Specification

ABH Gas-Fired Water Heater

Category: High Efficiency Gas Domestic Water Heaters with Integral Digital Recirculation Valve

Type: Condensing

Model: ABH

1.0 GENERAL

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label heaters to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: heaters shall have minimum efficiency according to "Gas and Oil-Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test heaters for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." heaters shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.2 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Installation Manual.

1.3 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Condensing Heaters: 10 years from date of Substantial Completion on heat exchanger.

2. Warranty Period for Condensing Heater components: 15 months from the Warranty start date for all other components.

2.0 PRODUCTS

2.1 CONDENSING WATER HEATERS

A. Manufacturers: Subject to compliance with requirements, **provide products by the following**:

B. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** Armstrong International ABH or comparable product by one of the following:

1. <**Insert manufacturer's name**>

C. Description: Factory-fabricated, -assembled, and -tested, water-tube condensing heater with heat exchanger sealed pressure tight; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. The heater shall be LabTest certified and listed under ANSI Z21.13, CSA 4.9 heater test standard for the US and Canada. The Heater shall comply with the energy efficiency requirements of the ASHRAE 103 Standard. The Heater shall meet U.S. Environmental Protection Agency and Department of Energy guidelines for “Energy Star” efficiency. The Heater shall have been tested and certified by a third party listed and certified testing agency to have the following:

1. The Heater shall operate at high-fire with a minimum thermal efficiency of 90% when supplied with 160°F entering water.
2. The Heater shall operate at thermal efficiency of 99.8% when supplied with 54°F entering water.
3. The Heater shall operate at a combustion efficiency of up to 94.7%
4. The Heater shall have a rating for Oxides of Nitrogen (NOx) of 30 ppm or less, when corrected to 3% O2.
5. The Heater shall have an AFUE rating of 93.7% or greater.
6. The Heater shall operate at altitudes up to 9000 feet above sea level without additional parts or loss of BTU output.

D. Heat Exchanger: The heat exchanger shall be constructed of 316L stainless steel and shall bear the ASME “H” stamp for 160 PSI working pressure and shall be National Board listed.

E. Combustion Chamber: Shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly, keeping the primary combustion chamber free of excess moisture. The heater shall contain an integral non-return valve in the vent connection and proprietary fan and multiple appliance control algorithms, providing for the ability to utilize a common inlet and exhaust vent for up to 8 appliances when coupled together for a common load.

F. Burner: The burner shall be a premix design and constructed of high temperature stainless steel to provide a full input burner port loading ratio of 3400 btu/sq. inch or greater. Burner shall be suitable for firing with natural gas or propane.

G. Blower: Centrifugal fan with ECM drive to operate during each burner firing sequence, to pre-purge and post-purge the combustion chamber, and to provide 5:1 modulating firing rates for maximum efficiency.

H. Gas Train: Shall be supplied with a negative pressure gas valve providing precise control of the air-gas offset ratio and maximum firing rate. The gas valve outlet shall be coupled to an air gas mixing venturi with a full port gas valve outlet and a free air inlet of no less than 2.5 times greater than the gas valve outlet area.

I. Ignition: The ignition system shall be direct-spark ignition with integrated flame sensor and soft start. Hot-surface ignition shall not be accepted

J. Condensate Drain: The heater shall contain a built-in condensate drain trap that shall allow condensation to drain freely from the heat exchanger assembly, while providing a water trapping height of a minimum of 1.5 times the maximum fan outlet pressure. This trap shall contain an integral clean out that allows complete access and cleaning of the condensate trap assembly without opening the appliance or shutting it down. The safety control system shall incorporate a pressure switch or transducer that monitors the condensate drain system for any restriction causing a backup or leakage through trap and shall shut the appliance down and display a fault code to indicate such a condition exists.

K. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Painted side panels and stainless-steel front cover.
4. Combustion-Air Connections: Inlet and vent duct collars.
5. Mounting base to secure ABH.

    a. The heater shall be supplied with a seismic rated and certified welded steel rack and legs that will be fabricated from 2” x 3/16” inch tubular iron and Unistrut™. The base for the rack legs will also have threaded openings for supplied leveling bolts and factory drilled holes to allow for securing the stand to the floor. The stand shall be factory painted with machine grade enamel paint.

    b. Seismic Fabrication Requirements: Fabricate mounting base and attachment to heater pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

L. Characteristics and Capacities:

1. Heating Medium: Hot water.
2. Design Water Pressure Rating: 160 psig.
3. Safety Relief Valve Setting: 125 psig.
4. Entering-Water Temperature: see Schedule.

5. Leaving-Water Temperature: see Schedule.
6. Design Water Flow Rate: per heater manufacturer requirements
7. Minimum Water Flow Rate: per heater manufacturer requirements
8. Design Pressure Drop: per heater manufacturer requirements
9. Minimum Efficiency AFUE: 93.7 percent.
10. Minimum Thermal Efficiency: 90 percent at high-fire with 160°F incoming water and 20°F delta T.
11. Minimum Combustion Efficiency: up to 94.7 percent.
12. Heater Input: see Schedule.
13. Heater Output Capacity: see Schedule.
14. Gas Pressure: 4” to 14” water column.

2.2 TRIM

A. Safety Relief Valve: ASME rated and sized as required.

B. Pressure and Temperature Gage: Minimum 2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

C. Heater Air Vent: Automatic or Manual.

D. Drain Valve: Minimum NPS 3/4 hose-end ball valve.

E. Circulation Pump: Non-overloading pumps with motor having lubricated bearings; designed to operate at specified heater pressures and temperatures; sized for heater required flow rates.

F. Condensate Neutralizer: Each condensing heater system shall be supplied with condensate neutralizer. The neutralizer shall be factory engineered and sized for the heater condensate capacity with adequate soak-time to bring the condensate to a pH of 7 and with sufficient volume of neutralizing agent to provide for 2000 hours of operation in a fully condensing application. The neutralizer shall be factory mounted with a single point drain connection for multiple heaters. The neutralizing agent shall be ½” – ¾” common limestone aggregate.

2.3 CONTROLS

A. The heater shall utilize integrated control circuit and components. The control system shall have an LCD display with self-diagnostic microprocessor controls for heater set-up, heater status, and heater diagnostics. All components shall be easily accessed and serviceable from the front of the jacket without removing any additional panels. The heater controls shall be equipped with the following:

1. Dual High Limit sensor (fixed and adjustable).
2. Exhaust temperature sensor.
3. Gas inlet pressure transducer.
4. Flue back pressure/ condensate back up protection.
5. Water flow protection (flow switch or transducer).
6. Built-in freeze protection.

B. The heater shall be equipped with an outdoor air reset function that shall automatically operate when a 10,000-Ohm sensor is attached to the provided terminal strip.

C. The heater shall automatically sense when an external 10,000-ohm sensor has been attached to the terminal strip and it shall become the primary sensor for temperature control.

D. The heater controls shall include a cascading control feature able to control up to 8 heaters in parallel using (1 or more) system sensor and factory supplied interconnecting wiring from Master/Lead controller to Member/Lag heaters, allowing for continuously adjusting the reaction to load changes in precise BTU increments.

1. No steps; increase or decrease in BTU by more than 1% at a time shall be allowed.
2. Only the number of heaters required to meet set point are to be brought on.
3. Heaters are to be shut down in same sequence they are brought on line.
4. Determination and assignment of Lead heater in light off and shut down sequence shall occur at 1 hour of burner on time intervals, to allow for no more than 1 hour in burn time difference per unit in the Cascade at any time.
5. Smart PID Control system, shall “learn” with each burn cycle as to how quickly or slowly set point was met and how precisely it was held. In subsequent burn cycles it shall automatically adjust it’s reaction rates (time, modulation range and rate of BTU change per second) to hold a closer difference to set point.

E. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display all points displayed on the local display(s).

1. Hardwired Points:

a. Monitoring:

1) Inlet/Outlet temperature
2) Exhaust Temperature
3) Gas Inlet Pressure
4) Run Status
5) Numerous other points, see Schedule

2. An optional communication interface, see Schedule if required, for building automation system shall enable building automation system operator to remotely control and monitor the heater from an operator workstation. Control features available, and monitoring points displayed, locally at heater control panel shall be available through building automation system.

2.4 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

B. Multiple heaters shall be provided with a pre-wired power supply to heaters and heaters pumps with an individual service disconnect for each heater for a single-point field electrical connection.

1. Electrical Characteristics:

a. Volts: 208-240 V.
b. Phase: Single/Split
c. Hertz: 60.
d. Full-Load Amperes: see Schedule.
e. Minimum Circuit Ampacity: see Schedule.
f. Maximum Overcurrent Protection: see Schedule.

2.5 PLUMBING KITS

A. The Heater shall be provided with pre-piped manifolds for single point supply and return connections per one of the following:

1. The manifolds shall be copper reverse return piping to eliminate any unwanted residual flow through off heaters. Each heater pump assembly shall have flanged 1/4-turn full port brass ball valves for isolation. Package shall be Lead Free and rated for design pressure applications. Piping shall be constructed in such a fashion as to allow it to remain in its finished position during shipping. All piping shall be air tested to a minimum of 100 PSI and checked to be free of leaks; all ball valves will be cycled during this pressure test to ensure their integrity. Piping is sized for maximum flow rate of package specification.
2. ABH Lead Free Compliance see Technical Bulletin TB028

B. The Heater shall have a common gas manifold constructed of welded or threaded black steel pipe and shall contain a drip leg at the single point gas connection. The common gas manifold shall contain corrugated stainless steel flexible tubing to each heater, as well as an individual brass ¼ turn gas-rated shutoff valve. The entire gas piping system shall be factory engineered and installed prior to shipment. Piping shall be constructed in such a fashion as to allow it to remain in its finished position during shipping. All piping shall be air tested to a minimum of 30 PSI and checked to be free of leaks; all ball valves will be cycled during this pressure test to ensure their integrity. Piping is sized for maximum flow rate.

2.6 DIGITAL MIXING VALVE

A. The Heater shall be provided with pre-piped manifolds including The Brain Model Digital Recirculating Valve (DRV).

1. Re-Circulating Valve shall be digital of lead-free stainless steel/polymer construction
2. DRV shall have no minimum system draw off requirement
3. DRV shall have all of the following operational capabilities:

a. +/- 2F water temperature control
b. 2F minimum inlet to outlet water temperature differential
c. Automatic shutoff of hot water flow upon cold water inlet supply failure
d. Automatic shutoff of hot water flow in the event of a power failure
e. Programmable set point range of 81-158°F (27-70°C)
f. Programmable thermal disinfection mode
g. Programmable 1st level hi/lo temp alarm display
h. Programmable temperature error level for safety shutdown

4. DRV shall have all of the following connectivity capabilities:

a. SPCO relay outputs which are energized during operation
b. LCD display which indicates: set point, delivered temperature, error codes and alarm conditions
c. MODBUS 485 port for remote set point adjustment and remote operating temperature visibility
d. RS485 Serial Port for connection to a performance matched hot water monitoring system

5. DRV shall be compliant with ASSE Standard 1017 and CSA B125 and so certified and identified
6. DRV shall be UL listed and identified

2.7 VENTING KITS

A. The Heater shall have common vent manifolds constructed of AL 29-4C stainless steel rated to minimum of 5” w.c. positive pressure and shall contain the appropriate pitch for condensate to drain. The common vent manifolds shall each contain (2) condensate drain fittings that shall be routed through a condensate trap containing a removable clean-out cap and then on to the Factory supplied Condensate Neutralizer. There shall be no more than two vent pieces per heater in addition to the required condensate drain fittings for the entire common vent manifold. Common vent manifolds shall carry the UL 795 approval, each system shall have up to (8) heaters with (1) combustion air manifold and (1) exhaust vent manifold. Systems utilizing individual heater vent/air piping shall not be allowed.

2.8 SOURCE QUALITY CONTROL

A. 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 combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled heaters, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality control testing of Heaters. Notify Architect 14 days in advance of testing.

3.0 EXECUTION

3.1 EXAMINATION

A. Before heater installation, 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 heater performance, maintenance, and operations.

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

B. Examine mechanical spaces for suitable conditions where heaters will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HEATER INSTALLATION

A. Install heaters on factory-supplied rack as required based on manufacturers installation instructions. Heaters must be installed level and anchored to floor or wall as required.

B. Install gas-fired heaters according to NFPA 54.

C. Assemble and install heater trim.

D. Install electrical devices furnished with heater but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to heater to allow service and maintenance.

C. Install piping from condensate neutralizer drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect gas piping to heater gas-train inlet with union/ flange. Piping shall be at least full size of gas train connection. Provide a reducer if required.

E. Connect hot-water piping to supply- and return-heater piping.

F. Connect cold-water piping to supply.

G. Install piping from safety relief valves to nearest floor drain.

H. Heater Venting:

1. Install flue venting kit and combustion-air intake kit (as provided).
2. Flue venting and combustion air intake must be installed in accordance with NFPA 54 and all manufacturer's installation instructions.
3. The flue shall be PVC, CPVC or AL29-4C sealed, category IV vent material. The air inlet pipe may be PVC, CPVC, ABS or AL29-4C sealed pipe.
4. Connect full size to heater connections (unless otherwise specified during design). [Comply with requirements in Section 235100 "Breechings, Chimneys, and Stacks."]

I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections [**with the assistance of a factory-authorized service representative**]:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit breaker trip ranges as indicated.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

F. Occupancy Adjustments: When requested within [**12 months of date of Substantial Completion**] <**Insert time period**>, 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.

G. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Heaters shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of heaters.

    a. Test for full capacity.
    b. Test for heater efficiency at [**low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20**] <**Insert range**> percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain heaters. [**Video training sessions.**] Refer to Section 017900 "Demonstration and Training."

END OF SECTION