

SECTION 23 81 43 SAMPLE SPECIFICATION FOR AIR-SOURCE UNITARY HEAT PUMPS
PATTERSON-KELLEY, LLC **HEAT PUMP APPLIANCES**

Part 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. NBIC - Part 1 (Installation)
- B. NFPA 70 (National Electric Code)
- C. AHRI 550/590 Efficiency Metric

1.02 SUMMARY

A. This section includes air-source, packaged, monobloc heat pump products utilizing R-32 Refrigerant.

B. Related Sections include, but are not limited to, the following:

1. Section 03 30 00 "Cast-in-Place Concrete"
2. Section 23 01 00 "Operation and Maintenance of HVAC Systems"
3. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping"
4. Section 23 05 19 "Meters and Gages for HVAC Piping"
5. Section 23 05 23 "General-Duty Valves for HVAC Piping"
6. Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment"
7. Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping..."
8. Section 23 05 53 "Identification for HVAC Piping and Equipment"
9. Section 23 06 70.16 "Packaged Outdoor HVAC Equipment Schedule"
10. Section 23 07 19 "HVAC Piping Insulation"
11. Section 23 09 13 "Instrumentation and Control Devices for HVAC"
12. Section 23 21 00 "Hydronic Piping and Pumps"
13. Section 23 25 13 "Water Treatment for Closed-Loop Hydronic Systems"
14. Section 23 53 00 "Heating Appliance Feedwater Equipment"
15. Section 23 82 16.13 "Refrigerant Air Coils"
16. Section 28 47 17.13 "Notification Appliances and Methods Outdoors"

1.03 SUBMITTALS

- A. The contractor must submit, in a timely manner, all submittals for approval to the engineer. Under no circumstances will the contractor install any materials until the engineer has made final approval on the submittals.
- B. Product data and/or drawings must be submitted to the engineer for approval and must consist of:
 - 1. General assembly drawing of the appliance including product description, model number, dimensions, clearances, weights, service sizes, etc.
 - 2. Schematic flow diagram of the appliance hydronic piping system.
 - 3. Schematic wiring diagram of the appliance's control system that shows all components, interlocks, etc. and must clearly identify factory wiring and field wiring.
- C. Part-load efficiency and operation tests verified by the manufacturer. A Factory Authorized Start-up must be completed prior to final acceptance by the engineer.
- D. Operation and Maintenance Manuals must be submitted prior to final acceptance by the engineer and must contain shop drawings, product data, operating instructions, cleaning procedures, replacement parts list, maintenance and repair data, etc.

1.04 QUALITY ASSURANCE

- A. The equipment must, at a minimum, be in strict compliance with the requirements of this specification, must perform as specified and must be the manufacturer's standard commercial product unless specified otherwise.
- B. Electrically operated components specified are to be "Listed" and/or "Labeled" as defined by NFPA 70, Article 100.
- C. Appliance must be AHRI tested in accordance with the Packaged unitary heat pump program and the AHRI 550/590 testing standard.
- D. The manufacturer must make available, upon request, all quality assurance documentation and results of Full Function Test based on the appliance serial number.

1.05 COORDINATION

- A. Equipment must be handled, stored and installed in accordance with the manufacturer's instructions.
- B. Factory Authorized Start-up must be completed after all appliance connections are completed, e.g. hydronic piping, & electrical.

1.06 WARRANTY

- A. The appliance manufacturer must warrant each unit, including appliance, trim, appliance control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of twelve (12) months from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.
- B. The appliance manufacturer must warrant the appliance heat exchanger for a period of five (5) years from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

1.07 CERTIFICATION

- A. Manufacturer's Certification - The appliance manufacturer must certify the following:
 - 1. The products and systems furnished are in strict compliance with the specifications.
 - 2. The appliance, and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable appliance.
 - 3. The appliance must be AHRI certified for at least COP = 3.7 efficiency based on operating conditions specified for testing under AHRI 550/590.
- B. Contractor's Certification - The installing contractor must certify the following:
 - 1. The products and systems installed are in strict compliance with the specifications and all applicable local and/or state codes.
 - 2. The specified field tests have been satisfactorily performed by a factory authorized startup agent.
 - 3. The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

Part 2 - Product

2.01 MANUFACTURERS

- A. Furnish and install factory “packaged” heat pump appliance(s) as manufactured by Patterson-Kelley, LLC or as approved and accepted by the Engineer as defined in the table below:

Model Number	Fuel Type	Voltage	Amps (A)	Max Input (kW)	Min Input (kW)	Turndown Ratio	Max Output (BTU/Hr)	COP
HP-250	Electric	208-230V 3PH	91.3	18.99	4.75	4:1	255900	3.95

*Values represent Heating 105F LWT at 47F Ambient Conditions

- B. Each factory “packaged” appliance must be complete with all components and accessories necessary for a complete and operable appliance as hereinafter specified. Each appliance must be furnished factory assembled with the required wiring and piping as a self-contained unit. Each appliance must be readily transported and ready for installation.
- C. All “Approved Equal” or “Approved Alternate” appliances must demonstrate compliance with the requirements of this specification.

2.02 COMPONENTS

A. CABINET ENCLOSURE

1. Each appliance must feature a fully assembled cabinet enclosure fabricated from Carbon Steel or Aluminum sheet metal (minimum 16 Gauge) with powder coat finish.
2. The appliance’s cabinet enclosure must feature removable access panels / doors that can be easily opened.
3. The appliance’s cabinet enclosure must eliminate the use of refractory or other insulating materials by baffling the air around the heat exchanger and the outer surface temperature must not exceed 20°F above ambient temperature.
4. The appliance’s cabinet enclosure must prominently display all required safety, instruction, compliance and factory runout labels.

B. HEAT EXCHANGER

1. Each completed heat exchanger must include an integral stainless-steel condensate pan/collector, condensate drain, inlet temperature sensor, outlet temperature sensor, and all necessary assembly hardware.

2. Each stainless-steel heat exchanger must be designed to maintain water turbulence at the full published range of acceptable flow rates at various appliance conditions as described below:
 - a. The maximum allowable flow rate will generate a 9.5°F ΔT when the appliance is operating at full capacity.
 - b. The minimum allowable flow rate will generate a 40°F ΔT when the appliance is operating at full capacity.
3. The appliance's completed heat exchanger must be capable of operating with a minimum outlet water temperature of 40°F.
4. Each heat exchanger must be hydrostatically tested by the manufacturer to a minimum of 1-1/2 times the maximum allowable working pressure for a minimum of 5 minutes. During this hydrostatic pressure test, the operator will inspect the pressure gauge and visually verify there are no water leaks.

C. APPLIANCE SAFETY and TRIM DEVICES

1. The appliance manufacturer must furnish and test the following safety and trim devices with each appliance:
 - a. Safety relief valve must be provided in compliance with the ASME code. Contractor is required to pipe the relief valve discharge piping to an acceptable drain.
 - b. Water pressure/temperature gauge.
 - c. Operating temperature control to control the sequential operation of the inverter.
2. The appliance must be capable of interfacing with the following external safety devices:
 - a. Emergency Stop (E-Stop) switch.
 - b. External Safety Device w/ contact closure.

D. APPLIANCE CONTROL SYSTEM

1. Each appliance must be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each appliance control system must be properly interlocked with all safeties.
2. Each appliance must be provided with a "Full Modulating" control system whereby the rate is infinitely proportional at any rate between low and high output. Both power input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.
3. The appliance's control system must provide the minimum capabilities:
 - a. Color touchscreen display.
 - b. Standard on-board Ethernet port for wired internet connectivity.

- c. Programmable Relay Outputs for direct control of pumps, control valves, dampers and other auxiliary devices.
 - d. Multiple appliance “cascade” network up to 8 appliances. (optional)
 - e. Automatic hybrid system control for multiple appliance “cascade” systems with both condensing and non-condensing appliances. This control logic prioritizes heat pump appliances at low water temperatures and prioritizes gas-fired appliances at high water temperatures. (optional)
 - f. Programmable Appliance and System pump control with modulating capabilities for multiple appliance “cascade” systems installed in a Primary-Secondary piping arrangement.
 - g. Programmable Control Valve logic with modulating capabilities for multiple appliance “cascade” systems installed in a Primary-Only piping arrangement.
 - h. Integration with external Building Management Systems (BMS) via MODBUS® RTU protocol. **NOTE:** Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the appliance manufacturer.
 - i. Hardwire integration with Building Management Systems (BMS) via 4-20mA analog control signal for temperature or firing rate control.
 - j. On-Screen error notifications with a comprehensive description of all alarm conditions and several troubleshooting steps.
 - k. Automatic differential temperature compensation to prevent over-firing of the appliance equipment in a low flow condition.
 - l. Automatically adjust the temperature set point and shutdown the appliance based on the outdoor air temperature conditions.
 - m. Maintain single temperature set point with a minimum outlet (supply) water temperature of 42°F up to a maximum outlet (supply) water temperature of 140°F.
 - n. DHW Priority capable of seamless transition between Comfort Heat (CH) and Domestic Hot Water (DHW) operation. (optional)
 - o. CH&DHW operation for simultaneous Comfort Heat (CH) and Domestic Hot Water (DHW) operation. (optional)
 - p. Alarm Relay Output to announce alarm conditions which require manual reset on master or any member appliance from a single appliance source.
 - q. Local Manual Operation.
2. The appliance control system must be capable of interfacing with the following external control devices:
- a. Building Management System (MODBUS®). **NOTE:** Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the appliance manufacturer.
 - b. Domestic Hot Water Break-on-Rise Aquastat (Normally Closed).
 - c. Domestic Hot Water Tank Temperature Sensor (12kΩ).
 - d. External Header Temperature Sensor (12kΩ).

- e. Outdoor Air Temperature Sensor (12kΩ) both wired and wireless.

Part 3 - Execution

3.01 INSTALLATION

- A. Installation must be performed by the contractor in accordance with the requirements of the applicable codes. Contractor must review the appliance and installation for compliance with requirements and/or issues that may affect appliance performance. Installation should not proceed until unsatisfactory conditions have been corrected.
- B. The contractor must mount the equipment as described below:
 - 1. Install appliances on cast-in-place concrete equipment base in compliance with the requirements for equipment bases and foundation specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 2. If required by the local code, install vibration isolation devices in compliance with Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. The contractor must assemble and install any external appliance safety/trim devices.
- D. The contractor must install any electrical devices furnished with the appliance, but not specified to be factory-mounted.
- E. The contractor must install control wiring to field mounted electrical devices in accordance with the requirements of NFPA 70.
- F. The contractor must install electrical (power) wiring to the appliance in accordance with the requirements of NFPA 70.

3.02 CONNECTIONS

A. HYDRONIC PIPING

- 1. Each appliance must be provided with all necessary inlet (supply) and outlet (return) connections. Refer to the appliance's specification sheet or manual for connection sizes.
- 2. Check manufacturer's installation manual for clearance dimensions and install piping that will allow for service and ease of maintenance.
- 3. Install piping from equipment drain connection to nearest floor drain. Piping must be at least full size of connection and adhere to proper codes for neutralization.

4. The hydronic piping and related components must comply with the requirements of 23 21 00 "Hydronic Piping and Pumps".
5. All meters and gages in the hydronic piping must comply with the requirements of Section 23 05 19 "Meters and Gages for HVAC Piping".
6. All instrumentation and controls in the hydronic piping must comply with the requirements of Section 23 09 13 "Instrumentation and Control Devices for HVAC".
7. All valves in the hydronic piping must comply with the requirements of Section 23 05 23 "General-Duty Valves for HVAC Piping".
8. All expansion fittings must comply with the requirements of Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping".
9. Any pipe hangers or supports must comply with the requirements of Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".
10. Any vibration isolation devices on the hydronic piping must comply with the requirements of Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
11. The feedwater piping must comply with the requirements of Section 23 53 00 "Heating Appliance Feedwater Equipment".
12. The hydronic piping must be insulated in accordance with the requirements of Section 23 07 19 "HVAC Piping Insulation".
13. After insulation, all hydronic piping must be identified in accordance with the requirements of Section 23 05 53 "Identification for HVAC Piping and Equipment".
14. Any water treatment of the hydronic system must be in accordance with the appliance manufacturer's requirements and/or Section 23 25 13 "Water Treatment for Closed-Loop Hydronic Systems".

B. AIR INTAKE

1. All air inlet components must comply with the requirements of Section 23 37 00 "Air Outlets and Inlets".

D. ELECTRICAL

1. Install an external disconnect and overload protection for each appliance in accordance with the requirements of NFPA 70.
2. The voltage requirements for each appliance must be configured for:
 - a. HP250: 208-230VAC, Three-Phase, 60Hz
3. The amperage requirements for each appliance are described in the table below:

	HP-250
Internal Overload Protection (MCA)	135 Amps
Recommended Circuit Capacity	150 Amps