SECTION 238146.13 - WATER-TO-AIR HEAT PUMPS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Concealed horizontal or vertical units, 6 tons and smaller.

Concealed horizontal or vertical units larger than 6 tons.

Vertical-stack units.

Exposed, floor-mounted console units.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Include rated capacities, furnished specialties, and accessories for each model.

* + - * 1. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring.

Retain "Samples" paragraph below for single-stage Samples, with a subordinate list if applicable. Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs for two-stage Samples.

* + - * 1. Samples: For each exposed product and for each color and texture specified.
				2. Samples for Initial Selection: For units with factory-applied color finishes.
				3. Samples for Verification: For each type of unit indicated.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

Revise subparagraphs below to suit Project.

Suspended ceiling components.

Structural members to which heat pumps are attached.

Method of attaching hangers to building structure.

Size and location of initial access modules for acoustical tile.

Items penetrating finished ceiling, including the following:

Lighting fixtures.

Air outlets and inlets.

Speakers.

Sprinklers.

Access panels.

**<Insert item>**.

Retain "Product Certificates" paragraph below to require submittal of product certificates from manufacturers.

* + - * 1. Product Certificates: For each type of water-source unitary heat pump, signed by product manufacturer.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Submit certification that water-source heat pumps, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Retain one of first two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified, and the unit will be fully operational after the seismic event."

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

* + - * 1. Field quality-control reports.
				2. Sample Warranty: For special warranty.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For water-to-air heat pumps to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS

Extra materials may not be allowed for publicly funded projects.

* + - * 1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Revise subparagraphs below to suit Project.

**[One] <Insert number>** set(s) of matched fan belts for each belt-driven fan.

**[One] <Insert number>** set(s) of filters for each unit.

**[One] <Insert number>** spare heat-pump unit(s) of each size and model furnished.

* + - 1. QUALITY ASSURANCE

"ASHRAE Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Verify, with manufacturers, availability of units with components and features that comply with these requirements.

* + - * 1. ASHRAE Compliance:

ASHRAE 15.

Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

"ASHRAE/IES Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IES 90.1.

* + - * 1. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
				2. Comply with NFPA 70.
				3. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.
				4. Comply with safety requirements in UL 1995 for duct-system connections.
			1. WARRANTY

When warranties are required, verify with Director’s Representative's that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, refrigeration components.

Verify available warranties and warranty periods for refrigerant components.

Warranty Period: **[Four] <Insert number>** years from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER

Concealed water-source heat pumps, 6 tons (21 kW) and smaller, are characterized by direct-drive fan and absence of mixing box including outdoor-air dampers.

Many optional features are available for this product, and some are mutually exclusive. Specify all those required for Project. Identify optional features for specific units in the schedule or on Drawings.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Carrier Global Corporation.

ClimateMaster, Inc.

Daikin-McQuay.

Trane Inc.

York.

Approved equivalent.

* + - * 1. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

* + - * 1. Cabinet and Chassis: Galvanized-steel casing with the following features:

Access panel for access and maintenance of internal components.

Knockouts for electrical and piping connections.

Flanged duct connections.

Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C1071, and ASTM G21.

Units field convertible for various discharge configurations.

Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1.

Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.

ASHRAE compliance in "Airstream Surfaces" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction.

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

Retain "Sound Attenuation Package" subparagraph below for sound attenuation package. Verify, with manufacturer, availability of method selected.

Sound Attenuation Package: Provide one or more of the following:

Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch- thick foam gasket around the compressor and perimeter of end panel.

Sound attenuating blanket over compressor.

Hot-gas muffler.

**<Insert method>**.

* + - * 1. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet and with inlet rings to allow wheel removal from one side without removing housing.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Motor: Multispeed, permanently lubricated, **[permanent split capacitor] [ECM]** motor.

* + - * 1. Water Circuit:

Refrigerant-to-Water Heat Exchangers:

Retain one of first two subparagraphs below.

Coaxial heat exchangers with **[copper] [cupronickel]** water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

Stainless-steel, brazed-plate heat exchanger is leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

Verify availability of water-regulating valves and motorized water valves.

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.

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

"Refrigerant-to-Air Coils" paragraph below describes both heating/cooling and reheat coils.

* + - * 1. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.
				2. Refrigerant Circuit Components:

Sealed Refrigerant Circuit: Charge with R-410A refrigerant.

Filter-dryer is unavailable from some manufacturers.

Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.

Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

Options in "Compressor" subparagraph below depend on unit size. Verify with manufacturers. Delete if these features are not specific selection criteria.

Compressor: Hermetic **[rotary] [reciprocating] [scroll], [single-stage] [two-stage]** compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

Antirecycle timer.

High-pressure cutout.

Low-pressure cutout or loss of charge switch.

Internal thermal-overload protection.

Retain first two subparagraphs below for compressor safety switches.

Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below **[35 deg F] <Insert temperature>**.

Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

Water-coil, low-temperature switch.

Air-coil, low-temperature switch.

Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.

Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.

Retain one of two "Refrigerant Metering Device" subparagraphs below.

Refrigerant Metering Device: Thermal-expansion valve.

Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from **[25 to 125 deg F] <Insert temperature range>**.

Retain "Hot-Gas Reheat Valve" subparagraph below for hot-gas reheat.

Hot-Gas Reheat Valve: Pilot-operated, sliding-type valve with replaceable magnetic coil.

Electric heating coil is an optional feature for "boilerless" system. Some features are mutually exclusive. Verify availability with manufacturer. Temperature set point is adjustable and varies with system type.

* + - * 1. 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 **[25 deg F] [40 deg F] [60 deg F] <Insert temperature>**.

Retain "Hot-Gas Reheat" paragraph below for hot-gas reheat for humidity control; water-regulating valves may be required.

* + - * 1. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

Retain one of five "Filters" paragraphs below. Verify availability of filter options in first paragraph with manufacturers.

* + - * 1. Filters: Disposable, glass-fiber, flat type, **[1 inch] <Insert dimension>** thick, treated with adhesive, and having a minimum efficiency reporting value of 5 according to ASHRAE 52.2.
				2. Filters: Disposable, pleated type, **[1 inch] <Insert dimension>** thick and with a minimum efficiency reporting value of 7 according to ASHRAE 52.2.
				3. Filters: Electronic air cleaner type; 1 inch; cleanable.
				4. Filters: Disposable, pleated type, **[4 inches] <Insert dimension>** thick and with a minimum efficiency reporting value of 13 according to ASHRAE 52.2.
				5. Filters: Disposable, pleated type, **[2 inches] <Insert dimension>** thick and with a minimum efficiency reporting value of 11 according to ASHRAE 52.2.
				6. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Retain last paragraph above and delete "Controls" paragraph below if controls are part of overall temperature-control system.

* + - * 1. Controls:

Basic Unit Control Modes and Devices:

Dehumidification mode.

Unit shutdown on high or low refrigerant pressures.

Unit shutdown on low water temperature.

Low- and high-voltage protection.

Overcurrent protection for compressor and fan motor.

Random time delay, three to ten seconds, start on power-up.

Time delay override for servicing.

Control voltage transformer.

Water-coil freeze protection (selectable for water or antifreeze).

Air-coil freeze protection (check filter switch).

Condensate overflow shutdown switch.

Option to reset unit at thermostat or disconnect.

Fault type shall be retained in memory if reset at thermostat.

Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.

Ability to defeat time delays for servicing.

Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.

The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.

Remote fault-type indication at thermostat.

Selectable 24-V dc or pilot duty dry contact alarm output.

24-V dc output to cycle a motorized water valve with compressor contactor.

Electric heat output to control two stages of electric heat (emergency heat).

Service test mode for troubleshooting and service.

Unit-performance sentinel warns when the heat pump is running inefficiently.

Thermostat:

Wall-Mounted Thermostat:

Heat-cool-off switch.

Fan on-auto switch.

**[Manual] [Automatic]** changeover.

**[Concealed] [Exposed]** temperature set point.

**[Concealed] [Exposed]** temperature indication.

Deg **[F] [C]** indication.

Wall-Mounted Humidistat: **[Concealed] [Exposed]**.

Temperature set point.

Temperature indication.

Wall-mounted temperature sensor.

Unoccupied period override push button.

LED to indicate fault condition at heat pump.

Data entry and access port.

Input data include room temperature and humidity set points for occupied and unoccupied periods.

Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

Terminal Controller:

Scheduled operation for occupied and unoccupied periods on **[seven] [365]**-day clock with minimum of four programmable periods per day.

**[Two] <Insert number>**-hour unoccupied override period.

Remote-control panel to contain programmable timer and LED for fault condition.

Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.

Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.

Return-air temperature high-limit (firestat). Stop unit on high temperature.

Backup for volatile memory.

Differential pressure switch to indicate fan status. Fan failure alarm.

Differential pressure switch to indicate filter status. Dirty filter alarm.

Interface with DDC system for HVAC requirements as further described in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Interface relay for scheduled operation.

Interface relay to provide indication of fault at central workstation.

Provide **[BAC-net] [or] [LonWorks]** interface for central DDC system for HVAC 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 to include supply air, room air temperature and humidity, and entering-water temperature.

Occupied and unoccupied schedules.

* + - * 1. Electrical Connection: Single electrical connection**[ with fused disconnect]**.

If Project has more than one of this type of heat pump, delete "Capacities and Characteristics" paragraph below and schedule heat pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Fan:

Airflow: **<Insert cfm>**.

External Static Pressure: **<Insert inches wg>**.

Fan Speed: **<Insert rpm>**.

Motor Speed: **<Insert rpm>**.

Motor Horsepower: **<Insert value>**.

Water Supply:

Water Flow: **<Insert gpm>**.

Pressure Loss: **<Insert feet wg>**.

Entering-Water Temperature (Cooling): **<Insert deg F>**.

Entering-Water Temperature (Heating): **<Insert deg F>**.

Antifreeze Protection Chemical: **<Insert chemical name>**.

Antifreeze Concentration: **<Insert percentage>**.

Cooling:

Total Capacity: **<Insert Btu/h>**.

Sensible Capacity: **<Insert Btu/h>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Energy-Efficiency Ratio (EER): **<Insert value>**.

Entering-Air Temperature Dry Bulb: **<Insert deg F>**.

Entering-Air Temperature Wet Bulb: **<Insert deg F>.**

Heating:

Capacity: **<Insert Btu/h>**.

Entering-Air Temperature: **<Insert deg F>**.

Air Temperature Rise: **<Insert deg F>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Coefficient of Performance (COP): **<Insert value>**.

Electric Heating Coil (Optional Feature):

Capacity: **<Insert Btu/h>**.

Number of Steps: **<Insert number>.**

Filters:

Face Area: **<Insert sq. ft.>**.

Maximum Face Velocity: **<Insert fpm>**.

Electrical Characteristics for Single Connection:

Volts: **[120] [208] [230] <Insert value>**.

Phase: **[Single] [Three]**.

Hertz: 60.

Full-Load Amperes (F.L.A.): **<Insert value>**.

Maximum Circuit Amperage (MCA): **<Insert value>**.

Maximum Overcurrent Protection (MOCP): **<Insert amperes>**.

* + - 1. CONCEALED WATER-SOURCE HEAT PUMPS LARGER THAN 6 TONS

Concealed water-source heat pumps larger than 6 tons (21 kW) are characterized by belt-drive fan and absence of mixing box including outdoor-air dampers.

Many optional features are available for this product, and some are mutually exclusive. Specify all those required for Project. Identify optional features for specific units in the schedule or on Drawings.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Carrier Global Corporation.

ClimateMaster, Inc.

Daikin-McQuay.

Trane Inc.

York.

Approved equivalent.

* + - * 1. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

* + - * 1. Cabinet and Chassis: Galvanized-steel casing with the following features:

Access panel for access and maintenance of internal components.

Knockouts for electrical and piping connections.

Flanged duct connections.

Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C1071, and ASTM G21.

Units field convertible for various discharge configurations.

Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1.

Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.

Airstream Surfaces: Surfaces lined with one-half-thick, foil-backed fiber insulation in contact with the airstream shall comply with requirements in ASHRAE 62.1.

Retain "Sound Attenuation Package" Subparagraph below for sound attenuation package. Verify, with manufacturer, availability of method selected.

Sound Attenuation Package: Provide one or more of the following:

Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch- thick foam gasket around the compressor and perimeter of end panel.

Sound attenuating blanket over compressor.

Hot-gas muffler.

**<Insert method>**.

* + - * 1. Fan: Belt driven, centrifugal, with motor installed on an adjustable fan base resiliently mounted in chassis and with inlet rings to allow wheel removal from one side without removing housing.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project. Permanently lubricated ball bearings are available for motors up to and including 5 hp. Larger motors have grease-lubricated ball bearings.

General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Motor: Single-speed, permanently lubricated, ECM motor.

* + - * 1. Water Circuit:

Refrigerant-to-Water Heat Exchanger:

Retain one or both of first two subparagraphs below.

**[Coaxial] [Coil-in-shell] [Shell-and-tube]** heat exchanger with **[copper] [cupronickel]** water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

Stainless-steel, brazed-plate heat exchanger is leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

Verify availability of water-regulating valves and motorized water valves.

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.

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

"Refrigerant-to-Air Coils" paragraph below describes both heating/cooling and reheat coils.

* + - * 1. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.
				2. Refrigerant Circuit Components:

Sealed Refrigerant Circuit: Minimum of two circuits required for units **[**10 tons**] <Insert value>** and larger. Intertwine circuits in refrigerant to air coil.

Charge with R-410A refrigerant.

Filter-dryer is unavailable from some manufacturers.

Filter-Dryer: Factory installed to clean and dehydrate each refrigerant circuit.

Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.

Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

Options in "Compressor" subparagraph below depend on unit size. Verify with manufacturers. Delete if these features are not specific selection criteria.

Compressor: **[Hermetic reciprocating] [Scroll] [Single-stage] [Two-stage]** compressor installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:

Antirecycle timer.

High-pressure cutout.

Low-pressure cutout or loss of charge switch.

Internal thermal-overload protection.

Retain first subparagraph below for compressor safety switches.

Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below **[35 deg F] <Insert temperature>**.

Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

Water-coil, low-temperature switch.

Air-coil, low-temperature switch.

Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.

Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes per ASTM E84.

Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.

Retain "Hot-Gas Reheat Valve" subparagraph below for hot-gas reheat.

Hot-Gas Reheat Valve: Pilot-operated, sliding-type valve with replaceable magnetic coil.

Electric heating coil is an optional feature for "boilerless" system. Some features are mutually exclusive. Verify availability with manufacturer. Temperature set point is adjustable and varies with system type.

* + - * 1. 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 **[25 deg F] [40 deg F] [60 deg F] <Insert temperature>.**

Retain "Hot-Gas Reheat" paragraph below for hot-gas reheat for humidity control; water-regulating valves may be required.

* + - * 1. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

Retain "Hot-Gas Bypass" paragraph below for hot-gas bypass for capacity control; water-regulating valves may be required.

* + - * 1. 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.

Retain one of four "Filters" paragraphs below. Verify availability of filter options in first paragraph with manufacturers.

* + - * 1. Filters: Disposable, glass-fiber, flat type, **[1 inch] [2 inches] [4 inches] <Insert dimension>** thick, treated with adhesive, and having a minimum efficiency reporting value of 5 according to ASHRAE 52.2.
				2. Filters: Disposable, pleated type, **[1 inch] <Insert dimension>** thick and with a minimum efficiency reporting value of 7 according to ASHRAE 52.2.
				3. Filters: Disposable, pleated type, **[2 inches] <Insert dimension>** thick and with a minimum efficiency reporting value of 11 according to ASHRAE 52.2.
				4. Filters: Disposable, pleated type, **[4 inches] <Insert dimension>** thick and with a minimum efficiency reporting value of 13 according to ASHRAE 52.2.
				5. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Retain last paragraph above and delete "Controls" paragraph below if controls are part of overall temperature-control system.

* + - * 1. Controls:

Basic Unit Control Modes and Devices:

Dehumidification mode.

Unit shutdown on high or low refrigerant pressures.

Unit shutdown on low water temperature.

Low- and high-voltage protection.

Overcurrent protection for compressor and fan motor.

Random time delay, three to ten seconds, start on power-up.

Time delay override for servicing.

Control voltage transformer.

Water-coil freeze protection (selectable for water or antifreeze).

Air-coil freeze protection (check filter switch).

Condensate overflow shutdown switch.

Option to reset unit at thermostat or disconnect.

Fault type shall be retained in memory if reset at thermostat.

Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.

Ability to defeat time delays for servicing.

Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.

The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.

Remote fault-type indication at thermostat.

Selectable 24-V dc or pilot duty dry contact alarm output.

24V dc output to cycle a motorized water valve with compressor contactor.

Electric heat output to control two stages of electric heat (emergency heat).

Service test mode for troubleshooting and service.

Unit-performance sentinel warns when the heat pump is running inefficiently.

Thermostat:

Wall-Mounted Thermostat:

Heat-cool-off switch.

Fan on-auto switch.

**[Manual] [Automatic]** changeover.

**[Concealed] [Exposed]** temperature set point.

**[Concealed] [Exposed]** temperature indication.

Deg **[F] [C]** indication.

**[One] [Two]-**stage heating.

**[One] [Two]**-stage cooling.

Wall-Mounted Humidistat: **[Concealed] [Exposed]**.

Temperature set point.

Temperature indication.

Wall-mounted temperature sensor.

Unoccupied period override push button.

LED to indicate fault condition at heat pump.

Data entry and access port.

Input data include room temperature and humidity set points for occupied and unoccupied periods.

Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

Terminal Controller:

Scheduled operation for occupied and unoccupied periods on **[seven] [365]**-day clock with minimum of four programmable periods per day.

**[Two] <Insert number>**-hour unoccupied override period.

Remote-control panel to contain programmable timer and LED for fault condition.

Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.

Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.

Return-air temperature high-limit (firestat). Stop unit on high temperature.

Smoke alarm with smoke detector installed in **[supply] [return] [supply and return]** air. Stop unit on smoke detection.

Backup for volatile memory.

Differential pressure switch to indicate fan status. Fan failure alarm.

Differential pressure switch to indicate filter status. Dirty filter alarm.

Interface with DDC system for HVAC requirements as further described in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Interface relay for scheduled operation.

Interface relay to provide indication of fault at central workstation.

Provide **[BAC-net] [or] [LonWorks]** interface for central DDC system for HVAC 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 to include supply air, room air temperature and humidity, and entering-water temperature.

Occupied and unoccupied schedules.

* + - * 1. Electrical Connection: Single electrical connection**[ with fused disconnect]**.
				2. Capacities and Characteristics:

Fan:

Airflow: **<Insert cfm>**.

External Static Pressure: **<Insert inches wg>**.

Fan Speed: **<Insert rpm>**.

Motor Speed: **<Insert rpm>**.

Motor Horsepower: **<Insert value>**.

Water Supply:

Water Flow: **<Insert gpm>**.

Pressure Loss: **<Insert feet wg>**.

Entering-Water Temperature (Cooling): **<Insert deg F>**.

Entering-Water Temperature (Heating): **<Insert deg F>**.

Antifreeze Protection Chemical: **<Insert chemical name>**.

Antifreeze Concentration: **<Insert percentage>**.

Cooling:

Total Capacity: **<Insert Btu/h>**.

Sensible Capacity: **<Insert Btu/h>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Energy-Efficiency Ratio (EER): **<Insert value>**.

Entering-Air Temperature Dry Bulb: **<Insert deg F>**.

Entering-Air Temperature Wet Bulb: **<Insert deg F>**.

Heating:

Capacity: **<Insert Btu/h>**.

Entering-Air Temperature: **<Insert deg F>**.

Air Temperature Rise: **<Insert deg F>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Coefficient of Performance (COP): **<Insert value>**.

Electric Heating Coil (Optional Feature):

Capacity: **<Insert Btu/h>**.

Number of Steps: **<Insert number>**.

Filters:

Face Area: **<Insert sq. ft.>**.

Maximum Face Velocity: **<Insert fpm>**.

Electrical Characteristics for Single Connection:

Volts: **[120] [208] [230] <Insert value>**.

Phase: **[Single] [Three]**.

Hertz: 60.

Full-Load Amperes (F.L.A.): **<Insert value>**.

Maximum Circuit Amperage (MCA): **<Insert value>**.

Maximum Overcurrent Protection (MOCP): **<Insert amperes>**.

* + - 1. VERTICAL-STACK, WATER-SOURCE HEAT PUMPS

Vertical-stack, water-source heat pumps are distinguished from other types by their approximate cooling capacity of from 1/2 to 3 tons (1.7 to 10.5 kW), direct-drive fans, unfinished cabinet concealed in the occupied space, and absence of outdoor-air dampers.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Carrier Global Corporation.

ClimateMaster, Inc.

Daikin-McQuay.

Trane Inc.

York.

Approved equivalent.

* + - * 1. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

* + - * 1. Cabinet and Chassis: Manufacturer's standard galvanized-steel casing with the following features:

Return-air opening with access panel for access to internal components.

Knockouts for electrical and piping connections.

Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C1071, and ASTM G21.

Retain "Sound Attenuation Package" subparagraph below for sound attenuation package. Verify, with manufacturer, availability of method selected.

Sound Attenuation Package: Provide one or more of the following.

Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch thick foam gasket around the compressor and perimeter of end panel.

**<Insert method>**.

ASHRAE compliance option in "Condensate Drainage" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction.

Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting to unit exterior and complying with ASHRAE 62.1.

Condensate Overflow Protection: Solid state electronic; mechanical float switch not permitted.

Discharge Grille: Double deflection grille for adjustable discharge air pattern.

Discharge and Return Grille Color: Selected by Director’s Representative from manufacturer's [standard] [custom] color selection.

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

Fan: Direct driven, centrifugal, with multispeed motor mounted on a removable fan-motor board and with inlet rings to allow wheel removal from one side without removing housing.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Motor: Multispeed, permanently lubricated, **[permanent split capacitor] [ECM]**.

* + - * 1. Water Circuit:

Refrigerant-to-Water Heat Exchanger: **[Coaxial] [Coil-in-shell]** heat exchanger with **[copper] [cupronickel]** water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

Risers: **[ASTM B88, Type L] [ASTM B88, Type M]** copper pipe with hose and ball valve for system flushing.

* + - * 1. Refrigerant-to-Air Coil: Copper tubes with aluminum fins, leak tested to 450 psig.
				2. Refrigerant Circuit Components:

Sealed Refrigerant Circuit: Charge with R-410A refrigerant.

Filter-dryer is unavailable from some manufacturers.

Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

Charging Connections: Service fittings on suction and liquid for charging and testing.

Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

Options in "Compressor" subparagraph below depend on unit size. Verify with manufacturers. Delete if these features are not specific selection criteria.

Compressor: Hermetic [rotary] [scroll] compressor installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:

Antirecycle timer.

High-pressure cutout.

Low-pressure cutout or loss of charge switch.

Internal thermal-overload protection.

Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below **[35 deg F] <Insert temperature>**.

Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

Water-coil, low-temperature switch.

Air-coil, low-temperature switch.

Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.

Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.

Refrigerant Metering Device: Thermal-expansion valve to allow specified operation with entering-water temperatures from [65 to 100 deg F] **<Insert temperature range>.**

Retain one of two "Filters" paragraphs below. Verify availability of filter options in first paragraph with manufacturers.

* + - * 1. Filters: Disposable, glass-fiber, flat type, **[1 inch] <Insert dimension>** thick, treated with adhesive, and having a minimum efficiency reporting value of 5 according to ASHRAE 52.2.
				2. Filters: Disposable, pleated type, **[1 inch] <Insert dimension>** thick and with a minimum efficiency reporting value of 7 according to ASHRAE 52.2.
				3. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Retain last paragraph above and delete "Controls" paragraph below if controls are part of overall temperature-control system.

* + - * 1. Controls:

Basic Unit Control Modes and Devices:

Dehumidification mode.

Unit shutdown on high or low refrigerant pressures.

Unit shutdown on low water temperature.

Low- and high-voltage protection.

Overcurrent protection for compressor and fan motor.

Random time delay, three to ten seconds, start on power-up.

Time delay override for servicing.

Control voltage transformer.

Water-coil freeze protection (selectable for water or antifreeze).

Air-coil freeze protection (check filter switch).

Condensate overflow shutdown switch.

Option to reset unit at thermostat or disconnect.

Fault type shall be retained in memory if reset at thermostat.

Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.

Ability to defeat time delays for servicing.

Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.

The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.

Remote fault-type indication at thermostat.

Selectable 24-V dc or pilot duty dry contact alarm output.

24-V dc output to cycle a motorized water valve with compressor contactor.

Electric heat output to control two stages of electric heat (emergency heat).

Service test mode for troubleshooting and service.

Unit-performance sentinel warns when the heat pump is running inefficiently.

Thermostat:

Wall-Mounted Thermostat:

Heat-cool-off switch.

Fan on-auto switch.

**[Manual] [Automatic]** changeover.

**[Concealed] [Exposed]** temperature set point.

**[Concealed] [Exposed]** temperature indication.

Deg **[F] [C]** indication.

Terminal Controller:

Scheduled operation for occupied and unoccupied periods on seven-day clock with minimum four periods per day.

**[Two] <Insert number>**-hour unoccupied override period.

Backup for volatile memory.

* + - * 1. Electrical Connection: Single electrical connection**[ with fused disconnect]**.

If Project has more than one of this heat-pump type, delete "Capacities and Characteristics" paragraph below and schedule heat pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Fan:

Airflow: **<Insert cfm>**.

External Static Pressure: **<Insert inches wg>**.

Fan Speed: **<Insert rpm>**.

Motor Speed: **<Insert rpm>**.

Motor Horsepower: **<Insert value>**.

Water Supply:

Water Flow: **<Insert gpm>**.

Pressure Loss: **<Insert feet wg>**.

Entering-Water Temperature (Cooling): **<Insert deg F>**.

Entering-Water Temperature (Heating): **<Insert deg F>**.

Antifreeze Protection Chemical: **<Insert chemical name>**.

Antifreeze Concentration: **<Insert percentage>**.

Cooling:

Total Capacity: **<Insert Btu/h>**.

Sensible Capacity: **<Insert Btu/h>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Energy-Efficiency Ratio (EER): **<Insert value>**.

Entering-Air Temperature Dry Bulb: **<Insert deg F>**.

Entering-Air Temperature Wet Bulb: **<Insert deg F>**.

Heating:

Capacity: **<Insert Btu/h>**.

Entering-Air Temperature: **<Insert deg F>**.

Air Temperature Rise: **<Insert deg F>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Coefficient of Performance (COP): **<Insert value>**.

Filters:

Face Area: **<Insert sq. ft.>**.

Maximum Face Velocity: **<Insert fpm>**.

Electrical Characteristics for Single Connection:

Volts: **[120] [208] [230] <Insert value>**.

Phase: **[Single] [Three]**.

Hertz: 60.

Full-Load Amperes (F.L.A.): **<Insert value>**.

Maximum Circuit Amperage (MCA): **<Insert value>**.

Maximum Overcurrent Protection (MOCP): **<Insert amperes>**.

* + - 1. EXPOSED, CONSOLE WATER-SOURCE HEAT PUMPS

Exposed, console water-source heat pumps are distinguished from other types by their approximate cooling capacity of from 1/2 to 2 tons (1.7 to 7 kW), finished cabinet exposed in the occupied space, hot-gas bypass for capacity control, optional motorized outdoor-air damper, and direct-drive fans.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Carrier Global Corporation.

ClimateMaster, Inc.

Daikin-McQuay.

Trane Inc.

York.

Approved equivalent.

* + - * 1. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

* + - * 1. Cabinet and Chassis: Manufacturer's **[standard] [low] [standard- and low]**-height, **[flat] [sloped]**-top, **[extended ]**galvanized-steel casing with the following features:

Access panel for access and maintenance of internal components.

Knockouts for electrical and piping connections.

Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C1071, and ASTM G21.

Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with ASTM C1071 and NAIMA AH124, "Fibrous Glass Duct Liner Standard."

Retain "Sound Attenuation Package" subparagraph below for sound attenuation package. Verify, with manufacturer, availability of method selected.

Sound Attenuation Package: Provide one or more of the following:

Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch thick foam gasket around the compressor and perimeter of end panel.

**<Insert method>**.

ASHRAE compliance option in "Condensate Drainage" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction.

Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting to unit exterior and complying with ASHRAE 62.1.

Condensate Overflow Protection: Solid state electronic; mechanical float switch not permitted.

Discharge Grille: Steel, aluminum, or plastic grille for adjustable discharge air pattern.

Color: Selected by Director’s Representative from manufacturer's **[standard] [custom]** color selection.

ASHRAE compliance with "Airstream Surfaces" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction.

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

* + - * 1. Fan: Direct driven, centrifugal, with multispeed motor mounted on a removable fan-motor board.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Motor: Multispeed, permanently lubricated, **[permanent split capacitor] [ECM]**.

* + - * 1. Water Circuit:

Refrigerant-to-Water Heat Exchanger: Coaxial heat exchanger with [copper] [cupronickel] water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig for refrigerant side and 400 psig for water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

"Water-Regulating Valves" subparagraph below is a feature with some manufacturers.

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.

"Refrigerant-to-Air Coils" paragraph below describes both heating/cooling and hot-gas reheat coils.

* + - * 1. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.
				2. Refrigerant Circuit Components:

Sealed Refrigerant Circuit: Charge with R-410A refrigerant.

Filter-dryer is unavailable from some manufacturers.

Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

Charging Connections: Service fittings on suction and liquid for charging and testing.

Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.

Compressor: Hermetic rotary compressor installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:

Antirecycle timer.

High-pressure cutout.

Low-pressure cutout or loss of charge switch.

Internal thermal-overload protection.

Retain first subparagraph below for compressor safety switches.

Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below **[35 deg F] <Insert temperature>**.

Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

Water-coil, low-temperature switch.

Air-coil, low-temperature switch.

Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.

Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes per ASTM E84.

Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from **[25 to 125 deg F] <Insert temperature range>**.

Retain "Hot-Gas Reheat Valve" subparagraph below for hot-gas reheat.

Hot-Gas Reheat Valve: Pilot-operated, sliding-type valve with replaceable magnetic coil.

Electric heating coil is an optional feature for "boilerless" system. Some features are mutually exclusive. Verify availability with manufacturer. Temperature set point is adjustable and varies with system type.

* + - * 1. Electric Heating Coil: Energized on call for heating when entering-water-loop temperature is less than **[60 deg F] <Insert temperature>**.

Retain "Hot-Gas Reheat" paragraph below for hot-gas reheat for humidity control; water-regulating valves may be required.

* + - * 1. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when [remote] [unit-mounted] humidistat calls for dehumidification.

Retain "Outdoor-Air Damper" paragraph below for outdoor-air damper.

ASHRAE/IESNA 90.1 sets requirements for dampers. If applying for sustainability certification, retain second option in "Outdoor-Air Damper" paragraph below to comply with ASHRAE/IESNA 90.1.

* + - * 1. Outdoor-Air Damper: Two-position, **[manual] [motorized]** outdoor-air damper for fixed minimum intake up to 25 percent of fan capacity.

Retain one of two "Filters" paragraphs below. Verify availability of filter options in first paragraph with manufacturers.

* + - * 1. Filters: Disposable, glass-fiber, flat type, **[1 inch] <Insert dimension>** thick, treated with adhesive, and having a minimum efficiency reporting value of 5 according to ASHRAE 52.2.
				2. Filters: Disposable, pleated type, **[1 inch] <Insert dimension>** thick and with a minimum efficiency reporting value of 7 according to ASHRAE 52.2.
				3. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Retain last paragraph above and delete "Controls" paragraph below if controls are part of overall temperature-control system.

* + - * 1. Controls:

Basic Unit Control Modes and Devices:

Dehumidification mode.

Unit shutdown on high or low refrigerant pressures.

Unit shutdown on low water temperature.

Low- and high-voltage protection.

Overcurrent protection for compressor and fan motor.

Random time delay, three to ten seconds, start on power-up.

Time delay override for servicing.

Control voltage transformer.

Water-coil freeze protection (selectable for water or antifreeze).

Air-coil freeze protection (check filter switch).

Condensate overflow shutdown switch.

Option to reset unit at thermostat or disconnect.

Fault type shall be retained in memory if reset at thermostat.

Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.

Ability to defeat time delays for servicing.

Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.

The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.

Remote fault-type indication at thermostat.

Selectable 24-V dc or pilot duty dry contact alarm output.

24V dc output to cycle a motorized water valve with compressor contactor.

Electric heat output to control two stages of electric heat (emergency heat).

Service test mode for troubleshooting and service.

Unit-performance sentinel warns when the heat pump is running inefficiently.

Retain subparagraphs below to suit Project; delete those not required. Verify availability with manufacturers.

Thermostat:

**[Wall] [Unit]**-Mounted Thermostat:

Heat-cool-off switch.

Fan on-auto switch.

**[Manual] [Automatic]** changeover.

**[Concealed] [Exposed]** temperature set point.

**[Concealed] [Exposed]** temperature indication.

Deg **[F] [C]** indication.

**[Wall] [Unit]**-Mounted Humidistat: **[Concealed] [Exposed]**.

Temperature set point.

Temperature indication.

**[Wall] [Unit]**-mounted temperature sensor.

Unoccupied period override push button.

LED to indicate fault condition at heat pump.

Data entry and access port.

Input data include room temperature and humidity set points for occupied and unoccupied periods.

Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

Terminal Controller:

Scheduled operation for occupied and unoccupied periods on **[seven] [365]**-day clock with minimum of four programmable periods per day.

**[Two] <Insert number>**-hour unoccupied override period.

Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.

Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.

Backup for volatile memory.

Differential pressure switches for statuses of fan and filter are unavailable from some manufacturers.

Differential pressure switch to indicate fan status. Fan failure alarm.

Differential pressure switch to indicate filter status. Dirty filter alarm.

Interface with DDC system for HVAC requirements as further described in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Interface relay for scheduled operation.

Interface relay to provide indication of fault at central workstation.

Provide **[BAC-net] [or] [LonWorks]** interface for central DDC system for HVAC 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 to include supply air, room air temperature and humidity, and entering-water temperature.

Occupied and unoccupied schedules.

* + - * 1. Electrical Connection: Single electrical connection**[ with fused disconnect]**.

If Project has more than one of this type of heat pump, delete "Capacities and Characteristics" paragraph below and schedule heat pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Fan:

Airflow: **<Insert cfm>**.

External Static Pressure: **<Insert inches wg>**.

Fan Speed: **<Insert rpm>**.

Motor Speed: **<Insert rpm>**.

Motor Horsepower: **<Insert value>**.

Water Supply:

Water Flow: **<Insert gpm>**.

Pressure Loss: **<Insert feet wg>**.

Entering-Water Temperature (Cooling): **<Insert deg F>**.

Entering-Water Temperature (Heating): **<Insert deg F>**.

Antifreeze Protection Chemical: **<Insert chemical name>**.

Antifreeze Concentration: **<Insert percentage>**.

Cooling:

Total Capacity: **<Insert Btu/h>**.

Sensible Capacity: **<Insert Btu/h>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Energy-Efficiency Ratio (EER): **<Insert value>**.

Entering-Air Temperature Dry Bulb: **<Insert deg F>**.

Entering-Air Temperature Wet Bulb: **<Insert deg F>**.

Heating:

Capacity: **<Insert Btu/h>**.

Entering-Air Temperature: **<Insert deg F>**.

Air Temperature Rise: **<Insert deg F>**.

Sustainability ratings require minimum efficiency equal to requirements in ASHRAE/IESNA 90.1, Table 6.8.1B, "Electrically Operated Unitary and Applied Heat Pumps - Minimum Efficiency Requirements."

Minimum Coefficient of Performance (COP): **<Insert value>**.

Electric Heating Coil (Optional Feature):

Capacity: **<Insert Btu/h>**.

Number of Steps: **<Insert number>**.

Filters:

Face Area: **<Insert sq. ft.>**.

Maximum Face Velocity: **<Insert fpm>**.

Electrical Characteristics for Single Connection:

Volts/Phase/Hertz: **<Insert values>**.

Full-Load Amperes (F.L.A.): **<Insert value>**.

Maximum Circuit Amperage (MCA): **<Insert value>**.

Maximum Overcurrent Protection (MOCP): **<Insert amperes>**.

* + - 1. HOSE KITS

Retain this article for hose kits furnished with each water-source heat pump. Revise for size and components. Delete this article if retaining "Hose Kit Assemblies" Article.

* + - * 1. General: Hose kits shall be designed for minimum 400-psig working pressure and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
				2. Hose: Length **[24 inches] [36 inches]** braided stainless steel, complete with adapters, **<Insert dimension>**. Minimum diameter, equal to water-source, heat-pump connection size.
				3. Isolation Valves: Two-piece, bronze-body ball valves with stainless-steel, standard-port ball and stem with normal pipe thread (NPT) connections, and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.
				4. Strainer: Y-type with blowdown valve in supply connection.
				5. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

Retain one of three subparagraphs below. Retain more than one if using different balancing valves on different heat-pump types.

Automatic balancing valve, factory set to operate within 10 percent of design flow rate over a 40:1 differential pressure range of 2 to 80 psig.

Manual, calibrated-orifice balancing valve.

Manual, venturi-type balancing valve.

* + - * 1. Motorized Water Valve: Slow-acting, 24-V dc, with NPT connections.
			1. HOSE KIT ASSEMBLIES

The assemblies in this article ship with the valves already assembled to the hose described.

* + - * 1. Supply and return hoses having ball valve with pressure temperature port.
				2. Supply hose having ball valve with pressure temperature port; return hose having automatic flow regulator valve with pressure temperature ports, and ball valve.
				3. Supply hose having "Y" strainer with blowdown valve, and ball valve with pressure temperature port; return hose having automatic flow regulator with PT ports, and ball valve.
				4. Supply hose having "Y" strainer with blowdown valve, and ball valve with pressure temperature port.
				5. Return hose having ball valve with pressure temperature port.
			1. PUMP MODULE

Retain this article for individual heat pumps that stand alone from a central circulating water loop. Values in first paragraph below are examples only; verify actual values with manufacturer.

* + - * 1. Minimum **[1/6] <Insert value>**-hp, 230-V, single-phase pump rated to move at least **[**16 gpm**] <Insert value>** at **[**20-feet wg**] <Insert value>** head pressure.

Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Include pump module hose kit with thread to barb fittings, hose, and hose clamps.
				2. Three-way brass shut-off/flushing/purging valve.
				3. Include controls to operate pump as required to maintain room temperature and ventilation set points.
1. EXECUTION
	* + 1. EXAMINATION
				1. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
				2. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduits before installation.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION
				1. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install water-source heat pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 230923.27 "Temperature Instruments," Section 230923.19 "Moisture Instruments," and Section 230923 "Direct Digital Control (DDC) System for HVAC."
			1. CONNECTIONS

Coordinate requirements for piping installation and specialty arrangements with Drawings and with requirements specified in hydronic piping and steam and condensate piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

Connect supply and return hydronic piping to heat pump with **[unions and shutoff valves] [hose kits]**.

Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

Coordinate duct installation requirements with Drawings and with requirements specified for duct systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Duct installation requirements are specified in other Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

* + - * 1. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
				2. Install piping adjacent to machine to allow service and maintenance.
				3. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
				4. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
			1. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following field tests and inspections:

After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.

Inspect for and remove shipping bolts, blocks, and tie-down straps.

Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Heat pumps will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. STARTUP SERVICE

Delete first paragraph below if factory-authorized service representative is not required.

* + - * 1. Engage a Company Field Advisor per OGS Spec Section 014216 to perform startup service.
				2. Complete installation and startup checks according to manufacturer's written instructions and do the following:

Inspect for visible damage to unit casing.

Inspect for visible damage to compressor, coils, and fans.

Inspect internal insulation.

Verify that labels are clearly visible.

Verify that clearances have been provided for servicing.

Verify that controls are connected and operable.

Verify that filters are installed.

Adjust vibration isolators.

Inspect operation of barometric dampers.

Verify bearing lubrication on fan.

Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

Adjust fan belts to proper alignment and tension.

Start unit according to manufacturer's written instructions.

Complete startup sheets and attach copy with Contractor's startup report.

Inspect and record performance of interlocks and protective devices; verify sequences.

Operate unit for an initial period as recommended or required by manufacturer.

Verify thermostat and humidistat calibration.

Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

Retain testing requirements if not using Section 230593 "Testing, Adjusting, and Balancing for HVAC."

Start refrigeration system, and measure and record the following:

Coil leaving-air, dry- and wet-bulb temperatures.

Coil entering-air, dry- and wet-bulb temperatures.

Outdoor-air, dry-bulb temperature.

Outdoor-air-coil, discharge-air, dry-bulb temperature.

Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

Supply-air volume.

Return-air volume.

Relief-air volume.

Outdoor-air intake volume.

* + - 1. ADJUSTING
				1. Adjust initial temperature and humidity set points.
				2. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
				3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **[two] <Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.
			2. CLEANING
				1. Replace filters used during construction prior to air balance or Substantial Completion.
				2. After completing installation of exposed, factory-finished, water-source heat pumps, inspect exposed finishes and repair damaged finishes.
			3. DEMONSTRATION
				1. Engage a Company Field Advisor per OGS Spec Section 014216 to train Director’s Representative's Facility’s maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION 238146.13