 psig).

SPEC WRITER NOTE: Verify the maximum capacity for single refrigerant circuit. Insert the actual value, if different that 35 kW (10 tons).

R. Refrigerant Circuit Components: Minimum of 2 circuits required for units larger than // 35 kW (10 tons) // _____. Intertwine multiple circuits in refrigerant to air coil. Charge with // R-407C // 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.

S. Electric Heating Coil: Helix-wound, nickel-chromium wire-heating elements in ceramic insulators mounted on steel supports. Energize on call for heating when entering-water-loop temperature is less than // minus 4 deg C (25 deg F) // 5 deg C (40 deg F) // 15 deg C (60 deg F)//.

T. Hot-Gas Reheat: Reheat valve shall be a pilot-operated, sliding-type valve with replaceable magnetic coil to divert refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

U. Hot-Gas Bypass: Include constant pressure expansion valve, solenoid valve, and controls to maintain continuous refrigeration system operation at 10 percent of full load on lead compressor.

V. Filters: // Disposable, glass-fiber, flat type, 25 mm (1 inch) thick, treated with adhesive, and having a minimum of 80 percent arrestance according to ASHRAE 52.1 and a MERV of 5 according to ASHRAE 52.2. // Disposable, pleated type, 25 mm (1 inch) thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a MERV value of 7 according to ASHRAE 52.2.

W. //Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for Control equipment and sequence of operation.//

X. Controls:

1. Basic Unit Controls:
   a. Low and high voltage protection
   b. Over-current 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, // Manual // Automatic // changeover, // concealed // exposed // temperature set point, Deg// C // F // indication // one // two // stage heating // one // two // stage cooling
3. Terminal Controller:
   a. Scheduled operation for occupied and unoccupied periods on // 7 // 365 //-day clock with minimum 4 programmable periods per day, //Two-// _____- // hour unoccupied period override period Remote control panel to contain programmable timer and LED for fault condition.
   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.

   SPEC WRITER NOTE: Provide interface with DDC control system if present.

4. 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 atart/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

Y. Electrical Connection: Control box with single electrical connection factory installed and tested // with fused disconnect //.

SPEC WRITER NOTE: Show a list of Input/ Output Point Summary on drawings for maintenance of controls and alarms.

//Z. Hangers shall have manufacturer's recommended vibration isolators for horizontal type heat pumps. //

2.4 VERTICAL STACK WATER SOURCE HEAT PUMPS

A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to AHRI-ISO-13256-1.

B. Cabinet and Chassis: Manufacturer's standard galvanized-steel casing, with return-air opening. Unit shall have access panel, and knockouts for electrical and piping connections. Cabinet shall be factory insulated with glass-fiber duct liner, 13 mm (1/2 inch) thick and complying with UL 181. Unit shall have a plastic or stainless-steel drain pan with condensate drain piping projecting to unit exterior and complying with ASHRAE 62.1-2010. Discharge grille shall be double deflection with adjustable discharge air pattern. Discharge- and return-air grille color shall be as selected by Architect from manufacturer's // standard // custom // colors.

C. Fans:

// 1. Housed-Centrifugal Fan

Direct driven, centrifugal, with permanently lubricated multi-speed motor resiliently mounted in fan inlet

// 2. Plenum Fan(s)

Direct-driven, aluminum wheel, plenum fans mounted in Arrangement 4, and equipped with variable speed drives. Maximum number of fans in a single array shall not exceed four. //

D. Compressor: Hermetic, // rotary // 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 35 deg F (2 deg C). 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. Risers: // ASTM B 88M, Type B (ASTM B 88, Type L)// ASTM B 88M, Type C (ASTM B 88 Type M)// copper pipe with hose and ball valve for system flushing.

F. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

G. 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.

H. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 18 to 38 deg C (65 to 100 deg F).

I. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2010.

J. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

K. 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

L. General Motor Requirements: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT. Motor shall be multi-speed, permanently lubricated, // permanent split capacitor // ECM //.

SPEC WRITER NOTES: The standard heat exchanger is copper with the optional cupronickel for projects where superior corrosion protection is desired (i.e.; poor local water quality)

M. Water-to-Refrigerant Heat Exchanger:

//1. Coaxial heat exchangers with // copper // cupronickel // 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.

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-407C // 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. Electric Heating Coil: Helix-wound, nickel-chromium wire-heating elements in ceramic insulators mounted on steel supports. Energize on call for heating when entering-water-loop temperature is less than // minus 4 deg C (25 deg F) // 5 deg C (40 deg F) // 15 deg C (60 deg F)//.

Q. Hot-Gas Reheat: Reheat valve shall be a pilot-operated, sliding-type valve with replaceable magnetic coil to divert refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

R. Hot-Gas Bypass: Include constant pressure expansion valve, solenoid valve, and controls to maintain continuous refrigeration system operation at 10 percent of full load on lead compressor.

S. Filters: // Disposable, glass-fiber, flat type, 25 mm (1 inch) thick, treated with adhesive, and having a minimum of 80 percent arrestance according to ASHRAE 52.1 and a MERV of 5 according to ASHRAE 52.2.// Disposable, pleated type, // 25 mm (1 inch) // thick and with a minimum of 80 percent arrestance according to ASHRAE 52.1 and a MERV of 5 according to ASHRAE 52.2.//

T. // Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for control equipment and sequence of operation are specified.//

U. 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, // manual // automatic // changeover, // concealed // exposed // temperature set point, Deg // C // F // indication.

3. Terminal Controller: Scheduled operation for occupied and unoccupied periods on // 7 // 365 // -day clock with minimum 4 programmable periods per day, // two // -hour unoccupied period override period.

SPEC WRITER NOTE: Provide interface with DDC control system if present.

4. Comply with requirements in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for HVAC 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, entering-water temperature, and occupied/unoccupied schedules.

V. Electrical Connection: Control box with single electrical connection factory installed and tested // with fused disconnect //.

SPEC WRITER NOTE: Show a list of Input/ Output Point Summary on drawings for maintenance of controls and alarms.

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 // minimum 6.35-mm (0.25-inch) static deflection rubber-in-shear // 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 SEISMIC BRACING:

Where applicable provide Seismic bracing as required under specification Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.3 CONNECTIONS

A. Connect supply and return hydronic piping to heat pump with //unions and shutoff valves//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.

3.4 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.

3.5 INSTRUCTIONS

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

3.6 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.

3.7 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.

3.8 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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