

SECTION 15555

BOILERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Inclined Water Tube, Hot Water, Forced Draft
2. Flexible Tube, Hot Water, Forced Draft
3. Section Cast Iron, Hot Water, Forced Draft
4. High-Efficiency Compact Boiler

B. Related Sections:

1. Section 15010 - Basic Mechanical Requirements.
2. Section 15050 - Basic Mechanical Materials and Methods.
3. Section 15190 - Mechanical Identification.
4. Section 15575 - Breechings, Chimneys, Stacks and Flues.

1.02 REFERENCES

- A. American Gas Association (AGA).
- B. Institute of Boiler and Radiator Manufacturers (I-B-R).
- C. American Society of Mechanical Engineers (ASME).

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. General:

- a. This Section will be expanded to include central steam plant boilers at such time as an expansion or rehabilitation of the existing central plant is required.
- b. Boilers included at this time in this Design Guide Section are intended for structures which are constructed outside the practical limits of the campus central steam distribution system and have access to natural gas from Public Service Company utility distribution system.
- c. Design these systems as simple hot water hydronics systems to meet building heating requirements.
- d. Consult with University regarding insurance requirements for gas train.
- e. Whenever possible Specify the positive-pressure requirements at the collar of forced-draft boilers.
- f. Specify Honeywell series 7800 Burner Control.

PART 2 - PRODUCTS

2.01 BOILER (INCLINED WATER TUBE), Hot Water, Forced Draft

A. Manufacturers:

Ajax
Rite

B. Type:

Forced Draft inclined water tube boiler. Factory-assembled and tested. Non-condensing design to operate at 80% efficiency.

C. Construction:

1. Tube bundle assembly to consist of steel tubes, 2" diameter supported by steel frame with expansion joints at each corner. Headers to be 5/8" pressure vessel steel.
2. Tubes to be sloped upward at 1/2" per linear foot from rear to front to eliminate air bubbles.
3. Tube bundle assembly to be free-floating to prevent thermal shock damage.
4. Head gaskets to be full-face fabric reinforced neoprene, 3/16" thick.
5. Jacket to be 18 gauge galvanized or painted steel.
6. Larger models to be mounted on I-beam skids.

D. Pressure rating:

1. 125 psi working pressure, ASME stamped.

E. Burner: Forced Draft

1. U.L. Listed forced draft automatic burner for operation with pressurized vent stack without barometric damper or induced draft fan.
2. Burner to be designed to burn natural gas
3. Electronic supervised spark ignition
4. Burner operation to be Modulating Firing
5. Burner Safety Controls:
 - a. Electric safety controls to be U.L. and A.G.A. design certified
 - b. Scanner or ultraviolet flame detector
 - c. Air flow switch
6. Start-up by factory-authorized agent only
7. Specify positive pressure at flue collar

F. Fuel:

1. Natural Gas [840 BTU/CF @ 5200 ft. elevation] Inlet gas pressure to burner to be 7" to 11" W.G.

G. Boiler Controls and Trim:

1. Operating control
2. Hi-limit control
3. Low water cutoff
4. Electronic supervised spark ignition
5. ASME pressure relief valve set at proper psi, for operating conditions.
6. Combination temperature/pressure gauge
7. Built-in air elimination
8. Control panel with indicating lights
9. ASME CSD-1a compliance

H. Gas Train:

1. U.L. and FM-listed gas train completely factory assembled
2. Main and pilot gas shut-off valves
3. Main gas pressure regulator
4. Main gas valve
5. Auxiliary gas valve
6. Dual safety gas valves (IRI only)
7. Low and High gas pressure gas switches above 2500 MBH

I. Warranty:

1. Boiler to be guaranteed to operate at a minimum fuel to water efficiency of 80%.
2. Pressure vessel to have 20 year warranty from damage to thermal shock.

2.02 BOILERS (FLEXIBLE TUBE) Hot Water, Forced Draft

A. Manufacturers:

Bryan
Superior Combustion

B. Type:

1. Flexible watertube
2. Forced-draft flame retention gas burner

C. Construction: Each boiler shall be ASME-Stamped and shall conform to applicable State and Local Codes. The boiler shall be constructed and assembled as a complete packaged unit with the following features:

1. Shell:

Welded steel boiler plate. Boiler shall be constructed with adequately sized upper drums, water legs and tube headers, providing proper thermal internal water circulation, not requiring an external circulation source.

2. Water Tubes:

1" O.C., 13 gauge steel, flexible serpentine bend design, not subject to thermal shock damage. Individual water tubes shall be easily removable and replaceable without either welding or rolling. The entire tube area shall be easily accessible for fireside cleaning.

3. Insulation:

Complete with a metal jack, consisting of not less than 1 1/2" fiberglass insulation and heavy gauge rust-resistant, zinc coated steel casing, painted with a suitable heat resisting primer and lacquer. Complete jacket and insulation shall be easily removable where access is required.

4. Thermal Shock:

The boiler shall be warranted for 20 years against thermal shock damage on a non-prorated basis.

5. Forced Draft:

Forced draft units shall be furnished with a refractory tube combustion chamber to be constructed of high temperature insulating firebrick or insulating wool and properly insulated from steel base. Front and rear observation ports shall be furnished for flame observation.

D. Burner:

Power burner arranged for High-Low fire or Modulating (above 80 HP) with the following trim and controls:

1. Combination thermometer and pressure gauge

2. Water temperature control operator

3. High limit safety control

4. Low water cutoff

5. ASME safety relief valve

6. Automatic gas valve operator

7. Auxiliary safety shut-off valve

8. Pilot solenoid valve

9. Pilot ignition assembly

10. Ignition transformer

11. Manual gas shut-off valve

12. Pilot cock

13. Pilot and main gas pressure regulation

14. Air safety switch

15. Electronic combustion safety control with UV sensor

16. Specify positive pressure at flue collar

E. Pressure Rating: 30 psig at 250⁰ F

F. Fuel:

1. Natural gas
2. Pressure 11" w.c.

G. Control:

Boiler shall be suitable for on/off control by outdoor-compensated thermostat furnished under Automatic Temperature Control Division.

H. Trim and Accessories:

1. Suitable for use with 50% propylene or ethylene glycol and water heating fluid.

2.03 BOILERS (CAST IRON) Hot Water, Forced Draft

A. Manufacturers:

Buderus
Burnham
H.B. Smith
Peerless
Weil-McLain

*Housing wants only this manufacturer, with high-efficiency models

B. Type:

1. Sectional cast iron
2. Pressurized firebox, positive pressure outlet

C. Burner:

Forced Draft burner for operation with pressurized vent stack. Operation:

1. Modulation firing
2. Prepurge
3. Low fire start
4. High fire run
5. Modulating position air control
6. Post-purge
7. Specify positive pressure at flue collar

D. Burner Safety Controls:

1. Ultraviolet flame detector
2. Dual automatic gas valves
3. Proven gas pilot
4. Air flow switch

E. Pressure Rating:

1. 30 psig
2. Boiler with 40 psig pressure may be considered if larger expansion tank is provided, and complete calculations confirming expansion tank selection are submitted with boiler submittal.

F. Smoke Venting:

1. Burner/Boiler shall be design tested for forced draft firing
2. Double wall positive pressure stack shall be used for venting per NFPA 211

G. Fuel

1. Natural gas [840 BTU/CF @ 5200 ft. elevation]
2. Inlet gas pressure: [12" to 14" w.c.]

H. Control:

1. Boiler shall be suitable for temperature control by outdoor-compensated thermostat furnished under Automatic Temperature Control Division.

I. Trim and Accessories

1. ASME rated relief valve, set at boiler pressure rating
2. Low water cutoff
3. High limit control
4. Operating control
5. Manual main gas shut-off valves
6. High pressure gas switches
7. Electronic pilot ignition
8. Safety pilot switches, 100% shut-off
9. Gas pressure regulator
10. Pilot shut-off valves
11. Combination pressure temperature altitude gauge
12. Built-in air eliminator

J. Burner start-up and Combustion Test:

1. Start-up shall be performed by a factory authorized technician. A complete combustion test report shall be submitted to Engineered Products Company indicating CO₂ percent, CO percent, stack temperature and pressure, room temperature, and manifold gas pressure.

2.04 HIGH-EFFICIENCY COMPACT BOILER

A. Manufacturers:

1. Lochinvar Copper-Fin II
2. Patterson-Kelley Thermific

B. Type:

Radial fired, vertical hot water boiler with gas fired power burner. Non-condensing design to operate at AGA certified efficiency of 85%.

C. Construction:

1. Combustion chamber to be a minimum of 16 gauge corrosion resistant aluminized steel or cast iron.
2. Heating surface to be 7/8" I.D. intermeshed finned copper tubes. "V" baffles between tubes are NOT acceptable.
3. Outer cabinet to be minimum 16 gauge steel, air tight, with an insulating air space between the combustion chamber and outer cabinet.
4. Cabinet to be finished, both inside and out, with baked epoxy coating.
5. Boiler controls to be top mounted and readily accessible.
6. Control panel to be furnished with 10-point diagnostic annunciator with visual displays.
7. The entire boiler shall be factory assembled and fire-tested. Complete operating and start-up instructions are to be furnished in booklet form.

D. Pressure rating:

1. 160 psi working pressure
2. Boiler shall be constructed and stamped in accordance with Section IV of ASME Code with maximum water working pressure of 160 psi.

E. Burner:

1. Gas power burner, radial fired
2. Screen type diffuser to provide 360 degree flame pattern
3. Fuel-air mixture shall be controlled by multiple brass orifices and venturi core equipped to measure air flow rate to the burner.

F. Burner Controls:

1. Electric spark ignition with interrupted type pilot.

2. Flame rod pilot and main flame control
3. AGA-Approved electronic flame safeguard programmer with pilot failure and lock-out with manual reset.

G. Gas Manifold:

1. AGA lubricated plug cock
2. Pressure regulator
3. Low gas pressure switch
4. (2) solenoid operated diaphragm valves
5. Pilot gas manifold with cock, pressure regulator, gas filter and solenoid valve.
6. Bot gas manifolds (main and pilot) to be accessible without removing cabinet.
7. Boiler shall be capable of operating at 4" W.G. gas pressure.

H. Smoke Venting:

1. Boiler shall be AGA-certified as "Category 1" for venting, requiring either a double wall or an insulated type "B" vent pipe.

I. Trim & Accessories:

1. Combination temperature/pressure gauge
2. ASME relief valve set at 100 psi. [30, 60, 75, and 125 psi also available]
3. Manual reset high-limit temperature control with field adjustable ranges of 100 degrees F to 240 degrees F.
4. Water flow switch
5. Auxiliary low water cut off.

J. Warranty:

1. Boiler shall carry a 10 year guarantee against thermal shock.

K. Start-Up:

1. Boiler price shall include complete start-up services by a factory authorized service agent.

2.07 BOILER (SCOTCH MARINE 3-PASS), [LOW] [HIGH] PRESSURE STEAM

A. Manufacturers:

Burnham
Kewanee
Superior

B. General Boiler Requirements:

1. 3 Pass Wet-back Scotch Marine boiler/burner units. Each unit to be supplied with 840 B.T.U.H. per C.F.H. natural gas at 7"-11" W.G., and 14" W.G. for forced-draft boilers. The boiler/burner units to be complete and factory tested.

C. Low Pressure Construction Requirements for 15# S.W.P.
[High Pressure Construction Requirements for 150# S.W.P.]

ASME boiler shell with:

1. Skid base
2. Insulated metal jacket
3. Insulated front flue doors
4. 16" diameter refractory filled rear access with observation port
5. Lifting loops
6. [Roller expanded and beaded tubes for 150# S.W.P.]
7. 5" Diameter flue gas thermometer
8. ASME relief valves
9. Flanged rear smoke outlet with damper and locking quadrant
10. 6" diameter steam gauge
11. McDonnell Miller safety low water cut-off, water column with gauge glass and cocks
12. 2nd McDonnell Miller safety low water cut-off
13. Magnetrol (No. APM-W-131L) modulating pneumatic feed water controller to control pneumatic modulating boiler feed valves provided for field mounting. The valve and controller require 15 to 20 psi control air.
14. Side feed water connection with internal baffle
15. Bottom blowdown connections [with slow opening and quick opening valves]
16. Safety high limit control
17. Operating control
18. Modulating fire controller

D. Gas UL/FM-approved forced-draft burner to produce full output at 5,400' elevation.

1. Forced-draft fan
2. Air flow safety switch
3. Radial port flame retention type burner head and diffusers
4. Ultra-violet flame detector
5. 6,000 volt ignition transformer
6. Gas/Elec pilot burner with direct spark ignition electrode
7. Modulating control motor with linkage to control the modulating gas or oil valve and air inlet damper

for the proper fuel air mixtures.

E. Control Panel Factory Mounted and Wired and Including:

1. Duct tight door with locking latch
2. Control voltage step-down transformer
3. Programming combustion relay
4. Control circuit fuse
5. Pilot lights
 - a. Power on
 - b. Ignition
 - c. Main fuel
 - d. Flame failure
 - e. Low water
6. Low water and flame failure alarm bell with alarm silencing switch and relay for remote alarm bell annunciation.
7. Burner on/off switch and manual potentiometer.

F. Gas Train To Be UL/FM [IRI] approved gas train consisting of:

1. Gas cock
2. Gas regulator
3. Motorized gas valve with proof of closure switch
4. Safety gas valve
5. Normally open vent valve
6. Gas checking cock
7. High and low gas pressure switches
8. Pilot cock
9. Pilot regulator
10. Pilot solenoid valve

G. Start-up, testing, adjusting, instruction of owners operating personnel and 90 days free service by representatives in-house factory authorized start-up personnel who are on 24 hour call.

H. Boiler to provide 80% plus efficiency of either fuel and shall have 10 year unlimited warranty on all refractory within the boiler.

2.08 BOILER, ELECTRIC, HOT WATER, STEAM

A. Manufacturers

Bryan
Burnham
Coates
Lochinvar
Weil-McLain Electric Boiler

B. Type:

1. Electric resistance element, cast iron packaged boiler
2. Factory assembled tested

C. Construction:

1. One piece cast iron boiler section built in compliance with ASME Boiler and Pressure Vessel Code
2. Incoloy sheathed, low watt density elements
3. Individual fuses for each element leg
4. Heavy duty steel jacket with fiberglass insulation and wall mount brackets
5. 24 volt control system with heavy duty contactors and electronic time-delay relays

D. Pressure Rating:

1. Boiler to be tested at 50 psi working pressure

E. Electrical Requirements:

1. [] KW, [] BTUH DOE heating capacity
2. [208] [240] [480] volts, 3-phase, 60 hertz power

F. Boiler Trim and Controls:

1. ASME safety relief valve
2. Low water cut-off
3. Hot water trim
 - a. Combination operating and high limit control
 - b. Pressure/temperature gauge
4. Steam Trim
 - a. High limit pressure control
 - b. Operating pressure control
 - c. Water gauge glass and gauge cocks
 - d. Steam pressure gauge

PART 3 - EXECUTION

3.01 INSTALLATION

- A. In general, for project specifications, remove "Design Requirements" in Part 1, paragraph 1.03, subparagraph A, and expand here on specific requirements of installation for boiler products specified in Part 2.

END OF SECTION