

SECTION 23 52 23

CAST-IRON BOILERS

PART 1 DESIGN REQUIREMENTS

1.01 REFERENCES

- A. AGA - Directory of Certified Appliances and Accessories.
- B. AGA Z21.13 - Gas-Fired Low-Pressure Hot Water Boilers.
- C. ASME Section IV - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.
- D. ASME Section VIII, Div 1 - Boiler and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 54 (AGA Z223.1) - National Fuel Gas Code.
- G. NFPA 70 - National Electrical Code.
- H. IRI - Industrial Risk Insurers - Fuel Gas Safety Requirements.

1.02 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70 code for internal wiring of factory wired equipment.
- B. Conform to ASME Boiler and Pressure Vessel Code Section IV for construction of heating boilers.
- C. Units: AGA certified.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc.
- E. Must meet CSDI standards/requirements.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Component and accessories list.
 - 2. Ratings and nameplate information.
 - 3. Finishes and colors.
 - 4. Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections
 - 5. Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.
- B. Drawings:
 - 1. Final control or specification drawing.
 - 2. Final assembly or outline drawing and list of parts.
 - 3. Dimensioned drawings.
 - 4. Wiring schematic.
 - 5. Wiring connection diagram or wire list.
- C. Quality Assurance Data:
 - 1. Certified production test reports or mill test reports.
 - 2. Test reports for previous design, and documentation showing previous design ratings and configurations.

3. Provide appropriate certificates of shop inspection and field assembly inspection as specified by ASME Code when required.
 4. IRI approval application form, where applicable.
 5. Manufacturer's field reports: Indicate specified performance and efficiency has been met or exceeded. Provide combustion test which shall include boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- D. Project Record Documents:
1. Shop Drawings:
 - a) Certified elevation and outline drawings with dimensions.
 - b) Certified plan view drawings with dimensions.
 - c) Wiring and termination drawings.
- E. Operation and Maintenance Data:
1. Operating and maintenance procedures.
 2. Complete set of manufacturers drawings.
 3. Complete documentation of inspections and tests performed, including any logs, curves, and certificates. Documentation shall note any replacement of equipment or components that failed during testing.
 4. Spare parts lists.
 5. Data sheets updated to reflect field installation conditions.
 6. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.05 WARRANTY

- A. All equipment provided shall be warranted against defects in workmanship and material for a period of twenty-four months after start-up and acceptance of the operation of the boiler by the owner. All defective material shall be replaced with no charge to the owner. Labor for replacement of defective parts shall be provided by the manufacturer. Warranty does not cover any parts replacement due to damage in shipment, exposure to weather or improper installation.

1.06 COMMISSIONING

- A. Factory start-up and commissioning shall be required. The factory start-up representative shall be responsible for all commissioning through the project turn-over to DPS. Field modifications and adjustments shall be made by a factory trained representative, not the installation contractor.

PART 2 DESIGN REQUIREMENTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Steam Boilers:
 1. Burnham
 2. Weil-Mclain
- B. Burners:
 1. Riello

- C. Controls: Siemens LMV5/linkageless burner controls.

2.02 GENERAL BOILER REQUIREMENTS

- A. The boiler(s) shall be of a low pressure, cast iron, wet base forced draft design and shall be tested and rated in accordance with the current edition of The Hydronics Institute Division of GAMA “Testing and Rating Standard for Heating Boilers”. Atmospheric boilers shall be allowed only where space limitation preclude the use of multiple force draft boilers.
- B. The boiler(s) shall be listed in the I=B=R Ratings Directory and shall be capable of developing full I=B=R listed output at 100 percent firing rate, and shall bear the I=B=R Emblem.
- C. The boiler(s) shall be constructed in accordance with the provisions of the ASME Boiler and Pressure Vessel Code and shall be stamped with the required ASME symbol.
- D. Each boiler section shall be hydrostatically pressure tested for one and a half times greater than its working pressure.
- E. The boiler(s) shall be factory assembled where conditions allow. If field conditions do not allow factory assembled boiler(s), the boiler(s) shall be field assembled and hydrostatically tested in accordance with the manufacturer’s installation instructions. All work shall be completed in a neat and workmanlike manner.

2.03 BOILER CONSTRUCTION FEATURES

- A. The boiler sections shall be assembled using individual draw rods between each section for ease of assembly and to evenly distribute tension between the sections.
- B. The boiler shall be a complete unit with all required parts to operate gas train, controls, etc.
- C. The boiler shall comply with State and City codes.
- D. Each section shall be evenly spaced with spacing pads and high temperature sealing rope shall be used to provide a permanent gas-tight seal between the sections.
- E. The boiler(s) sections shall be of a wet base design to provide a complete water backed heating surface around the combustion chamber area for maximum heat transfer and low floor temperatures.
- F. The boiler(s) shall be furnished with top and front cleanout plates for ease of inspection and cleaning of the flueways. The cleanout plates shall be sealed to the boiler with high temperature gaskets and/or high temperature sealing rope.
- G. The boiler(s) shall be furnished with an integral cast iron flue collector and a cast iron flue outlet.
- H. The boiler(s) shall be provided with a fibrous ceramic refractory chamber liner and target wall to protect the base of the firebox and the back section. Chamber liner shall be secured in a factory approved manner to the firebox to prevent movement of liner during start-up. Liner shall be 8lbs, density and two (2) inches thick.
- I. The boiler(s) shall be provided with an insulated burner mounting plate with the necessary tappings for mounting the burner(s).
- J. The boiler(s) shall be provided with pyrex glass front and rear flame observation ports to permit visual inspection of the burner flame.
- K. The boiler(s) shall be provided with an insulated steel flush jacket with a painted finish. The jacket shall be designed to permit installation after the supply and return piping is connected.
- L. The boiler(s) shall be furnished with steel channel rails to provide a level and smooth surface for ease of assembly.

2.04 INSPECTION TAPPINGS

- A. Boiler(s) shall have inspection tappings as specified per manufacturer.

2.05 BOILER TRIM AND CONTROLS

- A. The boiler(s) shall be provided with a safety valve set to relieve at 15 PSIG. The valve shall conform to Section IV of the ASME Boiler and Pressure Vessel Code.

- B. The boiler(s) shall be provided with a vacuum-PSI steam gauge to indicate boiler pressure. Steam gauges shall be 6" diameter minimum.
- C. The boiler(s) shall be provided with a 157S low water cut off with gauge cocks. Water gauges shall include a sight glass with a red background. Provide tri-cocks on sight glass(es) as required by the DPS standards.
- D. The boiler(s) shall be provided with an operating pressure control and a manual reset high limit pressure control.
 - 1. Model #L404f1060/L4079B 1033 MR.
- E. The boiler(s) shall be provided with a float type and probe type low water cut-off with manual reset.
- F. Provide manual bypass switch on the boiler control panel such that the boiler(s) can be manually operated independent of the building automation system.
- G. Provide and install a Killam model 1-1/4 GFLD flow-meter with a ball valve for shut off or approved equal. The flow-meter shall act as a gas leak detection gauge and shall be installed between the two gas valves on the gas train.
- H. Make-up water feed valves shall be fast acting valves manufactured by ASCO. End switches shall not be installed. Each boiler shall be provided with an independent make-up water valve. In addition to the automatic fill valve, a manual fill shall be installed down stream of the automatic valve.
- I. Provide and install a steam trap on all Hartford loops.
- J. Provide and install a pressure sensor on the main steam supply header. The pressure switch shall be utilized to control the boiler heating stages. Staging of the boilers shall be capable of changing the order of the lead/lag boilers.
- K. The boilers shall be equipped with a low fire hold controller installed in the boiler control sequence of operation. High fire should not be utilized until the boiler temperature reaches a minimum of 160 degrees.

2.06 DRAFT CONTROL DAMPER AS NEEDED PER JOB

- A. An automatic draft control system shall be installed in all steam boiler systems. Barometric shall not be allowed. The drafter control system shall be engineered to insure that the flue system is properly drafting. Draft control system shall include dampers and fans as required to accomplish the desired operating condition.

2.07 GAS BURNERS

- A. General Requirements:
 - 1. Furnish and install Underwriters' Labeled gas burners. The burner design, construction, components and installation shall meet all applicable code requirements.
 - 2. Provide mounting plate constructed with high temperature castable insulation refractory, 1" thick 1900 degree F insulating block, 2-inch IPS site glass to observe flame, and all necessary 304SS anchor bolts sized for boiler furnace diameter.
- B. General Burner Description:
 - 1. The burners shall be forced draft flame retention model. Each burner shall be capable of burning 1000 BTU/Cu. Ft. natural gas (840 BTU/CF @ 5,200 ft. elevation), with a specific gravity of approximately 0.65 to provide the capacity rating of the existing burner to be replaced. Project Altitude is approximately 5,280 Ft above sea level.
 - 2. Gas pressure applied to the burner gas train supply connection shall be a minimum of 18 In. W.C., 7-11" W.G. for natural draft, or 14" W.G. for forced draft.
- C. Approval Codes:
 - 1. Each burner shall be listed by Underwriters Laboratories and shall bear the appropriate U.L. label (in addition to the U.L. requirements, all equipment and installation procedures will meet the requirements of IRI codes.

- a) Siemens LMV51 linkage less Burner Control System.
 - b) Remote mounted burner control panel with main power disconnect switch.
 - c) Burner On/Off switch.
 - d) Alarm horn/bell with silencing switch.
 - e) Bacnet MSTP communications.
 - f) Control circuit transformer (fused).
 - g) Enable/Disable, General Fault, EPO, CAD terminals.
 - h) UL/FM/CSD-1 compliant.
 - i) Dual block pilot gas train.
 - j) Valve proving function with factory installed gas pressure switch.
 - k) Dual POC switches within FM gas train.
 - l) Temperature sensor for low fire hold (low fire hold to be performed by the Siemens LMV51 -not an aquastat).
 - m) Indicator lights for pilot on, low water, high limit, main gas on, power, call for heat.
 - n) QRI flame scanner.
 - o) 0-10vdc steam pressure transducer.
 - p) Remote/local switch.
 - q) 4-20ma remote modulation capable.
 - r) Siemens SKP15/SKP25 VG series gas valves with regulator.
 - s) Human interface.
- D. Combustion Head Design:
- 1. Each burner shall be of welded steel construction. The combustion head shall incorporate a multi blade, stainless steel, flame retention diffuser. The gas firing head shall be of the multi-port type and constructed such as to place annular gas distribution opening between two parallel air flow streams to achieve maximum fuel/air mixing. Burners with cast alloy blower housings will not be accepted.
 - 2. All air required for combustion shall be supplied by a blower mounted integral to the burner. The blower wheel shall be of the forward curved centrifugal design and shall be directly driven by 208 volt or 460 volt (as indicated on drawings and per DPS Section 15170), 60 Hertz 3 phase motor.
- E. Ignition Systems:
- 1. The burner ignition system which will light the main gas flame and shall utilize natural gas as the fuel source. The gas pilot system components shall include spark ignited pilot assembly, ignition transformer, pilot solenoid valve, pilot gas pressure regulator (Maxitrol 325-3 or equivalent) and manual gas ball valve shutoff cock. The flame proving system shall incorporate a Fireye Ultra-Violet flame detector which will monitor both the pilot and main flames. The pilot assembly shall fit within the confines of the blast tube - avoiding special burner front plate pilot cut outs.
- F. Fuel/Air Control System:
- 1. Modulation - The main on-off gas supply shall be controlled by a motorized gas valve. A modulating motor shall control the modulated positioning of the draft dampers, butterfly type gas proportioning valve to best meet varying system load conditions.
- G. Gas Control Train:
- 1. U.L. Requirements

2. The gas valve train shall contain the following:
 - a) (2) Manually lubricated shutoff valves.
 - b) Main gas pressure regulator: Maxitrol 210E – 100 percent lockup.
 - c) Manual reset high gas pressure switch: match existing or if new, Honeywell 0437D-1005 or similar.
 - d) Pressure tap on gas line upstream of main gas regulator.
 - e) Manual UL listed leak test cock.

H. Burner Operating Controls:

1. Steam Boiler:
 - a) The on-off operation of the burner shall be controlled by a pressure control. System pressure shall be controllable from 5-15 psig - adjustable. Refer to drawings for setpoint.
 - b) A safety manual reset type limit control shall be provided to shut the burner down in the event of excessive pressure.

I. Control Panel:

1. Appropriate electrical knockouts shall be provided on both sides of the panel to allow for necessary power and limit control wiring. The control panel shall be constructed of 16 gauge steel and shall be complete with a top switch and control section which shall be hinged to allow for full access to all panel mounted components. The control panel shall be painted in a color and finish identical to the burner being supplied.
2. The control panel shall include a control circuit transformer fused on both the primary and secondary windings - flame safeguard control as specified above - on-off switch - gas/oil selector switch - motor starters, relays, terminal blocks and other electrical devices as required.
3. Control Panel Options:
 - a) The control panel shall also include an alarm bell with automatic reset silencing switch. The bell shall ring on flame failure or low water condition.
 - b) Relay for DDC interface to allow for run enable signal from the building management system.
4. Control drawing shall be posted in the control panel.
5. Burner start up and test data form shall be posted in the control panel.
6. Provide manual bypass switch on the boiler control panel such that the boiler(s) can be manually operated independent of the building automation system.
7. The vent lines from the gas regulators shall be installed with steel piping. Soft copper or aluminum tubing shall not be installed.
8. Power disconnect switch to the boiler control panel shall be mounted on the side of the panel.

J. Product Liability Insurance:

1. The burner manufacturer will provide an insurance certificate documenting current coverage of product liability insurance.

K. Burner Start Up Information and Test Data:

1. On completion of the burner system start up – the burner manufacturer will complete the “Burner Start Up Information and Test Data” form.

PART 3 EXECUTION

3.01 BURNER INSTALLATION

A. General:

1. Install burners and components in accordance with manufacturer's installation instructions, state and local code requirements, and local utility company requirements.
2. Maintain manufacturer recommended clearances.
3. Coordinate the installation of the burners and associated components with the building owner.
4. If there is a multiple boiler installation, only one boiler shall be taken out of service at a time unless approved by DPS.

B. Electrical Work:

1. All wiring to be stranded.
2. Furnish a copy of manufacturer's wiring diagram submittal to Electrical Installer.
3. Verify that electrical installation is in accordance with manufacturer's submittal.
4. Do not proceed with startup until electrical work is acceptable to burner equipment manufacturer.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Division 23.
- B. Provide field representative for starting unit, training operator, and testing unit.

3.03 START-UP INFORMATION AND TEST DATA FORM

- A. See burner start-up information and test data form.

3.04 BOILER INSTALLATION

- A. Boilers shall have start-up, testing, adjusting, instruction of owners operating personnel and 90 days free service by factory-authorized service representative start-up personnel who are on 24 hour call.
- B. Perform installation and startup checks according to manufacturer's written instructions.
- C. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exists. Each boiler section shall be one and a half times greater than its working pressure.
- D. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Adjust temperature initial set points.
- G. Set field-adjustable switches and circuit breaker trip ranges as indicated
- H. Occupancy Adjustments: When requested within 24 months of date of substantial completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.
- I. Prepare written report that documents testing procedures and results.
- J. All conduits shall be supported above the floor. No conduits shall be on the floor.
- K. Provide and install pigtailed on all gauges.
- L. The boiler relief valve(s) and low water cut-off (s) shall drain to the nearest floor drain.
- M. Provide and install eccentric fittings on the drains from the boiler(s). Concentric fittings shall not be installed. Boiler drains, LWCO, steam skimmers and the like, from the boiler shall be piped to the nearest floor drain.
- N. The vent lines from the gas regulators shall be installed with steel piping. Soft copper or aluminum tubing shall not be installed. Unions shall be installed within 12 inches of each appliance for ease of removal.
- O. Pilot piping for power burners shall be hard piped with steel piping, soft metal such as aluminum shall not be accepted.

3.05 BOILER FOUNDATION

- A. A concrete housekeeping pad shall be provided. Housekeeping pads shall be constructed to provide a level and structurally sound support for the boiler(s) with steel skids for boiler to sit on.

3.06 FIELD QUALITY CONTROL

- A. Site Tests.
- B. Inspection.
- C. Manufacturer’s Field Services.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train owner’s maintenance personnel and custodial staff to adjust, operate, and maintain boilers. Provide a minimum of four (4) hours of on-site training with instruction manuals and procedures.

Please coordinate with Mechanical QAQC to received reference sheet.

BURNER START-UP AND TEST DATA FORM

The following information should be filled in by the burner manufacturer at start-up or after any adjustment to the burner. A copy of the Start-up Report MUST be returned to the Owner or Owners Representative.

Burner Model _____ Serial Number _____ Start-up Date _____

Burner Manufacturer _____ Start Up Contractors Name _____

Name of Technician Performing Start up _____

| TEST CONDUCTED | GAS | | | OIL | | |
|-----------------------------------|-----|-----|------|-----|-----|------|
| | LOW | 50% | HIGH | LOW | 50% | HIGH |
| Firing Rate | | | | | | |
| Stack Temp (Gross) F | | | | | | |
| O2% | | | | | | |
| CO2% | | | | | | |
| CO (PPM) | | | | | | |
| NOx (PPM) | | | | | | |
| Smoke (Bacharach) | | | | | | |
| Combustion Eff% | | | | | | |
| Stack Draft | | | | | | |
| Furnace Pressure | | | | | | |
| Blast Tube Pressure | | | | | | |
| Steam Pressure | | | | | | |
| Water Temperature | | | | | | |
| Supply Oil Pressure | | | | | | |
| Return Oil Pressure | | | | | | |
| Oil Temperature | | | | | | |
| Atom, Air Pressure | | | | | | |
| Gas Pressure @ Regulator Inlet | | | | | | |
| Gas Pressure @ Burner Manifold | | | | | | |

| PILOT GAS PRESSURE @ REGULATOR OUTLET | | | | | | |
|---------------------------------------|--|--|--|--|--|--|
| Flame Signal Pilot | | | | | | |
| Flame Signal Main | | | | | | |
| Ambient Temperature F | | | | | | |

| AMBIENT TEMPERATURE F | | | | | | |
|----------------------------|-------------|------------------|----|----------|----|----|
| ELECTRIC MOTORS | VOLTAGE | | | AMPERAGE | | |
| | L1 | L2 | L3 | L1 | L2 | L3 |
| Control Voltage | | | | | | |
| Blower Motor | | | | | | |
| Air Compressor | | | | | | |
| Air-Oil or Metering | | | | | | |
| | | | | | | |
| CONTROL CHECKS | TEST | SET POINT | | | | |
| Low Water C.O. | | | | | | |
| Aux. LWCO | | | | | | |
| Low Water Alarm | | | | | | |
| High Water Alarm | | | | | | |
| Operating Limit | | | | | | |
| High Limit | | | | | | |
| Operating Control | | | | | | |
| Stack Temp Interlock | | | | | | |
| Flame Failure | | | | | | |
| Combustion Air Switch | | | | | | |
| High Purge Switch | | | | | | |
| Low Fire Interlock | | | | | | |
| Oil Pressure Switch | | | | | | |
| Oil Valve P.O.C. Interlock | | | | | | |
| Atomizing Air Switch | | | | | | |
| High Gas Pressure Switch | | | | | | |
| Low Gas Pressure Switch | | | | | | |
| Gas Valve P.O.C. Interlock | | | | | | |
| | | | | | | |
| FOR LOW NOX BURNERS | | | | | | |
| Blast Tube Temp. Interlock | | | | | | |
| FGR Line Purge Switch | | | | | | |
| FGR Valve P.O.C. Switch | | | | | | |

END OF SECTION 23 52 23