

## SECTION 22 35 36 SAMPLE SPECIFICATION FOR DOMESTIC WATER BRAZED-PLATE HEAT EXCHANGERS

HARSCO INDUSTRIAL, PATTERSON-KELLEY **DURATION III** INSTANTANEOUS INDIRECT DOMESTIC WATER HEAT EXCHANGER PACKAGE

### Part 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

- A. P-K SONIC NURO Boiler Spec (Section 23 52 16.13)
- B. P-K MACH NURO Boiler Spec (Section 23 52 16.16)
- C. P-K MFD NURO Boiler Spec (Section 23 52 33.19)
- D. P-K VELOX NURO Boiler Spec (Section 23 52 33.19)
- E. ASME Section VIII – Div. 1 (“U” Stamp Unfired Pressure Vessels)
- F. NBIC - Part 1 (Installation)
- G. NFPA 70 (National Electric Code)

#### 1.02 SUMMARY

- A. This section includes double wall brazed-plate heat exchanger packages for instantaneous domestic water heating.
- B. Related Sections include, but are not limited to, the following:
  - 1. Section 03 30 00 “Cast-in-Place Concrete”
  - 2. Section 22 01 10 “Operation and Maintenance of Plumbing, Piping & Pumps”
  - 3. Section 22 05 16 “Expansion Fittings and Loops for Plumbing Piping”
  - 4. Section 22 05 19 “Meters and Gages for Plumbing Piping”
  - 5. Section 22 05 23 “General-Duty Valves for Plumbing Piping”
  - 6. Section 22 05 29 “Hangers and Supports for Plumbing, Piping & Equipment”
  - 7. Section 22 05 48 “Vibration and Seismic Controls for Plumbing, Piping...”
  - 8. Section 22 05 53 “Identification for Plumbing, Piping, and Equipment”
  - 9. Section 22 07 00 “Plumbing Insulation”
  - 10. Section 22 09 00 “Instrumentation and Control for Plumbing”
  - 11. Section 22 11 00 “Facility Water Distribution”
  - 12. Section 22 31 00 “Domestic Water Softeners”
  - 13. Section 22 32 00 “Domestic Water Filtration Equipment”
  - 14. Section 23 01 00 “Operation and Maintenance of HVAC Systems”
  - 15. Section 23 05 16 “Expansion Fittings and Loops for HVAC Piping”
  - 16. Section 23 05 19 “Meters and Gages for HVAC Piping”

- 17. Section 23 05 23 "General-Duty Valves for HVAC Piping"
- 18. Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment"
- 19. Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping..."
- 20. Section 23 05 53 "Identification for HVAC Piping and Equipment"
- 21. Section 23 07 19 "HVAC Piping Insulation"
- 22. Section 23 09 13 "Instrumentation and Control Devices for HVAC"
- 23. Section 23 21 00 "Hydronic Piping and Pumps"
- 24. Section 23 25 13 "Water Treatment for Closed-Loop Hydronic Systems"
- 25. Section 23 37 00 "Air Outlets and Inlets"
- 26. Section 23 51 00 "Breechings, Chimneys, and Stacks"
- 27. Section 23 52 16.13 "Stainless-Steel Condensing Boilers"
- 28. Section 23 52 16.16 "Aluminum Condensing Boilers"
- 29. Section 23 52 33.19 "Copper Water-Tube Boilers"

### **1.03 SUBMITTALS**

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

### **1.04 QUALITY ASSURANCE**

- A. The equipment shall, at a minimum, be in strict compliance with the requirements of this specification, shall perform as specified and shall 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. Heat exchanger(s) shall bear an ASME “U” stamp in accordance with ASME Section VIII – Division 1.
- D. The manufacturer shall make available, upon request, all quality assurance documentation based on the heat exchanger package’s serial number.

### **1.05 COORDINATION**

- A. Equipment shall 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 water piping, domestic water piping & electrical.

### **1.06 WARRANTY**

- A. The equipment manufacturer shall warrant each heat exchanger package, including trim, 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 equipment manufacturer shall warrant each brazed plate heat exchanger for a period of three (3) years from date of startup, provided that startup is completed within six (6) months of startup and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

### **1.07 CERTIFICATION**

- A. Manufacturer’s Certification - The manufacturer shall certify the following:
  - 1. The products and systems furnished are in strict compliance with the specifications.
  - 2. The heat exchanger, pump, control valve, control panel, and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable heat exchanger package.
- B. Contractor’s Certification - The installing contractor shall 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” instantaneous heat exchanger(s) as manufactured by Harsco Industrial, Patterson-Kelley or as approved and accepted by the Engineer as defined in the table below:

Model Number	# Plates	Heat Exchanger Type	GPM (60°F to 120°F)	GPM (40°F to 140°F)
D3-44I	44	Double Wall Brazed Plate	55	25
D3-88I	88	Double Wall Brazed Plate	70	45
D3-112I	112	Double Wall Brazed Plate	85	65

- B. Each heat exchanger package shall be complete with one heat exchanger, one 3-way electronic control valve, one domestic water recirculation pump, one control panel and all other components and accessories necessary for a complete and operable system as herein specified.
- C. Each heat exchanger package shall be furnished factory assembled with the required wiring and piping as a self-contained unit. Each heat exchanger package shall be readily transported and ready for installation.
- D. Each heat exchanger package is designed to pipe into an existing hydronic heating system in order to provide instantaneous delivery of domestic hot water without the use of domestic water storage tanks.
- E. Each heat exchanger package shall be sized accordingly to operate in conjunction with a high efficiency condensing boiler to provide instantaneous delivery of domestic hot water up to 140°F while maintaining boiler water return temperatures below 130°F to promote condensing operation.
- F. Each heat exchanger package shall also be capable of operation in conjunction with a standard efficiency non-condensing boiler to provide instantaneous delivery of domestic hot water up to 160°F.
- G. All “Approved Equal” or “Approved Alternate” heat exchanger packages must demonstrate compliance with the requirements of this specification.

## 2.02 COMPONENTS

### A. HEAT EXCHANGER

1. Each heat exchanger package shall contain one ASME Section VIII – Division 1 brazed-plate heat exchanger with a “U” stamp designed for a maximum allowable working pressure of not less than 150 PSIG and a maximum allowable temperature of not less than 300°F.
2. Each brazed-plate heat exchanger shall be of the double-wall type and provide a true air gap between heat exchanger plates and a visible leak path to atmosphere.
3. Each heat exchanger shall consist of 316 Stainless Steel plates with a Copper brazing material (or approved equal) oriented in a counter-flow arrangement. Plate-and-frame type heat exchangers are not acceptable.
4. Each heat exchanger shall have staggered / offset connection ports to avoid collision between the boiler water pipe / fittings and the domestic water pipe / fittings.
5. The completed heat exchanger package shall provide no less than the total heat transfer surface area defined in the table below:

Model Number	Heat Transfer Surface Area (FT <sup>2</sup> )
D3-44I	41.54
D3-88I	85.05
D3-112I	108.79

### B. CABINET ENCLOSURE / STRUCTURAL BASE

1. Each completed heat exchanger package shall feature a fully assembled cabinet enclosure and structural base fabricated from Carbon Steel or Aluminum sheet metal (minimum 16 Gauge) with powder coat finish.
2. The completed cabinet enclosure and structural base shall not exceed 15” width x 52” length x 44” height, and the completed heat exchanger package shall fit through a standard 32” wide doorway.
3. The structural base shall feature holes designed for easy maneuvering with a forklift or pallet jack.
4. The cabinet enclosure shall eliminate the use of refractory or other insulating materials.
5. The cabinet enclosure shall prominently display all required safety, instruction, compliance and factory runout labels.
6. The cabinet enclosure shall be designed to provide full visibility and access to pressure gauges, temperature gauges, drain valves, strainers, isolation valves, control valves, control panel, etc.

### **C. BOILER WATER PIPE & FITTINGS**

1. All pipe fittings and trim devices in contact with boiler water shall be carbon steel, ductile Iron, cast Iron, brass or bronze.
2. Each completed heat exchanger package shall feature 2" Schedule 40 steel piping on the boiler water supply & return connections.
3. Each completed heat exchanger package shall feature 2" grooved couplings / unions with removable EPDM gaskets to connect the steel pipe to the heat exchanger connection ports.
4. Each completed heat exchanger package shall terminate with 2" isolation valves on the boiler water supply & return connections.
5. Each completed heat exchanger package shall feature a wye-type strainer on the lower incoming boiler water piping.

### **D. BOILER WATER ELECTRONIC CONTROL VALVE**

1. Each completed heat exchanger package shall feature one (1) electronically actuated 3-way control valve with a maximum full-range positioning time of 2 seconds and a minimum stroke resolution of 1000:1.
2. Each completed heat exchanger package shall include an isolation valve on the boiler water piping upstream of the control valve's lower "B" port. Closing this isolation valve allows for 2-way control valve operation ("A" → "AB").
3. The electronic control valve shall be user-selectable for linear or equal-percentage characteristics.
4. The electronic control valve shall provide full bypass fail-safe operation ("B" → "AB") when de-energized.
5. The electronic control valve shall provide the ability to manually actuate the valve's stroke.

### **E. DOMESTIC WATER PIPE & FITTINGS**

1. All pipe fittings and trim devices in contact with domestic water shall be stainless steel, copper, lead-free bronze or lead-free brass and comply with the NSF-61 requirements for pipe, pipe fittings & fixtures.
2. Each completed heat exchanger package shall feature 2" Type L copper tubing on the domestic water supply & return connections.
3. Each completed heat exchanger package shall feature dielectric pipe fittings between the copper tubing and the heat exchanger connection ports.
4. Each completed heat exchanger package shall feature 2" grooved couplings / unions with removable EPDM gaskets to connect the copper tubing to the heat exchanger connection ports.
5. Each completed heat exchanger package shall terminate with 2" isolation valves on the domestic water supply & return connections.

6. Each completed heat exchanger package shall feature a wye-type strainer on the upper incoming domestic water piping. This strainer shall be equipped with a 1/2" manual isolation / blowdown valve.
7. Each completed heat exchanger package shall feature a 1/2" manual isolation / blowdown valve on the lower outgoing domestic water piping installed between the 3:00 and 6:00 position for ease of use.

#### **F. DOMESTIC WATER RECIRCULATION PUMP**

1. Each completed heat exchanger package shall feature one (1) lead-free bronze domestic water recirculation pump that complies with the NSF-61 requirements for pipe, pipe fittings & fixtures.
2. The domestic water recirculation pump shall feature 3 speed settings, allowing the user to adjust the recirculation flow.
3. The domestic water recirculation pump improves the accuracy and responsiveness of the heat exchanger package by maintaining constant water flow over the domestic hot water supply temperature sensor. This action also keeps the domestic hot water supply "primed" at the desired temperature.
4. The domestic water recirculation pump shall provide constant water flow through the heat exchanger(s) at all times to help prevent scale formation and bacterial growth due to stagnant water conditions.

#### **G. ELECTRONIC CONTROL SYSTEM & CONTROL PANEL**

1. Each completed heat exchanger package shall feature a control panel configured for 110-120 VAC, single phase (w/ Neutral), 60 Hz.
2. The completed control panel shall feature a PID temperature controller capable of maintaining the desired domestic hot water supply temperature within  $\pm 2^{\circ}\text{F}$  under constant load conditions, and within  $\pm 4^{\circ}\text{F}$  under normal fluctuating load conditions.
3. At a minimum, the PID temperature controller and control panel shall display the following information:
  - a. Domestic water supply temperature.
  - b. Domestic water temperature setpoint.
  - c. High temperature limit.
  - d. Alarm condition.
4. The PID temperature controller shall provide native MODBUS<sup>®</sup> communication in order for the DDC / BMS to remotely command or monitor the following:
  - a. Enable / Disable the heat exchanger package.
  - b. Adjust the desired domestic hot water supply temperature setpoint.
  - c. Monitor the operating status of the heat exchanger package.
  - d. Monitor the alarm status of the heat exchanger package.
  - e. Monitor the domestic hot water supply temperature.

5. The PID temperature control shall also be capable of interfacing with an optional protocol converter in order to provide the same remote functions through BACnet<sup>®</sup>, LONWORKS<sup>®</sup>, or Metasys N2 protocols.
6. The completed heat exchanger package shall contain an automatic reset high temperature limit aquastat which will immediately de-energize the electronic control valve and illuminate a red HIGH TEMP light if the domestic hot water supply temperature exceeds the user-adjustable high temperature setpoint.
7. The control panel shall provide convenient terminal connections for the incoming power supply and communication signals to/from the electronic temperature controller.
8. Each completed heat exchanger package shall be capable of easy integration into any hydronic boiler system, regardless of boiler manufacturer.

#### **H. SAFETY and TRIM DEVICES**

1. Each completed heat exchanger package shall be equipped with a high temperature limit safety aquastat installed in the domestic hot water supply piping. If the high temperature limit trips, the control panel shall immediately remove power from the electronic 3-way control valve, forcing all boiler to water to bypass the heat exchanger.
2. Each completed heat exchanger package shall be equipped with pressure gauges, temperature gauges, isolation valves, strainers, drain valves, couplings, and an automatic air vent.
3. All pressure and temperature gauges on the domestic water piping shall be installed between the 12:00 and 3:00 position for improved access and visibility. All pressure gauges shall have a manual shutoff cock upstream of the gauge to improve the accuracy of the reading.



## **Part 3 - Execution**

### **3.01 INSTALLATION**

- A. Installation shall be performed by the contractor in accordance with the requirements of the applicable codes. Contractor shall review heat exchanger package and installation for compliance with requirements and/or issues that may affect the heat exchanger's performance. Installation should not proceed until unsatisfactory conditions have been corrected.
- B. The contractor shall mount the equipment as described below:
  - 1. Install heat exchanger packages 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 22 05 48 "Vibration and Seismic Controls for Plumbing, Piping, and Equipment".
- C. The contractor shall install the paired gas-fired boiler(s) in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada).
- D. The contractor shall install the heat exchanger packages in accordance with NBIC – Part 1 (Installation), or another installation code having local jurisdiction.
- E. The contractor shall install a thermostatic mixing valve in the domestic water piping to ensure the Domestic Hot Water supply temperature to the building does not reach scalding temperatures.
- F. The contractor shall assemble and install any external safety/trim devices.
- G. The contractor shall install any electrical devices furnished with the heat exchanger package not specified to be factory-mounted.
- H. The contractor shall install control wiring to field mounted electrical devices in accordance with the requirements of NFPA 70.
- I. The contractor shall install electrical (power) wiring to the heat exchanger package in accordance with the requirements of NFPA 70.

## **3.02 CONNECTIONS**

### **A. DOMESTIC WATER PIPING**

1. Each heat exchanger package shall be provided with all necessary inlet (supply) and outlet (return) connections. Refer to the heat exchanger package'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 shall be at least full size of connection and adhere to proper codes for neutralization.
4. The domestic water piping and related components shall comply with the requirements of Section 22 11 00 "Facility Water Distribution".
5. All meters and gages in the domestic water piping shall comply with the requirements of Section 22 05 19 "Meters and Gages for Plumbing Piping".
6. All instrumentation and controls in the domestic water piping shall comply with the requirements of Section 22 09 00 "Instrumentation and Control for Plumbing".
7. All valves in the domestic water piping shall comply with the requirements of Section 22 05 23 "General-Duty Valves for Plumbing Piping".
8. All expansion fittings shall comply with the requirements of Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping".
9. Any pipe hangers or supports shall comply with the requirements of Section 22 05 29 "Hangers and Supports for Plumbing, Piping and Equipment".
10. Any vibration isolation devices on the hydronic piping shall comply with the requirements of Section 22 05 48 "Vibration and Seismic Controls for Plumbing, Piping, and Equipment".
11. All domestic water piping shall be insulated in accordance with the requirements of Section 22 07 00 "Plumbing Insulation".
12. After insulation, all domestic water piping shall be identified in accordance with the requirements of Section 22 05 53 "Identification for Plumbing, Piping and Equipment".
13. The domestic water softening equipment (if applicable) shall comply with the requirements of Section 22 31 00 "Domestic Water Softeners".
14. The domestic water filtration equipment (if applicable) shall comply with the requirements of Section 22 32 00 "Domestic Water Filtration Equipment".

## **B. HYDRONIC / BOILER WATER PIPING**

1. Check manufacturer's installation manual for clearance dimensions and install piping that will allow for service and ease of maintenance.
2. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and adhere to proper codes for neutralization.
3. The hydronic piping and related components shall comply with the requirements of 23 21 00 "Hydronic Piping and Pumps".
4. All meters and gages in the hydronic piping shall comply with the requirements of Section 23 05 19 "Meters and Gages for HVAC Piping".
5. All instrumentation and controls in the hydronic piping shall comply with the requirements of Section 23 09 13 "Instrumentation and Control Devices for HVAC".
6. All valves in the hydronic piping shall comply with the requirements of Section 23 05 23 "General-Duty Valves for HVAC Piping".
7. All expansion fittings shall comply with the requirements of Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping".
8. Any pipe hangers or supports shall comply with the requirements of Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".
9. Any vibration isolation devices on the hydronic piping shall comply with the requirements of Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
10. The hydronic piping shall be insulated in accordance with the requirements of Section 23 07 19 "HVAC Piping Insulation".
11. After insulation, all hydronic piping shall be identified in accordance with the requirements of Section 23 05 53 "Identification for HVAC Piping and Equipment".
12. Any water treatment of the hydronic system shall be in accordance with the boiler manufacturer's requirements and/or Section 23 25 13 "Water Treatment for Closed-Loop Hydronic Systems".

## **C. ELECTRICAL**

1. Install an external disconnect and overload protection for each heat exchanger package in accordance with the requirements of NFPA 70.
2. The heat exchanger package shall be configured for 110-120 VAC, single phase (w/ Neutral), 60Hz.
3. The heat exchanger package requires one electrical circuit with a minimum capacity of 10 Amps.