**Laars Heating Systems Company – MagnaTherm HTD Models MGH 1600-4000**

SECTION 235216 - CONDENSING 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 gas-fired, water-tube condensing boilers, trim, and accessories for generating hot water.
       3. ACTION SUBMITTALS
          1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, finishes for boilers, rated capacities, operating characteristics, and furnished options and accessories.
          2. Sustainable Design Submittals:

Product data showing compliance with ASHRAE 90.1.

* + - * 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.

Include diagrams for power, signal, and control wiring.

* + - 1. INFORMATIONAL SUBMITTALS
         1. Coordination Drawings: Plans and sections, drawn to scale and coordinated with each other, using input from installers of the items involved.
         2. Source quality-control reports.
         3. Field quality-control reports.
         4. Warranty: Standard warranty, shown below.
         5. Product Certificates:

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).

* + - 1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.
      2. 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. 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.
          2. ASME Compliance: Constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV, and labeled with ASME H-Stamp.
          3. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency in accordance with Table 6.8.1-6 and other requirements in Ch. 6 of ASHRAE/IES 90.1.
          4. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.
          5. AHRI: Boiler thermal and combustion efficiencies shall be determined and listed by AHRI.
          6. CSA Compliance: Test boilers for compliance with the latest edition of ANSI Z 21.13/CSA 4.9.
          7. 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.
          8. Mounting Base: For securing boiler to concrete base.
       2. FLOOR-MOUNTED, WATER-TUBE CONDENSING BOILERS
          1. Basis-of-Design Product: Subject to compliance with requirements, provide Laars Heating Systems Company MagnaTherm HTD Series Boiler with Laars Linc® control, 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, stainless steel water-tube, condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including powder coat, thermal set jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
        2. Heat Exchanger: Stainless steel heat exchangers.
        3. Combustion Chamber: Stainless steel, sealed.
        4. Burner: Natural gas, forced draft drawing from gas-premixing valve.
        5. Blower: Operates during burner-firing , prepurge, and postpurge of the combustion chamber.

Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 “Common Motor Requirements for HVAC Equipment.”

Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.

* + - * 1. Gas/Air System: The boiler shall have as standard equipment a controlled linkageless modulating valve system, Tru TracTM controlled oxygen trim system, and Laars Linc® burner integrated control system. The controlled components shall communicate with each other to ensure stable, clean combustion, high heat recovery, and consistent efficiency throughout the entire modulating range of the boiler, and shall feed information to the display on the boiler for set up, informational, and diagnostic purposes. The gas train shall consist of an on/off solenoid valve, on/off pressure regulating valve, fuel modulating damper, air modulating damper, and air/gas mixer.
        2. Oxygen Sensing System: Oxygen content of the flue gases shall be continually monitored by Tru TracTM system, and controlled within 2 minutes of boiler ignition, and throughout the rest of the firing period.
        3. Vent / Air Piping:

Boiler shall be designed and CSA certified for horizontal and vertical Category IV venting, using up to 100 equivalent feet of CPVC, polypropylene, or stainless steel vent material.

Boiler shall be designed and CSA certified for Category II venting, using CPVC, polypropylene, or stainless steel vent material.

Air may be taken from the room, or ducted directly to the boiler using up to 100 equivalent feet of PVC, CPVC, galvanized steel, ABS, or polypropylene air pipe material.

* + - * 1. Modulating Range: From 5-100% of full fire (20:1 turndown), without the use of gas valves that stage, and without affecting the minimum combustion efficiency ratings.
        2. Ignition: Spark ignition, with flame sensor with 100 percent main-valve shutoff and flame safety supervision.
        3. Casing:

Jacket: Sheet metal, with snap-in, mechanically fastened and/or interlocking closures. Built and CSA certified for indoor or outdoor installations.

Control Compartment Enclosures: Integral to boiler jacket.

Finish: Thermal set powder coat paint with textured finish or stainless steel.

* + - * 1. Capacities and Characteristics:

Heating Medium: Hot water.

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

Safety Relief Valve Setting: 75 psig (516 kPa).

Entering-Water Temperature: Minimum 40 deg F (4.4 deg C)>.

Leaving-Water Temperature: Maximum 195 deg F (90.5 deg C)>.

NOx Emissions: Less than 10 ppm, adjusted to 3 percent O2.

Water Flow and Headloss:

MGH 1600:

30°F delta-T: 100 gpm (6.3 L/s) flow and 14 feet (4.3 m) headloss.

Minimum: 76 gpm (4.8 L/s) flow and 8 feet (2.4 m) headloss.

MGH 2000:

30°F delta-T: 128 gpm (8.1 L/s) flow and 24.5 feet (7.5 m) headloss.

Minimum: 95 gpm (7.5 L/s) flow and 13.6 feet (4.1 m) headloss.

MGH 2500:

30°F delta-T: 158 gpm (10.0 L/s) flow and 24.6 feet (7.5 m) headloss.

Minimum: 119 gpm (4.8 L/s) flow and 13.6 feet (4.1 m) headloss.

MGH 3000:

30°F delta-T: 190 gpm (12.0 L/s) flow and 34.2 feet (10.4 m) headloss.

Minimum: 142 gpm (9.0 L/s) flow and 18.9 feet (5.8 m) headloss

MGH 3500:

30°F delta-T: 222 gpm (14.0 L/s) flow and 31.6 feet (9.6 m) headloss.

Minimum: 166 gpm (10.5 L/s) flow and 18.6 feet (5.7 m) headloss.

MGH 4000:

30°F delta-T: 255 gpm (16.1 L/s) flow and 38.2 feet (11.6 m) headloss.

Minimum: 190 gpm (12.0 L/s) flow and 22.5 feet (6.9 m) headloss.

AHRI Certified Thermal Efficiency:

MGH 1600: 95.0 %

MGH 2000: 95.0 %

MGH 2500: 95.0 %

MGH 3000: 95.0 %

MGH 3500: 95.0 %

MGH 4000: 95.0 %

AHRI Certified Combustion Efficiency:

MGH 1600: 96.0 %

MGH 2000: 93.6 %

MGH 2500: 93.8 %

MGH 3000: 93.8 %

MGH 3500: 93.6 %

MGH 4000: 93.1 %

AHRI Certified Input:

MGH 1600: 1,600,000 Btu/hr.

MGH 2000: 1,999,000 Btu/hr.

MGH 2500: 2,499,000 Btu/hr.

MGH 3000: 3,000,000 Btu/hr.

MGH 3500: 3,500,000 Btu/hr.

MGH 4000: 4,000,000 Btu/hr.

Available voltages:

MGH 1600:

120-V ac, single phase, 60 Hz.

208-V ac, single phase, 60 Hz.

220-240-V ac, single phase, 60 Hz.

MGH 2000:

120-V ac, single phase, 60 Hz.

208-V ac, single phase, 60 Hz.

220-240-V ac, single phase, 60 Hz.

208-V ac, three phase, 60 Hz.

480-V ac, three phase, 60 Hz.

600-V ac, three phase, 60 Hz.

MGH 2500, MGH 3000, MGH 3500 and MGH 4000 :

208-V ac, three phase, 60 Hz.

480-V ac, three phase, 60 Hz.

600-V ac, three phase, 60 Hz.

* + - * 1. Trim

Controls:

Three controls that work together to operating and modulate the boiler safely, ensuring consistent efficiency, clean burn, and stable combustion, throughout the entire modulation range:

Laars Linc® operating / modulation burner integrated control

Tru TracTM real-time O2 sensing / control

Linkageless modulating valve control

Large color touchscreen

Manual reset high limit.

Safety Relief Valve: ASME rated, 75psi.

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

Water Flow Switch

Low Water Cutoff

Vari-Prime® boiler pump control via user-selectable fixed boiler temperature rise, wired and programmed for use with variable speed pumps.

Air filter

Boiler Air Vent: Manual.

Drain Valve: Minimum NPS 3/4 (DN 20) valve in compliance with ASME pressure vessel code.

Condensate Trap: Primeless condensate trap with overflow protection.

Options – Boiler Mounted:

ASME CSD-1

Alarm bell for ignition failure with silencing switch

Additional manual and automatic reset high limit

BACnet IP / Modbus TCP/IP gateway

LonWorks gateway

Water connection flange kit

30psi pressure relief valve

50psi pressure relief valve

60psi pressure relief valve

125psi pressure relief valve

150psi pressure relief valve

Options – Field Installed:

High & low gas pressure switches

Boiler pump

BACnet IP / Modbus TCP/IP gateway

LonWorks gateway

Horizontal vent terminal

Vertical vent terminal

Horizontal air terminal

Vertical air terminal

Condensate neutralizer kit

Condensate neutralizer kit with pump

* + - * 1. CONTROLS

Boiler operating/modulating control shall be Laars Linc® and shall include the following devices and features:

Large color touch screen user interface with intuitive icon displays.

Clearly labelled terminal strip for field wiring connections.

Quick start menu option to access basic functionality.

Configuration menu option to access all available parameters.

Service menu to access all available service screens.

Modulates from 5 percent to 100 percent of full fire (20:1 turndown)

BACnet MSTP and Modbus RTU on board, via RS 485 connections.

USB functionality that allows:

Download of parameters from one boiler to another.

Upload of parameters to a thumb drive.

Upload history data from a boiler in tab deliminated text file.

Control transformer.

Maximum vent temperature cutoff.

Water flow switch.

Dry contacts for ignition failure alarm.

Dry contacts for run status.

Manual reset high limit stops burner if operating conditions rise above maximum boiler design temperature.

On/off toggle switch, lighted.

Controls multiple heat demands; two space heating and one indirect domestic water.

Adjustable set points.

Boiler temperature

Domestic water temperature

Boiler manual reset high limit.

Boiler automatic reset high limit.

Minimum and maximum boiler temperature rise limits.

Minimum and maximum temperature between which the system will modulate.

Deg F or deg C display.

PID parameters.

Manual firing rate control (forced min or max firing rate).

Flue temp limitation.

Priority feature allows the user to set priorities for each heat demand.

Pump exercise mode.

Anti-short cycle.

Integrates indirect domestic water heating.

Indirect water heater priority.

DHW temp sensor included.

Recognizes DHW sensor or closure from tank stat.

Multiple pump control for boiler pump, system pump, and indirect domestic water pump, each with delay.

Vari-Prime® boiler pump control via user-selectable fixed boiler temperature rise, wired and programmed for use with variable speed pumps

Spark to pilot ignition

24-V control circuit.

Accepts 4-20 mA or 0-10 V signal from external control or building automation system that can be programmed as a remote setpoint or remote firing rate signal.

Anti-short cycle feature.

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

Space heating loop 1 setpoint.

Space heating loop 2 setpoint.

Domestic hot water setpoint (when sensor is used).

Space heating loop 1 temperature.

Space heating loop 1 temperature.

Domestic hot water temperature (when sensor is used).

Oxygen and carbon dioxide levels.

Status of all pumps.

Boiler status that includes; running or standby, actual firing rate, target firing rate, outside air temperature (when sensor is used), and flame signal.

Inlet and outlet water temperature.

Boiler temperature rise.

System temperature inlet and outlet (when system sensor is used).

Icon that displays which heat demands are active.

Error and lockout codes.

Date & time.

Locked / unlocked status of control.

Outdoor Reset:

Customizable reset curves based on outdoor temperatures and desired system water temperature.

Warm weather shutdown.

Outdoor air temperature sensor included.

Cascade and lead-lag up to eight boilers without additional controllers, via RS 485 connections.

Cascade keeps each boiler at the lowest firing rate, with boilers modulating together to maximize efficiency, while satisfying the heat demand.

Rotation setup options include:

Run time mode – Chooses which unit fires first, based on run time hours.

Recurrence mode – adjust the hour and minute of the day for rotation, and how many days to wait for rotation, of the lead boiler.

Boiler control shall display the following system information:

Graphically depict the firing rate of each boiler in the system.

Boiler sequence order shown with each boiler in the system.

Auto-reset or lockout of individual boilers.

Target cascade power for the system, and for each boiler.

Actual cascade power for the system, and for each boiler.

System temperature displayed.

Redundancy feature that allows the user to choose how to treat a loss of communication with the lead unit:

Boiler internal setpoint - Continue to operate lag units in the same manner as when the communication stopped, via their internal setpoints.

Redundant lead – A lag unit will assume lead responsibilities.

Disabled – Lag units will no longer work to satisfy the heat demand.

User-programmable cascade base load values.

Three levels of password protection:

User level.

Installer level.

OEM level.

Service screens shall include:

Burner.

Digital inputs, including:

CH1.

CH2.

DHW.

Flow switch.

Low water cutoff.

Manual reset high limit.

Thermal cutout.

High gas pressure.

Low gas pressure.

Additional high limit.

Condensate level

Spare

Digital outputs, including:

Run.

Alarm.

Safety satisfied.

Boiler pump.

System pump.

DHW pump.

Auxiliary power output.

Auxiliary dry contact.

Analog inputs, including:

All temperature sensor readings.

Flame signal.

Voltage or current control signals.

Analog outputs, including:

Pump speed.

Fan speed.

Mixing valve value.

Auxiliary.

Screen restart and recalibrate.

History.

Restart.

Factory default reset.

Oxygen trim setpoint.

Modulating valve status, including:

Phase.

Fuel actuator position.

Air actuator position.

VSD setting.

Modulation rate.

Flame signal.

Error & diagnostic codes.

Inputs & outputs.

Burner ID.

Lower and upper trim levels.

Current trim.

Fan speed.

Information available from BACnet / Modbus connection:

All control setpoints.

All temperature sensor readings.

Flame signal

Voltage or current external input

Blower speed

Safety chain status.

Non-safety chain status.

Demand source.

Digital output status.

Gas and pilot valve status.

Status of all pumps.

Pump speed output.

Firing rate.

Lockout codes.

Error codes.

All history parameters.

Lead-lag system – state of each boiler.

Outdoor reset / warm weather shutdown status.

Control shall have a clock with battery backup.

The control shall differentiate between a lockout, a hold, or an alert. If an issue occurs, the system will display a brief description of the issue on the control screen. The user shall be able to tap the display to be presented with a more detailed explanation of the issue.

The user shall be able to choose how long the control will remain unlocked after interaction with control has stopped.

Boiler shall have the Tru Trac™ oxygen sensor control that continually measures the oxygen content of the flue gases, and a modulating gas valve control, in addition to the boiler’s operating control. The three controllers shall work together to ensure that the boiler’s combustion remains stable down to 5% of full fire, and that there is consistent efficiency, clean combustion, and high heat recovery throughout the modulation range. Oxygen control shall ensure that CO2 is maintained to achieve a dew point that enables condensing at all firing rates.

Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

Burner operating control shall be integral to the boiler control.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

* + - * 1. Examine mechanical spaces for suitable conditions where boilers will be installed.
        2. Proceed with installation only after unsatisfactory conditions have been corrected.
      1. BOILER INSTALLATION
         1. Install floor-mounted 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 any optional boiler trim.
         4. Install electrical devices furnished with boiler but not specified to be factory mounted.
         5. Install control wiring to field-mounted electrical devices.
      2. PIPING CONNECTIONS
         1. Comply with requirements for hydronic piping specified in Section 232113 "Hydronic Piping."
         2. Drawings indicate general arrangement of piping, fittings, and specialties.
         3. When installing piping adjacent to boiler, allow space for service and maintenance of condensing boilers. Arrange piping for easy removal of condensing boilers.
         4. 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.
         5. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
         6. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve, and union or flange at each connection.
         7. Install piping from safety relief valves to nearest floor drain.
      3. DUCT CONNECTIONS
         1. Boiler Intake and Exhaust Vent Piping:

For boilers placed indoors:

Intake air may be taken from the room, or ducted to the boiler. When ducted, air pipe material may be PVC, CPVC, galvanized steel, polypropylene or ABS. Air pipe length and diameter may be:

MGH 1600: Up to 100 equivalent feet of 6” diameter pipe.

MGH 2000 and MGH 2500: Up to 100 equivalent feet of 8” diameter pipe.

MGH 3000 and MGH 3500: Up to 100 equivalent feet of 10” diameter pipe.

MGH 4000: Up to 100 equivalent feet of 12” diameter pipe.

Exhaust vent may be Category IV or Category II.

Category IV vent pipe material in the U.S. must be stainless steel UL 1738, CPVC sch 40 ANSI/ASTM F441, or polypropylene ULC S636 Class 2C. Vent pipe material in Canada must be ULC S636 certified. Vent pipe length and diameter may be:

MGH 1600: Up to 100 equivalent of 8” diameter pipe, or up to 50 equivalent feet of 6” diameter pipe.

MGH 2000: Up to 100 equivalent of 8” diameter pipe.

MGH 2500: Up to 100 equivalent of 10” diameter pipe, or up to 50 equivalent feet of 8” diameter pipe.

MGH 3000: Up to 100 equivalent of 10” diameter pipe.

MGH 3500: Up to 100 equivalent of 12” diameter pipe, or up to 50 equivalent feet of 10” diameter pipe.

MGH 4000: Up to 100 equivalent of 12” diameter pipe.

Category II vent must be sized to achieve negative draft. Vent pipe material in the U.S. must be stainless steel UL 1738, CPVC sch 40 ANSI/ASTM F441, or polypropylene ULC S636 Class 2C. Vent pipe material in Canada must be ULC S636 certified. Typically, Category II vent will be:

MGH 1600 and MGH 2000: 14” diameter.

MGH 2500 and MGH 3000: 18” diameter.

MGH 3500 and MGH 4000: 22” diameter.

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

Comply with all boiler manufacturer’s installation instructions.

* + - 1. ELECTRICAL CONNECTIONS
         1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
         2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
         3. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
      2. CONTROL CONNECTIONS
         1. Install control and electrical power wiring to field-mounted control devices.
         2. Connect control wiring in accordance with 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. Tests and Inspections:

Perform installation and startup checks in accordance with manufacturer's written instructions.

Leak Test: Hydrostatic 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**