**Laars Heating Systems Company – Pennant Models PNCH 500-2000**

SECTION 235233 - WATER-TUBE BOILERS

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			2. SUMMARY
				1. Section includes packaged, factory-fabricated and -assembled, gas-fired, finned water-tube boilers for generating hot water.
			3. ACTION SUBMITTALS
				1. Product Data: For each type of product, include the following:

Construction details, material descriptions, dimensions, and weights of individual components, profiles, and finishes for boilers.

Rated capacities, operating characteristics, and furnished specialties and accessories.

AHRI certified boiler thermal and combustion efficiency.

Temperature and pressure rating, size, and materials of construction for boiler trim components, including piping, fittings, flanges, unions, and valves. Provide valve manufacturer's product data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.

Manufacturer's product data showing size, scale range, and accuracy of thermometers and pressure gages.

Detailed information of controls, including product data with technical performance, operating characteristics, and sequence of operation.

Product data for each motor, including performance, operating characteristics, and materials of construction.

* + - * 1. Sustainable Design Submittals:

Product Data: For energy performance.

* + - * 1. Shop Drawings: For boilers, boiler trim, and accessories.

Include plans, elevations, sections, and attachment details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Design calculations and base details, signed and sealed by a qualified professional engineer.

Design Calculations: Calculate requirements for selecting [**vibration isolators and**] seismic restraints and for designing bases.

Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.

Include piping diagrams of factory-furnished piping that indicate size and each piping component.

* + - 1. INFORMATIONAL SUBMITTALS
				1. Coordination Drawings: Plan and elevation views, drawn to scale, indicating equipment manufacturers' service clearances, structure and base attachment, piping, power, controls, and flues. Each view shows a screened background with the following:

Column grids, beams, columns, and concrete housekeeping pads.

Room layout with walls, floors, and roofs, including each room name and number.

Equipment and products of other trades that are located in vicinity of boilers and are part of final installation, such as lighting, fire-suppression systems, and plumbing systems.

* + - * 1. Seismic Qualification Certificates: For boilers, accessories, and components.

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

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. Installation instructions.
				2. Source quality-control reports.
				3. Field quality-control reports.
				4. Warranty: Standard warranty, shown below.
				5. Other Informational Submittals:

ASME Stamp Certification and Report: Submit ASME stamp certificate of authorization as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler. For Canadian installations, CSA B51 pressure vessel Canadian Registration Number (CRN).

Startup service reports.

* + - 1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
				2. Spare Parts List: Recommended spare parts list with quantity for each.
				3. Touch-up Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
				4. Instructional Videos: Including those that are prerecorded and those that are recorded during training.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Tool kit to include the following:

Special tools required to service boiler components not readily available to Owner service personnel in performing routine maintenance.

Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Boiler Tool Kit." Text size shall be at least 1 inch (25 mm) high.

A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 0.5 inch (13 mm) high.

* + - 1. WARRANTY
				1. Manufacturer’s Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period. Where “prorated” is indicated, the boiler manufacturer will cover the indicated percentage of cost of replacement parts. With “prorated” type, covered cost decreases as age of equipment increases.

Warranty Periods: Limited warranty is effective as of the date of installation or 6 months after the date of installation, whichever is first.

Heat Exchanger Failure Due to Thermal Shock: 25 years.

Heat Exchanger Failure Due to Other Than Thermal Shock: 10 years, with years 6 to 10 prorated.

Components Other Than Heat Exchanger: 1 year.

1. PRODUCTS
	* + 1. PERFORMANCE REQUIREMENTS
				1. Indoor and Outdoor Installations: Boiler shall be CSA certified for indoor and outdoor installation.
				2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
				3. ASME Compliance: Constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV, and labeled with ASME H-Stamp.
				4. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
				5. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.
				6. AHRI: Boiler thermal and combustion efficiencies shall be determined and listed by AHRI.
				7. CSA Compliance: Test boilers for compliance with the latest edition of ANSI Z21.13/CSA 4.9.
				8. Air Quality Compliance: Meets or exceeds the requirements of the most stringent air quality management codes, including but not limited to: SCAQMD, Rules 1146, 1146.1, or 1146.2 and Texas Commission on Environmental Quality (TCEQ) Title 30 Chapter 117, and Rule 117.465.
			2. FINNED WATER-TUBE BOILERS
				1. Basis-of-Design Product: Subject to compliance with requirements, provide Laars Heating Systems Company; Pennant model PNCH or comparable product by one of the following:

Raypak, Inc.

RBI; A Division of Mestek, Inc.

Thermal Solutions LLC.

Lochinvar, LLC.

* + - * 1. Description: Factory-fabricated, -assembled, and -tested boiler, with tubes sealed into headers pressure tight, and set on a steel base, including jacket, flue-gas vent connections, combustion-air-intake connections, water supply and return connections, and controls.
				2. Heat Exchanger:

ASME “H” Stamp.

160psi maximum operating pressure.

Finned copper tubing with stainless steel baffles.

Cast iron headers, glass-lined.

Two-pass, horizontal configuration.

Tubes shall be sealed in header by mechanically rolling tubes into header.

* + - * 1. Combustion Chamber Internal Insulation: Interlocking panels of refractory insulation, high-temperature cements, mineral fiber, and ceramic refractory tile for service temperatures of up to 2,000 deg F (1100 deg C).
				2. Casing:

Jacket: Sheet metal, with snap-in, mechanically fastened, and/or interlocking closures.

Built and CSA certified for indoor and outdoor installations.

Control Compartment Enclosure: Integral to boiler jacket.

Finish: Thermal set powder coat paint with textured finish.

Insulation: Minimum 1-inch- (25 mm-) thick, mineral-fiber insulation surrounding the heat exchanger.

Combustion-Air Connection: Inlet air duct collar that is field configurable for either top or back connection.

Mounting base to secure boiler.

* + - * 1. Burner/Gas Train:

Burner Tubes: Stainless steel, suitable for natural or propane gas.

Vent: Category I (fan-assisted) and III vent certification. Factory-mounted centrifugal fan to draw outside air into boiler and discharge flue gases into boiler vent.

Burner shall have a viewing port for observation of burner operation.

Boiler control will prepurge and postpurge the combustion chamber before firing.

Firing Rate:

Models 500 & 750: Two stage.

Model 1000: Three stage.

Models 1250, 1500, 1750 & 2000: Four stage.

Gas Train: Multiple combination gas valves with manual shutoff per CSA requirements.

Ignition: Proven hot surface ignition.

* + - * 1. Hot-Water Boiler Trim:

Safety Relief Valve: 75 psig (517kPa) ASME rated.

Pressure and Temperature Gauge: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gauge in compliance with ASME pressure vessel code.

Drain valve: Minimum NPS 3/4 (DN 20) hose-end valve.

Burner site glass.

Air intake filter.

Water flow switch.

Manual reset high limit.

Automatic reset high limit.

On/off toggle switch.

Options - Boiler Mounted:

ASME CSD-1.

Mounted boiler pump.

Cupronickel heat exchanger tubes.

Low water cutoff with manual reset and test button.

Reversed water connections

Bronze trim.

Alternate display orientation.

Additional manual reset high limit.

Additional auto reset high limit.

Alternate relief valves.

Options - Field Installed:

BACnet IP / Modbus TCP/IP gateway.

LonWorks gateway.

Side wall vent terminal.

Side-wall combustion air terminal.

Vent terminal for unit placed outdoors.

Air terminal for unit placed outdoors.

* + - * 1. Controls:

Integrated electronic temperature and ignition control includes:

UL 353 rating for high and low limits, such that a separate manual reset controller is not required.

Large color touch screen user interface.

Display shall be visible without the removal of any jacket panels.

Stage fires burners.

User configurable staging by adjusting differential, stage delay on/off, and minimum stage on/off.

Adjustable setpoints:

Boiler setpoint.

System setpoint.

Domestic water setpoint.

Domestic water priority.

Outdoor reset parameters.

Boiler high limit, automatic and manual.

Deg F or deg C display.

PID gain parameters.

Manual staging control.

Pump exercise mode.

Anti-short cycle.

Temperature differential

Pump time delay

Anti-frost setting

Control and display shall both hold the boiler’s configuration and programmed parameters. Each shall be able to upload/download those parameters to the other, allowing for each device to be replaced without reprogramming.

The control shall have a USB connection that will allow the transfer of parameter sets from one boiler to another, and will allow a boiler’s history data to be transferred to a USB memory device.

The control has a quick start feature allowing programming of the most commonly used subset of parameters.

Dry alarm contacts for ignition failure.

24-V ac control circuit.

Accepts 4-20 mA or 0-10 V dc input signal from external control or building automation system, with automatic remote signal detection, allowing external control of staging or temperature setpoint

The control shall recognize a domestic water sensor (shipped with unit) or a closure from a tank stat as a call for DHW.

Cascade and lead-lag up to 8 boilers without additional controllers.

When boilers are wired together, the controller on the lead unit shall automatically detect and configure all units.

The cascade system shall have built in redundancy, via either a lag unit’s internal setpoint or a configurable redundant leader.

Selectable firing sequence methods for cascade:

Keep each boiler at lowest firing rate and stage fire together.

Each boiler brought to high fire before additional boilers fired.

Automatic, alternating-firing sequence for multiple boilers to provide equal run time per boiler.

Boiler control shall graphically depict the firing rate of each boiler in the system.

Boiler control shall display information about the following for each boiler it is monitoring:

Navigation bar color shall indicate boiler status; normal operation, lockout, hold state, communication error. The control shall differentiate between a lockout, a hold, or an alert.

Navigation bar indicates where the user is within the menu structure, and displays brief descriptions of control information.

Boiler setpoint.

System setpoint.

Domestic water setpoint.

Domestic water priority status.

Outdoor air temperature.

Warm weather shutdown indication.

Cascade setpoints.

Boiler pump status.

Burner run status.

Status of each stage.

Blower status.

Cascade status.

Indicate active parameters currently in demand.

Real time status of firing rate

Real time temperature and temperature rise.

Displays date and time.

Displays errors and lockout information.

Displays password level access and lock indication for password security.

Icons to access quick start, configure and service menus.

Messages about boiler operation shall be indicated by and icon on the home screen that can be touched to display the whole message.

USB icon shall be displayed when USB port is in use.

Three levels of password protection; user level, installer level, and OEM level.

Modbus, and BACnet MSTP protocols standard on controller.

Information available from control protocols:

Inlet water temperature.

Outlet water temperature.

DHW temperature.

Outdoor air temperature.

Warm weather shutdown status.

Frost protection.

Status for all sensors.

Fan speed.

All setpoints.

Remote control input.

Burner status.

Lockout codes.

Alarm reasons.

Pump status.

Control diagnostics shall include:

Ignition failure.

Safety chain interrupt.

Flow switch.

Low water cutoff.

Manual reset high limit exceeded.

Auto reset high limit exceeded.

DHW high limit exceeded.

Block flue switch fault.

Combustion air switch fault

High gas pressure fault

Low gas pressure fault

Field interlock open.

Temperature sensor errors (open, short or drift).

Control shall have a clock with battery backup and runtime indicators for:

Demand cycles.

Burner cycles.

Pump cycles.

Firing time.

Ten most recent lockouts

* + - * 1. Capacities and Characteristics:

Heating Medium: Hot water.

Design Water-Pressure Rating: 160 psig (1100 kPa).

Safety Relief Valve Setting: 75 psig (517 kPa).

Entering-Water Temperature: Minimum 120 deg F (49 deg C).

Leaving-Water Temperature: Maximum 240 deg F (116 deg C).

Water-Flow and Headloss at 25°F delta-T:

Model 500: 34 gpm (2.15 L/s) flow and 1.1 feet (0.3 m) headloss.

Model 750: 51 gpm (3.22 L/s) flow and 2.3 feet (0.7 m) headloss.

Model 1000: 68 gpm (4.29 L/s) flow and 3.6 feet (1.1 m) headloss.

Model 1250: 85 gpm (5.36 L/s) flow and 6.1 feet (1.9 m) headloss.

Model 1500: 102 gpm (6.44 L/s) flow and 7.2 feet (2.2 m) headloss.

Model 1750: 119 gpm (7.51 L/s) flow and 10.5 feet (3.2 m) headloss.

Model 2000: 136 gpm (8.58 L/s) flow and 12.5 feet (3.8 m) headloss.

AHRI Certified Thermal Efficiency:

Model 500: 85.0 percent.

Model 750: 85.0 percent.

Model 1000: 85.0 percent.

Model 1250: 85.2 percent.

Model 1500: 85.2 percent.

Model 1750: 85.2 percent.

Model 2000: 85.2 percent.

AHRI Certified Combustion Efficiency:

Model 500: 85.0 percent.

Model 750: 85.0 percent.

Model 1000: 85.0 percent.

Model 1250: 85.1 percent.

Model 1500: 85.1 percent.

Model 1750: 85.1 percent.

Model 2000: 85.1 percent.

AHRI Certified Input:

Model 500: 500,000 Mbh (147 kW).

Model 750: 750,000 Mbh (147 kW).

Model 1000: 999,000 Mbh (293 kW).

Model 1250: 1,250,000 Mbh (366 kW).

Model 1500: 1,500,000 Mbh (440 kW).

Model 1750: 1,750,000 Mbh (513 kW).

Model 2000: 1,999,000 Mbh (586 kW).

Available Voltages: 120-V ac, single phase, 60 Hz.

Gas Pressure: 4 to 13 in. w.c. (995 to 3235 Pa).

NOx Emissions: Meets the most stringent NOx requirements.

* + - 1. SOURCE QUALITY CONTROL
				1. Test and inspect factory-assembled boilers, before shipping, in accordance with latest edition o the ASME Boiler and Pressure Vessel Code.
				2. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve performance requirements indicated.
1. EXECUTION
	* + 1. EXAMINATION
				1. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and flue; piping; controls; and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for flue, piping, controls, and electrical connections.

* + - * 1. Examine areas where boilers will be installed for suitable conditions.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. BOILER INSTALLATION
				1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
				2. Install gas-fired boilers according to NFPA 54.
				3. Assemble and install boiler trim, components, and accessories that are not factory installed.
				4. Install control and electrical devices furnished with boiler that are not factory mounted.
				5. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.
				6. Perform boil-out and cleaning procedures according to manufacturer's written instructions after completion of hydrostatic testing and before performing other field tests. Following boil-out and cleaning procedures, boiler shall be washed and flushed until water leaving boiler is clear.
			2. PIPING CONNECTIONS
				1. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to boiler(s), allow space for service and maintenance.
				3. Install condensate drain piping from equipment drain connection to nearest floor drain, or, if a neutralization system is used, to the condensate-neutralization unit and from neutralization unit to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.
				4. Connect gas piping to boiler gas-train inlet with dirt leg, shutoff valve, and union or flange. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
				5. Connect hot-water piping to supply- and return-boiler connections with shutoff valve and union or flange at each connection.
				6. Install piping from safety relief valves to nearest floor drain.
				7. Install piping from safety valves and drip-pan elbows. Extend piping from safety valves and terminate to vent outdoors, where required by local jurisdiction. Extend piping from drip-pan elbow drain to nearest floor drain.
				8. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
				9. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.

Provide a temperature-controlled non-potable domestic cold water source to cool hot equipment drains to deliver a discharge temperature that meets the requirements of the installation.

* + - 1. FLUE CONNECTIONS
				1. Boiler Intake and Exhaust Vent Piping: Install flue-venting kit and combustion-air intake.

For boilers placed indoors:

Intake air may be taken from the room, or ducted to the boiler with up to 50 feet of, and up to three elbows. Air pipe material may be single-wall galvanized steel, 24 gauge minimum, insulated or non-insulated, sealed with permanent duct tape or aluminum tape. Air pipe diameter may be:

Model 500: 6 inch.

Model 750: 8 inch.

Model 1000: 8 inch.

Model 1250: 12 inch.

Model 1500: 12 inch.

Model 1750: 12 inch.

Model 2000: 12 inch.

Exhaust vent may be Category III or fan-assisted Category I.

Category III vent may be up to 50 feet of pipe, and up to three elbows. Vent pipe material must comply with UL Standard UL1738, such as type 29-4C stainless steel, either insulated or non-insulated. Vent pipe diameter may be:

Model 500: 6 inch.

Model 750: 8 inch.

Model 1000: 8 inch.

Model 1250: 10 inch.

Model 1500: 10 inch.

Model 1750: 12 inch.

Model 2000: 12 inch.

Category I vent must be sized to achieve negative draft. The vent system must conform to the National Fuel Gas Code (ANSI Z223.1-Latest edition) in the U.S., or to CSA B149.1 (latest edition) in Canada. It must be sized as a fan-assisted Category I system.

For boilers placed outdoors, use air intake and exhaust vent accessories from boiler manufacturer.

* + - * 1. Install easily accessible test ports for field testing of flue gas from each boiler.
			1. ELECTRICAL POWER CONNECTIONS
				1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
			2. CONTROLS CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring between boilers and other equipment to interlock operation as required, to provide a complete and functioning system.
				3. When external control is used, connect control wiring between boiler control interface and external control system. Comply with applicable requirements in Section 230923 “Direct Digital Control (DDC) System for HVAC” and Section 260523 “Control-Voltage Electrical Power Cables.”
			3. FIELD QUALITY CONTROL
				1. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
				2. Perform the following tests and inspections:

Perform installation and startup checks according to manufacturer's written instructions.

Hydrostatic Leak Test: Repair leaks and retest until no leaks exist.

Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

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

Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.

Set field-adjustable switches and circuit-breaker trip ranges as indicated.

* + - * 1. Boiler will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
				3. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

**END OF SECTION 235216**