



Part 1 – GENERAL

1.1 SCOPE

- A. The work to be performed includes all new equipment, labor and materials required to furnish and install high-efficiency Pulse hydronic boilers as described in this specification.

1.2 REFERENCES

- A. ASME Section IV.
- B. ASME CSD1 – Controls and Safety Devices
- C. ANSI Z21.13
- D. GE GAP
- E. NEC – National Electric Code
- F. CSA

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model, weights (shipping, installed, and operating), installation and start-up instructions, along with furnished accessory information.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for boilers including ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacturing of Pulse combustion, ultra-high efficiency, condensing boilers, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 20 years.
- B. The hot water boiler maximum working pressure will be 160 PSIG.
- C. The Pulse Boiler Flame Safeguard Control will be of an accepted quality manufacturer bearing UL Certification.

- D. The entire boiler system and its installation shall conform to the manufacturer's instructions, applicable codes and associated National Board requirements.

1.5 WARRANTY

- A. The boiler manufacturer shall guarantee in writing the equipment to be free of defects for one year after start-up date or 18 months from factory shipment, and to repair or replace at the manufacturer's expense any defective parts. Unit shall receive such factory tests as are deemed advisable by the manufacturer.
- B. Each boiler shall be completely tested before leaving the manufacturing factory. This includes a hydrostatic pressure test prior to final assembly and factory test fired prior to shipment. Combustion must be set on all fuels and all firing rates. A factory test fire report and wiring diagram shall be provided with each boiler.
- C. The pressure vessel shall be guaranteed against thermal shock for 10 years (non-prorated) when utilized in a closed loop hydronic heating system with a maximum temperature differential rating of up to:
 - a. Carbon Steel Units: 170 degrees Fahrenheit
 - b. Duplex Alloy Steel Units: 100 degrees Fahrenheit.The boiler pressure vessel shall be guaranteed accordingly without a minimum return water temperature requirement. The boiler shall not require the use of flow switches or other devices to ensure a minimum flow through the boiler.
- D. The pressure vessel shall carry a 10-year warranty against material and workmanship defects. This warranty shall be non-prorated for the first 7 years and years 8-10 shall be pro-rated as per schedule posted on the current product warranty.
- E. The combustor and exhaust pipes (heat exchanger) shall be guaranteed against flue gas corrosion for a period of 10 years on carbon steel boilers or duplex alloy steel boilers. This warranty shall be non-prorated for the first 7 years and years 8-10 shall be pro-rated as per schedule posted on the current product warranty.
- F. All parts not covered by the above warranty shall carry a one-year warranty. This shall include all electrical and burner components.

Part 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The specification is based on products as manufactured by Fulton Heating Solutions, Inc, Pulse PHW Series.
- B. Basis of design: Fulton Heating Solutions, Inc. Model PHW- [300, 500, 750, 1000, 1400, 2000].
- C. The boiler heat exchanger must be designed and built by the manufacturer whose name is on the finished product. Heat exchangers shall not be designed or manufactured by a third party.

2.2 BOILER CONSTRUCTION

- A. The exhaust decoupler shall be constructed of a ¼" corrosion resistant Corten alloy and include a flue gas condensate drain connection.
- B. The pressure vessel shell shall be SA-53B ERW pipe or SA-285 Grade C plate.
- C. Combustion chamber flue pipes will be constructed of SA-790 Grade 2205 Duplex Alloy Steel or SA-53 Carbon Steel.
- D. The heads shall be:
 - a. SA-516 Grade 70 plate (PHW-300, 500, 750, 1000)
 - b. Steel dished heads (PHW-1400, PHW-2000)
- E. The pressure vessel shall be fully insulated with 2" of high temperature insulation. Jackets shall be insulated with ¼" thick high density board insulation with an internal heat reflective coating.
- F. The pulse combustor location shall be such that all combustor assembly components are located within water-backed areas.
- G. The boiler's pressure vessel, combustor, and exhaust decoupler shall be encased in an 18 gauge metal cabinet with primer and finish coat of paint.
- H. Boilers utilizing the following metals in the heat exchanger designs are not acceptable:
 - a. Copper
 - b. Stainless Steel in a 300 Series grade
 - c. Cast Aluminum
 - d. Cast Iron
- I. Boilers utilizing a coating, paint or lining in the condensate collection areas are not acceptable.
- J. Maintenance shall be able to be performed on burner or boiler assembly without the necessity to wear respiratory protective equipment.

2.3 BOILER DESIGN

- A. The boiler shall be a fire tube design, utilizing the principles of pulse combustion. The boiler shall be self-aspirating and require no forced or induced draft fan to supply air for combustion after ignition.
- B. External convection and radiation heat losses to the boiler room from the boiler shall be less than 0.5% of the rated boiler input. The boiler shall not contain any refractory, refractory lining or ceramic in the furnace or firebox.
- C. The boiler shall be designed for operation in a condensing mode, in order to extract the latent heat from the combustion products. The boiler shall have a minimum acceptable fuel-to-water efficiency of 91% at a return water temperature of 80 degrees F and at the full rated input capacity of the boiler. Overall efficiency of the low fire rated input capacity will be 98%.
- D. The boiler shall be able to operate without the use of a three-way valves or primary/secondary piping loops.
- E. The boiler shall have no return water temperature requirements.

- F. The boiler's manufacturer recommended annual replacement parts shall cost no more than \$500 to the end customer.
- G. The boiler shall be able to be utilized in applications with up to 100% glycol. Ethylene or propylene glycol is acceptable, and no inhibitors shall be required.
- H. The water flow pressure drop through the boiler shall not be greater than:
 - a. PHW-300 & PHW-500 – 11 FT @ 100 GPM
 - b. PHW-750 & PHW-1000 – 10 FT @ 125 GPM
 - c. PHW-1400 – 12 FT @ 140 GPM
 - d. PHW-2000 – 20 FT @ 350 GPM
- I. The dry weight of the boiler shall not be less than:
 - a. PHW-300 & PHW-500 – 1,395 LBS
 - b. PHW-750 & PHW-1000 – 1,800 LBS
 - c. PHW-1400 – 2,230 LBS
 - d. PHW-2000 – 2,900 LBS
- J. The water volume of the boiler shall not be less than:
 - a. PHW-300 & PHW-500 – 34 Gallons
 - b. PHW-750 & PHW-1000 – 42 Gallons
 - c. PHW-1400 & PHW-2000 – 75 Gallons

2.4 CONTROLS

- A. The flame safeguard system shall be Fulton Model RM7865 with an LED display module. The control shall provide a 35-second pre-purge and post-purge. The control shall maintain a running history of operating hours, number of cycles, and the most recent six faults. The control shall have the capability to be connected to a keyboard display module that will retrieve this information.
- B. Pulse combustion controls shall include the following:
 - a. Operating Temperature Controller for automatic start/stop of the pulse combustion process. The controller will have auto-tune PID capabilities for simplified loop configuration and fast response to water temperature fluctuations. A Type J temperature sensor shall be located in the boiler pressure vessel.
 - b. High limit temperature aquastat with manual reset.
 - c. One low water cutoff probe in the boiler shell with manual reset and push-to-test capability.
 - d. Air safety switch to prevent operation unless sufficient pre-purge air is assured.
 - e. High condensate cut-off probe located in the exhaust decoupler.
 - f. A Proof of Flame switch and Flame Rod operating in parallel, to prove combustion.
- C. A combustion control system shall be furnished which provides a turndown ratio of 5:1 (3:1 for LPG fired boilers) over the input range from high to low fire. The supply temperature and setpoint temperature shall be displayed at all times by the operating temperature control. Firing rate shall be controlled by a continuous 4-20mA analog signal to a modulation motor.
- D. Boilers shall have infinite modulation between 20% and 100% firing rates.
- E. Boilers shall not be configured for turndown greater than 5:1 for field operation.

- F. Boilers shall not operate with excess air percentages greater than 50 percent at any firing rate.
- G. Circuit boards of any type shall not be allowed in the control schematic design.
- H. All controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and also located to prevent possible damage by water according to CSA requirements. Electrical power supply shall be 120 volts, 60 cycle, single phase, 10 amps maximum. Boiler shall draw less than 1 Amp while in run mode. No additional electric power shall be required for devices such as forced draft fans.
- I. When multiple boilers are to be installed in a common hydronic loop, a Fulton ModSync Boiler Sequencing System shall be provided to stage the boilers. Boilers that have simple lead-lag capabilities built into the control on each boiler are not acceptable; the sequencing must be done by a separate panel. Boiler manufacturers who do not manufacture their own sequencing panel are not acceptable.
 - a. Please refer to the ModSync specifications for complete details on the requirements on the multiple boiler sequencing system requirements.

2.5 MAIN GAS TRAIN COMPONENTS

- A. The boiler shall have an integral gas train, factory assembled and installed.
- B. The gas train shall be CSD-1 code compliant.
- C. The main gas train will include:
 - a. One manual shut-off valve at gas inlet.
 - b. Gas inlet trap.
 - c. Gas regulator rated for maximum 14" WC supply pressure.
 - d. Two safety shut off valves. One to be a solenoid and one to be a motorized valve.
 - e. Independent low and high gas pressure switches shall be supplied.
- D. The boiler manufacturer shall have the capability of providing a dual fuel gas train with natural gas and propane.
- E. The boiler manufacturer shall have the capability of providing custom gas trains upon request.

2.6 BOILER FITTINGS

- A. The boiler shall be supplied with an ASME Section IV approved, side outlet type safety relief valve. The safety relief valve size shall be in accordance with ASME code requirements.
 - a. Trim pressures from 30 PSIG through 160 PSIG shall be available.
- B. A temperature/pressure gauge shall be supplied with each boiler.
- C. A Fulton condensate drain kit will be provided to collect and drain the flue gas condensate.

2.7 INSTALLATION

- A. The boiler shall be CSA approved as a direct vent boiler. A conventional chimney or stack shall not be required. Direct venting shall be accomplished with AL294C stainless steel, single or double wall. Vent

pipng shall be installed in accordance with applicable national and local codes and per the boiler manufacturer's recommendations.

- B. The boiler shall have the outside combustion air intake supply ducted with PVC pipe, or approved equivalent pipe.
- C. The boiler shall have the exhaust piping ducted with AL294C pipe, as approved for Category IV boilers.
- D. An air intake muffler shall be provided by the boiler manufacturer and mounted within 10 feet of the boiler intake connection. An exhaust muffler shall be provided by the boiler manufacturer and mounted within 10 feet of the boiler exhaust connection.
- E. It shall be acceptable to install any number of PHW boilers side by side with 1" clearance between units.

2.8 EMISSIONS

- A. The boiler shall operate with CO emissions less than 100 PPM corrected to 3% O₂ and shall operate with NO_x emissions less than 55 PPM corrected to 3% O₂ over the entire turndown range.
- B. Low Emissions Requirements: For models PHW-750, 1000, 1400 and 2000, the boiler shall have the option of operating with CO emissions less than 50 PPM corrected to 3% O₂ and shall operate with NO_x emissions less than 30 PPM corrected to 3% O₂ over the entire turndown range.

2.9 OPERATING MANUAL

- A. Instructions for installation, operation and maintenance of the boiler shall be contained in a manual provided with each boiler unit.
- B. A wiring diagram corresponding to the boiler configuration shall be permanently affixed to the boiler near the electrical panel.

Part 3 – EXECUTION

3.0 INSTALLATION

- A. Equipment and materials shall be installed in an approved manner and in accordance with the boiler manufacturer's installation requirements.
- B. The installer shall construct a level continuous concrete pad (minimum 3.5 inches high) for the entire boiler system according to the boiler manufacturer's erecting instructions.
- C. Assemble unit sections and parts shipped loose or unassembled for shipment purposes. Follow manufacturer's installation recommendations and instructions.
- D. Install electrical control items furnished by the manufacturer per wiring diagram provided by the manufacturer.
- E. Complete water piping installation as required by the manufacturer for operation of the system.
- F. Provide air intake and exhaust piping, size and type as recommended by the manufacturer.
- G. Provide boiler manufacturer recommended manifold pipe and fittings from each boiler to the nearest floor drain or as indicated.

3.1 FIELD QUALITY CONTROL

- A. After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator.
- B. Arrange with National Board of Boiler and Pressure Vessel Inspectors for inspection of boilers and piping. Obtain certification for completed boiler units, deliver to Owner, and obtain receipt.