

SECTION 15510

HEATING BOILERS

PART 1 –GENERAL

1.1 SUMMARY

- A. Section includes boilers, controls and boiler trim, steam and condensate connections, hot water connections, fuel burning system and connections, collector, draft hood, draft fan, chimney connections and circulator, expansion tank and tankless water heater options.

1.2 REFERENCES

- A. AGA (American Gas Association) - Directory of Certified Appliances and Accessories.
- B. AGA Z21.13 (American Gas Association) - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- C. ASME SEC I (American Society of Mechanical Engineers) - Boiler and Pressure Vessels Code - Rules for Construction of Power Boilers.
- D. ASME SEC IV (American Society of Mechanical Engineers) - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.
- E. ASME SEC VIII DIV 1 (American Society of Mechanical Engineers) - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
- F. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
- G. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. NFPA 31 (National Fire Protection Association) - Installation of Oil Burning Equipment.
- I. NFPA 54 (AGA Z223.1) (National Fire Protection Association) - National Fuel Gas Code.
- J. NFPA 58 (National Fire Protection Association) - Storage and Handling of Liquefied Petroleum Gases.

K. UL 726 (Underwriters Laboratories, Inc.) - Oil-Fired Boiler Assemblies.

1.3 SUBMITTALS

- A. See Section 01330 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit general layout and dimensions. Include size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.
- C. Test Reports: Indicate specified performance and efficiency is met or exceeded. Provide combustion test that includes 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. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01770 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.5 QUALITY ASSURANCE

- A. Conform to ASME SEC IV for construction of boilers. The boiler shall be registered with the National Board of Boiler and Pressure Vessel Inspectors.
- B. Unit Certification: AGA certified.
- C. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- D. Conform to CAC Title 8 – Boiler and Fixed Pressure Vessel Safety Orders.

E. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. as suitable for the purpose specified and indicated.

F. Perform Work in accordance with Stanford Facilities Design Guidelines.

G. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

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

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETING

A. Section 01330 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store and protect equipment.

B. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.

C. Protect boilers from damage by leaving packing in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01770 - Execution Requirements: Product warranties and product bonds.

B. Provide five year manufacturers warranty for boilers. Provide 20 year warranty against thermoshock.

1.11 MAINTENANCE SERVICE

A. Section 01770 - Execution Requirements: Maintenance service.

- B. Provide service and maintenance of boilers as directed by Stanford Facilities Engineers.

1.12 MAINTENANCE MATERIALS

- A. Section 01770 - Execution Requirements: Spare parts and maintenance products.

1.13 EXTRA MATERIALS

- A. Section 01770 - Execution Requirements: Spare parts and maintenance products.
- B. Supply one set of circulator pump seals.

PART 2 –PRODUCTS

2.1 FINNED WATER TUBE BOILERS

- A. Manufacturers:
 1. Kewanner Manufacturing Co.
 2. Teledyne Laars
 3. Ray Pack
 4. Ajax
 5. or approved equal
- B. Hot water natural draft boiler with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim including circulator and fill system consisting of diaphragm type expansion tank, fill and check valve, and automatic air vent.

2.2 FINNED WATER TUBE BOILER FABRICATION

- A. Assembly: Finned copper or steel tube heat exchanger assembled within combustion chamber conforming to ASME SEC 4 and SEC 8D requirements, and tested for maximum working pressure of 160 psi.
- B. Combustion Chamber: Line with interlocking refractory insulating panels of vermiculite, high temperature cements, asbestos fiber and refractory clay for service temperatures to 2100 degrees F.
- C. Exchanger: Fabricate of finned copper tubing with stainless steel baffles and sealed into bronze, steel, or cast iron headers with silicone O-ring gaskets or finned steel tubing with baffles and welded into steel headers.
- D. Jacket: Galvanized steel with factory applied baked enamel, insulated with foil faced fiberglass insulation.

2.3 FINNED WATER TUBE BOILER FUEL BURNING SYSTEM

- A. Induced Draft or Atmospheric Gas Burner: Stainless steel burners for modulating firing and natural gas with adjustable combustion air supply, gas pressure regulator, diaphragm gas valves, manual shut-off, intermittent spark, thermistor flame sensing device, and automatic 100% safety gas shut-off.
- B. Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and allow gas valve to open.
- C. Flue Gas Collector and Draft Hood: Integral with boiler casing. External draft diverter with automatic motorized vent damper integral with boiler casing with built-in induced draft fan, with draft gage and draft providing switches.

2.4 FINNED WATER TUBE BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Low water cut-off or inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.
- C. Temperature gage to indicate outlet water temperature
- D. Pressure gage with a scale graduated from 1-1/2 to 3 times the safety relief valve set pressure.

2.5 FINNED WATER TUBE BOILER CONTROLS

- A. Operating Controls: Pre-wired, factory assembled electric control including pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.
- B. Electronic operating temperature controller:
 - 1. NEMA 250 Type 1 enclosure with full cover for wall mounting.
 - 2. Ambient temperature range of -30 to 150 degrees F.
 - 3. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
 - 4. Integral set point adjustment 80 to 230 degrees F.
 - 5. Electronic primary and outdoor sensors.
 - 6. Suitable for on-off switching of pilot duty single-throw double-pole relays.

- C. High limit temperature controller with automatic reset for burner to prevent boiler water temperature from exceeding safe system temperature.

2.6 FINNED WATER TUBE BOILER PERFORMANCE

- A. Performance rating in accordance with HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

2.7 CAST IRON BOILERS

- A. Manufacturers:

1. Kewanner Manufacturing Co.
2. Teledyne Laars
3. or approved equal

- B. Hot Water or Steam Boilers: induced draft with insulated jacket, sectional cast iron heat exchanger, gas burning system, refractory and, controls. Tankless water heater and boiler trim including circulator and fill system consisting of diaphragm type expansion tank, fill and check valve and automatic air vent.

- C. Provide water wall design consisting of water backed combustion area with water circulating around firebox. Refractory chamber or separate base not required.

2.8 CAST IRON BOILER FABRICATION

- A. Assembly: Cast iron sections with 100 psig water or 15 psig steam ASME Boilers and Pressure Vessels Code rating, assembled with push nipples or gaskets and draw rods.

- B. Provide Access for flue passages for cleaning and flame observation ports.

- C. Structural Base: Aluminized steel lined with high temperature mineral fiber insulating panels.

- D. Jacket: Glass fiber insulated steel jacket, finished with factory applied baked enamel.

- E. Tankless Water Heater: Finned, copper tube heat exchanger.

2.9 CAST IRON STEAM BOILER TRIM

- A. ASME rated pressure relief valve.

- B. Steam pressure gage.

- C. Water column gage glass set with cocks.
- D. Low water cut-off to prevent burner operation when boiler water drops below safe level and boiler condensate return pump control to maintain water level by controlling pump operation.
- E. Operating pressure controller for burner to maintain steam pressure setting.
- F. High limit pressure control with manual reset for burner to prevent steam pressure from exceeding system pressure.

2.10 CAST IRON HOT WATER BOILER TRIM

- A. ASME rated pressure relief valve
- B. Combination water pressure and temperature gage. Scale on pressure gage shall be graduated from 1-1/2 to 3 times the pressure relief valve set pressure.
- C. Low water cut-off to prevent burner operation when boiler water falls below safe level.
- D. Electronic operating temperature controller:
 - 1. NEMA 250 Type 1 enclosure with full cover for wall mounting.
 - 2. Ambient temperature range -30 to 150 degrees F.
 - 3. Adjustable reset ratio of outside air temperature change to discharge control point change 1:2 to 100:1.
 - 4. Integral set point adjustment 80 to 230 degrees F.
 - 5. Electronic primary and outdoor sensors.
 - 6. Suitable for on-off switching of pilot duty single-throw double-pole relays.
- E. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.
- F. Boiler air vent.

2.11 CIRCULATOR

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in line mounting, oil lubricated, for 125 psig maximum working pressure.
 - 1. Cast-iron casing.
 - 2. Impeller: Cadmium plated steel, keyed to shaft.
 - 3. Bearings: Oil lubricated bronze sleeves.
 - 4. Shaft: Alloy steel with copper sleeve, integral thrust collar.

5. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
6. Drive: Flexible-coupling.

2.12 DIAPHRAGM TYPE EXPANSION TANK

- A. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8D; rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, and steel legs or saddles
- B. Accessories: Pressure gage and air-charging fitting, tank drain.
- C. Provide isolation valve, drain tee, and union.

2.13 FIRE TUBE BOILER SHELL

- A. Construct to applicable ASME Boiler and Pressure Vessels Code.
- B. Provide two lifting eyes on top of boiler.
- C. Hinged front and rear doors, gas tight, insulated, and secured with heavy-duty cap crews and replaceable brass nuts.
- D. Front and rear tube sheets and flue fully accessible for inspection and cleaning when doors are open.
- E. Provide observation ports at each end of boiler.
- F. Provide hand holes and arm holes for boiler inspection and cleaning.
- G. Insulate casing with readily removable, 2-inch thick glass fiber blanket insulation covered by sectional preformed sheet metal jacket. Boiler casing temperature not to exceed ambient room temperature by 18 degrees F maximum with surface air velocity of 1 foot per second.
- H. Factory-paint boiler, base, and other components with hard finish silicone enamel.
- I. Water entering hot water boiler thoroughly mixed with hot boiler water through jet induced circulation.
- J. Provide bi-metal type thermometer, 3-1/2 inch diameter with black letters on white background.

2.14 FIRE TUBE STEAM BOILER TRIM

- A. Provide ASME rated pressure relief valve.
- B. Steam pressure gage, graduated from 1-1/2 to 3 times the safety valve set Pressure
- C. Water column gage glass set with cocks, low water cut-off and feedwater pump control.
- D. Low water cut-off to prevent burner operation when boiler water drops below safe level and boiler feedwater pump control to maintain water level by controlling pump operation.
- E. Operating pressure controller for burner to maintain steam pressure setting
- F. High limit pressure control with manual reset for burner to prevent steam pressure from exceeding system pressure.

2.15 FIRE TUBE HOT WATER BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Water temperature gage.
- C. Water pressure gage.
- D. Low water cut-off to prevent burner operation when boiler water falls below safe level.
- E. Operating temperature controller to control burner to maintain water temperature set point.
- F. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.
- G. Boiler air vent.

2.16 FIRE TUBE BOILER FUEL BURNING SYSTEM

- A. General: Forced draft automatic burner integral with front head of boiler designed to burn natural gas, modulating with low fire ignition position and automatically maintains fuel-air ratio.
 - 1. Blower: Statically and dynamically balanced to supply combustion air; direct connected to motor.

2. Damper Motor: Single motor controlling combustion air damper and fuel valves.

B. Gas Burner: Forced draft, high-radiant multi-port power burner with electric ignition.

1. Natural Gas Burner Piping: Include on unit complete gas train including high and low gas pressure switches, plug valve, and gas pressure regulator.

2.17 FIRE TUBE BOILER CONTROL PANEL

- A. Mount panel on boiler. Hinged metal cabinet with key lock shall contain programming relay, blower motor starter.
- B. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, pilot, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.
- C. Manual/automatic selector switch and damper motor positioning switch to permit automatic firing in accordance with load demand, or manual control of firing rate at any desired point between low fire and maximum rating.
- D. Electronic detector to prevent primary fuel valves from opening until pilot flame is established.
- E. Panel shall include indicating lights to show low water level, flame failure, fuel valve open and load demand. Mount indicating lights and switches in hinged drop-panel for wiring access.

2.18 FIRE TUBE BOILER PERFORMANCE

- A. Minimum Efficiency: Minimum 85 percent.

2.19 STEEL WATER TUBE STEAM BOILER TRIM

- A. Water Column: With cocks, gage glass set and blowdown valves for gage glass and column.
 1. Low water cut-off: Integral with water column with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.
 2. Feedwater pump control: Integral with water column to automatically maintain water level by controlling pump operation.

- B. Auxiliary Low Water Cut-off: With drain valve to automatically prevent burner operation whenever boiler water falls below safe level and on failure of primary low water cut-off.
- C. Steam Pressure Controls:
 - 1. Auto reset type shall control burner on and off to maintain steam pressure setting.
 - 2. Auto reset type shall control burner firing rate to maintain steam pressure setting.
 - 3. Manual reset type shall control burner to prevent steam pressure from exceeding safe system pressure.
- D. ASME rated pressure relief valves.
- E. Steam pressure gage with cock and test connection.

2.20 STEEL WATER TUBE HOT WATER BOILER TRIM

- A. Low Water Cut-off: With drain valve and manual reset to automatically prevent burner operation whenever boiler water falls below safe level.
- B. Temperature Controls:
 - 1. Auto reset type shall control burner on and off to maintain temperature.
 - 2. Auto reset type shall control burner firing rate to maintain temperature.
 - 3. Manual reset type shall control burner to prevent boiler water temperature from exceeding safe system water temperature.
- C. Pressure Control: Fixed setting type shall control burner to ensure minimum operating pressure.
- D. Blend Pump: Mounted between supply and return connections ensures minimum continuous circulation through boiler.
- E. ASME rated pressure relief valves.
- F. Combination pressure and thermometer gage.

2.21 STEEL WATER TUBE FUEL BURNING SYSTEM

- A. General: Forced draft automatic burner integral with front head of boiler designed to burn natural gas and maintain fuel-air ratios automatically.
 - 1. Blower: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Damper Motor: Single motor controlling combustion air damper and fuel valves.

- B. Gas Burner: Forced draft, high-radiant multi-port power burner with electric ignition modulating with low fire ignition position.
 - 1. Natural Gas Burner Piping: Include on unit complete gas train including high and low gas pressure switches, plug valve, and gas pressure regulator.

2.22 CONDENSING TYPE BOILERS

- A. Provide factory assembled, factory fire-tested, readily transported Condensing Boiler/burner units for low pressure Hot Water Heating service, arranged for completely automatic operation for firing gas, except for connection of water, fuel, electrical, and vent services.
- B. Unit: Steel membrane wall water tube boilers on integral structural steel frame base with integral forced draft burner, burner controls, boiler trim, refractory, insulated metal jacket

2.23 CONDENSING BOILER SHELL

- A. Construct applicable ANSI/ASME Boiler and pressure Vessels Code for allowable working pressure of 125 psi hot water.
- B. Provide two lifting eyes on top of boilers.
- C. Provide adequate tapings, observation ports, removable panels and access doors for entry, cleaning, and inspection.
- D. Insulate casing with readily removable glass fiber blanket insulation covered by sectional performed sheet metal jacket. Boiler casing temperature not to exceed ambient boiler room temperature by 18 degrees F maximum with air surface velocity of one foot per second.
- E. Factory paint boiler, base, and other components with hard finish silicone enamel.

2.24 CONDENSING BOILER TRIM

- A. Provide pressure gauge and thermometer and ASME rated pressure relief valves.
- B. Provide low water cut-off with manual reset to automatically prevent burner operation when boiler water drops below safe level.
- C. Provide operating temperature controller to control burner operation to maintain boiler water temperature.

- D. High limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.
- E. Provide air vent tapping in boiler shell.
- F. Provide barometer draft diverter.
- G. Provide primary pump with each boiler.

2.25 CONDENSING BOILER FUEL BURNING SYSTEM

- A. General: Fan assist automatic burner integral with boiler gas. Burner operation modulating with low fire ignition position for hot water boilers.
- B. Natural Gas Burner Piping: Include on unit complete gas train including pressure reducing valve or valves. Run a $\frac{3}{4}$ inch vent pipe from the pressure-regulating valve to outside the building.
- C. Drip Pan: Provide 24 x 24 x 2 inches deep, 16 gauge galvanized steel soldered pan on floor under each oil burner.

2.26 CONDENSING BOILER CONTROL PANEL

- A. Mount panel on boiler. Hinged metal cabinet to contain programming relay, blower motor starter, and control switches.
- B. Program relay to control ignition, starting and stopping of burner, and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, pilot, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.
- C. Manual-automatic selector switch and damper motor positioning switch to permit automatic firing in accordance with load demand, or manual control of firing rate at any desired point between low fire and maximum rating.
- D. Electronic detector to prevent primary fuel valves from opening until pilot flame is established.

2.27 CONDENSING BOILER FLUE GAS RECIRCULATION SYSTEM

- A. The flue gas recirculation system supplied shall meet the BACT requirements of South Coast Air Quality Management Districts:
 - 1. Flue gas recirculation fan and motor drive mounted on a base plate shall be assembled in the field.

2. An electrical cabinet containing FGR controls, lights, and switches shall be furnished with the following:
 - a. Motor starter for the FGR motor.
 - b. Time delay relay to energize the FGR system only after the main flame is established.
 - c. Time delay to insure the boiler modulation to high fire only after the FGR system is energized.
 - d. Potentiometer to enable the operator to modulate and set up the FGR system independent of the boiler operation. This potentiometer should only be used during the initial start-ups.
 - e. FGR operating system switch.
 - f. Main disconnection means.
3. Flue gas temperature monitoring gauge.
4. Flue gas housing to be installed in the burner.
5. Flue gas modulating butterfly valve.

B. All of the above equipment shall be designed and furnished by the boiler-burner manufacturer. All components shall be shipped loose for field installation, under the supervision of the boiler-burner manufacturer. The contractor shall furnish and install all interconnecting ductwork and insulation, all pneumatic tubing and electrical interconnections, all modifications to the burner, and controls to accommodate the flue gas recirculation system.

C. After normal start-up of the boiler has been completed on both fuels, the flue gas recirculation system shall be placed into operation at the recirculation rate specified by the Santa Clara County or Bay Area Air Quality District, whichever is more strict. Any testing of emissions shall follow this start-up and the cost of these tests shall be paid by the contractor.

D. The FGR system shall be complete and shall include the following:

1. Flue gas outlet transition section.
2. Stack gas temperature gauge.
3. Pilot port for measuring FGR flow.
4. Flue gas recirculation fan and motor.
5. FGR fan motor starter with overloads.
6. Butterfly valve, with modulating motor.
7. FGR control panel with all necessary lights and switches.
8. FGR housing installed on the burner.
9. Duct from stack to fan.
10. Duct from fan to boiler.

2.28 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory-mount in control panel or on equipment.

PART 3 –EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 54.
- B. Install boiler on concrete housekeeping base, minimum 3-1/2 inches high and 6 inches larger on each side than boiler base.
- C. Provide connection of natural gas service in accordance with NFPA 54 (AGA Z223.1).
- D. Pipe relief valves and drain valves to nearest floor drain.
- E. Install circulator and diaphragm expansion tank on boiler.
- F. Provide for connection to electrical service.
- G. Mount thermometer in boiler breeching within 12 inches of flue nozzle for fire tube boilers.

3.2 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance procedures.

END OF SECTION