# SECTION 23 52 00

# HEATING BOILERS

# BASED ON DFD MASTER SPECIFICATION DATED 03/07/2023

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

# PART 1 ‑ GENERAL

## SCOPE

This section includes specifications for hot water and steam heating equipment. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Reference Standards

Quality Assurance

Energy Efficiency

Submittals

Operation and Maintenance Data

Registration

Warranty

PART 2 - PRODUCTS

Non-Condensing Boiler

Fire Tube Boiler

Flexible Water Tuber Boiler

Force Draft Boiler

Sealed Combustion Boiler, Water Tube

Condensing Boiler

Flexible Stainless-Steel Water Tube Boiler

High Efficiency Condensing Boiler

Sealed Combustion Boiler, Stainless Steel Water Tube, Modular

Sealed Combustion Boiler, Stainless Steel Water Tube or Fire Tube, Modular (Non-Giannoni Heat Exchanger)

Stainless Steel, Fire Tube, Variable Flow

Boiler Blowdown Separators

Continuous Blowdown Heat Recovery System

Boiler Kill Switch

PART 3 - EXECUTION

Installation

Boilers

Boiler Blowdown Separators

Boiler Kill Switch

Construction Verification

Functional Performance Testing

Agency Training

## RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 08 00 – Commissioning of HVAC

Section 23 21 13 – Hydronic Piping

Section 23 05 23 – General Duty Valves for HVAC Piping

Section 23 51 00 – Breeching, Chimneys and Stacks

Section 26 29 00 – Low Voltage Controllers

## REFERENCE

Applicable provisions of Division 1 govern work under this section.

## REFERENCE STANDARDS

ASME CSD-1 Control and Safety Devices for Automatically Fired Boilers

ASME Boiler and Pressure Vessel Code I - Rules of Construction of Power Boilers

ASME Boiler and Pressure Vessel Code VIII - Rules for Construction of Pressure Vessels

ASME Boiler and Pressure Vessel Code IX - Welding and Brazing Qualifications

ASME Boiler and Pressure Vessel Code I V - Rules for Construction of Heating Boilers

UL 296 Oil Burners

UL 795 Commercial Industrial Gas Heating Equipment

NFPA 70 Electrical wiring and devices

NEC National Electric Code

## QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

## ENERGY EFFICIENCY

All boilers with a capacity of less than 300,000 btu/hr input must be labeled as Energy Star by its manufacturer.

All boilers with a capacity of 300,000 btu/hr input must meet the efficiencies specified. Minimum boiler efficiencies are based on Federal Energy Management Program (FEMP) recommendations.

## SUBMITTALS

Refer to division 1, General Conditions, Submittals.

Include data concerning dimensions, capacities, and material of construction, ratings, weights, manufacturer's installation requirements and performance limitations.

Submit manufacturer's installation instructions including required clearance to combustible materials.

## OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

Delete the following if there are no additional requirements.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]

Modify Warranty to meet standard Manufacturer’s Warranty for specific type of boiler Specified.

## REGISTRATION

Complete Boiler and Unfired Pressure Vessel (UPV) Installation Registration and forward to the Department of Safety and Professional Services in accordance with the Wisconsin Administrative Code Chapter SPS 341.24.

## WARRANTY

Modify Warranty to meet standard Manufacturer’s Warranty for specific type of boiler Specified.

(1) (5) (10)-year Boiler pressure vessel warranty against leakage due to defective workmanship. (1) (5) - year period heat exchanger tubes/combustion chamber assembly warranty against failure due to thermal stress or failure of condensate corrosion. All other boiler, burner and control parts warranted for one year from startup.

Sealed combustion boiler, condensing, hi-efficiency, (modular,) helical heat exchanger/combustion chamber design that will be self-supporting and warranted for a period of (5) (10) (20) years to withstand thermal shock. Heat exchanger shall be warranted against leakage for a period of (5) (10) years.

Sealed combustion boiler, non-condensing, modular helical heat exchanger/combustion chamber design that will be self-supporting and warranted for a period of (5) (10) (20) years to withstand thermal shock. Heat exchanger shall be warranted against leakage for a period of (5) (10) years.

# PART 2 ‑ PRODUCTS

All boilers specified must meet or exceed the following performance standards, (High-pressure Boilers excluded). These efficiencies are based on Federal Energy Management Program (FEMP) recommendations and ASHRAE90.1 2010 . Contact DFD if special project circumstance exist that prohibit a boiler installation with the listed efficiency, or special installation circumstances and/or operating parameters result in a seasonal low number of hours of operation in the condensing mode, reducing a reasonable payback.

Boiler Performance Requirements

|  |  |  |
| --- | --- | --- |
| Type | Rated Capacity (Btu/h) | Thermal Efficiencya |
|  |  |  |
| Gas / Water | ≥300,000 - <2,500,000 | 95% Et |
| Gas / Water | ≥2,500,000 - <10,000,000 | 94% Et |
| Gas / Steam | ≥300,000 - <2,500,000 | 81% Et |
| Gas / Steam | ≥2,500,000 - <10,000,000 | 83% Et |
| #2 Oil/ Water | ≥300,000 - <2,500,000 | 85.5% Et |
| #2 Oil/ Water | ≥2,500,000 - <10,000,000 | 86% Et |
| #2 Oil/ Steam | ≥300,000 - <2,500,000 | 84% Et |
| #2 Oil/ Steam | ≥2,500,000 - <10,000,000 | 85.5% Et |

a Thermal Efficiencya  (Et), also known as “boiler efficiency” or “overall efficiency,” is the boiler’s energy output divided by energy input, as defined by ANSI Z21.13. In contrast to combustion efficiency (Ec), thermal accounts for radiation and convection losses through the boiler’s shell.

b Annual Fuel Utilization Efficiency

## NON-CONDENSING BOILER

## FIRE TUBE BOILER

Boiler Characteristics

* Capacity Range: 100,000 – 63,000,000 BTU/HR Input
* Turn Down: 6:1 (Gas)
* Efficiency: 83.5 – 85%
* Warranty: 10-year heat Exchanger warranty
* Advantages – Very large capacity ability. High steam pressure rating.
* Disadvantages – Susceptible to thermal shock. Higher service areas required as compared to flex tube. Requires a rated mechanical room.
* Recommended use – Very Large applications where flexible tube does not have capacity.

Manufacturers:

Hurst Boiler, Cleaver‑Brooks, Johnston, Superior, Sellers.

General:

Provide Scotch Marine type boiler listed and rated by American Boiler Manufacturer's Association with capacity and operating characteristics indicated on schedules.

Furnish units complete with boiler, boiler fittings, burner equipment, forced draft fans, combustion and safety controls, insulation and asbestos free refractory, boiler trim and accessories; all piped, wired and assembled on structural steel base frames.

Provide complete UL listed and labeled boiler‑burner units completely preassembled, and fire tested at manufacturer's facilities prior to shipment. Minimum 84% efficiency when fired at 30% to 100% of rated capacity with fuels specified.

Include the following paragraph when factory tests are witnessed. Coordinate expenditures in advance with project manager.

Provide Owner witness Factory performance test. The initial boiler performance test shall begin no later than Wednesday of a full business week. Test shall be conducted between the hours of 7:00 AM and 5:00 PM, local time in force at the location of the factory test. Document minimum test points from 30% to 100% of boiler rated capacit8y in 5% increments the manufacturer shall notify the Owner in writing and include a printout of the predicted Performance Test at all test point load conditions with complete calculations at least 14 days in advance of the performance test. The Owner will assume travel, transportation, meals and lodging (two nights) cost for the Owner’s representative to witness the initial boiler performance test. Should the boiler fail the initial performance test and re-testing occur, the bidder shall be responsible for all additional expenses, including additional travel, transportation, meals, lodging, etc. for the Owner’s representative to complete the factory witness test. Re-testing shall conclude by 5:00 PM Friday.

Insert working pressure required for specific project, below.

Boilers shall be constructed, tested and stamped in accordance with the latest ASME Code for \_\_\_ psi working pressure and must be inspected by authorized boiler inspection agency and registered with National Board.

Not less than 5 sq. ft of heating surface per rated boiler horsepower, measured on fireside (ASME method).

Furnish boilers with flanges and/or threaded openings for trimmings and external connections, sufficient hand-holes and manhole for thorough inspection and cleaning and lifting loops.

Furnish boilers with front **[hinged or davited]** and rear **[hinged or davited]** access doors to provide access to fireside surfaces without removal of door plates, baffles, or refractories. Access to tube sheets and fire tubes for inspection and/or cleaning to be provided without disconnecting any fuel piping or electrical wiring. Doors and access openings to be gas tight and lined with insulating asbestos refractory.

Furnish units with factory installed enameled steel jacket over minimum 2“ thick, mineral fiber or fiberglass insulation.

Entire fuel burning equipment to bear UL label and be factory assembled, wired, mounted and tested.

Furnish unit with electrical entrance cabinet, NEMA 1, to accept single source of **[208] [480]** volt, 3 phase, 60 cycle power to accommodate motors and control circuit power. Include step-down transformer to provide control circuit power of 120 volt, single phase, and 60 hertz.

Burner:

Furnish units with burner, forced draft fan with combustion air damper, fuel control, limit control, operating control and flame sensing device.

Verify project requires 60 ppm maximum before specifying.

Furnish units with low emission option for guaranteed NOx performance at 60 ppm maximum, dry volume basis when firing natural gas.

Furnish burner with on-off firing sequence for boilers up to 50 HP, with high-low fire with low fire start for boilers 60 to 80 HP, and full modulation with low fire start for boilers over 80 HP. Minimum input to output efficiency of (84%) (Adjust to meet Femp requirements) based on stack loss method shall be maintained for 100% through 30% firing range.

Burner shall burn specified fuel without objectionable vibration, noise or pulsation with not more than 15% excess air for gas, 20% excess air for oil, not more than 200 ppm of CO in products of combustion on gas firing, and maximum of No. 1 smoke as measured at Bachrach scale when firing No. 2 oil.

Provide permanent observation port at each end of boiler to allow observation of both pilot and main flame.

Choose one of the three paragraphs below.

Burner to be suitable for firing natural gas, consisting of annular port flame retention type gas burner.

Burner to be suitable for firing No. 2 fuel oil, consisting of mechanical pressure atomizing on burners with inputs under 50 GPH and air atomizing on burner over 50 GPH.

Burner to be gas‑oil type consisting of combination annular port flame retention type gas burner and of mechanical pressure atomizing on burners with inputs under 50 GPH and air atomizing on burner over 50 GPH.

Include the two paragraphs below when combination burner is specified.

Change over from one fuel to another to be accomplished by manual fuel selector switch in control cabinet. No changes in linkage, burner position or mechanical adjustment to be necessary when changing fuels.

Furnish fuel selector switch to provide, through combustion control relay, proper ignition timing for fuel being burned.

Furnish units with fuel trains conforming to the latest UL requirements **[and FM requirements] [and IRI requirements]** and be factory assembled, wired, mounted and tested.

Provide gas pressure regulators at burners to reduce pressure suitable to burner operation.

Furnish positive displacement type fuel oil pump for each unit on burner or on boiler base, complete with strainer, gauges, relief valve and necessary motor control devices.

Controls:

Furnish unit with control cabinet, NEMA 1A enclosure with lock and exterior resets for blower motor starter and flame failure.

Provide control cabinet with magnetic motor starters with thermal overload protection, electronic flame safeguard, programming timer for pre‑purge and post‑purge, burner switch, control circuit switch and fuse, necessary switching relays, low water and flame failure alarm, manual automatic selector switch, damper motor positioning control dial, indicating lights for major operations, numbered terminal strips, numbered wiring and engraved nameplates.

Include high limit **[manual][ reset],** operating limit **[auto reset],** and firing rate control.

Provide boiler with low fire hold control to keep boiler at low fire on start-up until boiler reaches preset minimum temperature.

Provide status and alarm indication auxiliary contacts to BAS. Alarm condition shall be reported to BAS whenever alarm condition is indicated at boiler packaged control panel.

Provide dry contacts and/or relays in control cabinet for remote alarm indication for any safety shutdown.

Provide necessary control devices to allow lead boiler to operate on emergency power.

Edit the following paragraphs for multiple boiler installations.

Furnish unit with lead‑lag sequence control panel.

Furnish 2 operating limit controls and one dual potentiometer modulating control for field installation in common boiler water supply header.

Furnish selector switch for lead boiler selection and it is to be factory mounted and wired for boiler number on entrance box.

Furnish assured low fire cutoff control.

Provide standard boiler-mounted modulating, operating and high limit control. These shall be wired through three-position selector switch mounted in each boiler panel. This arrangement shall allow boiler local/manual, local/auto and remote lead-lag/auto firing rate control.

Furnish temperature sensor required for lead-lag control.

Boiler controls shall sequence lead-lag boilers in response to temperature sensor, located in hot water supply header, to maintain supply water temperature set-point of \_\_\_**ºF** (FA). On drop in water temperature below set-point, lead boiler shall be brought on-line at low fire. On continued drop below set-point, lead boiler shall be modulated to high fire. If lead boiler, at high fire is unable to maintain supply water temperature set-point, lag boiler shall start at low fire. When lag boiler flame has been established and minimum temperature reached, lag boiler shall modulate to high fire and share load equally with lead boiler. As load is met, both boilers shall modulate in unison down to low fire. On continued drop in load, lag boiler shall shut off and lead boiler shall be modulated according to system demand. On further drop in load, lead boiler shall reduce firing rate to minimum and shut off.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ **psi**
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Second Float Type low water cut‑off with blow down for boilers 80 HP input an above
* Drain valve
* Stack thermometer

Steam Boiler Trim:

Furnish complete steam trim including:

* ASME safety valves set at \_\_\_ **psi**
* Steam pressure gauge with gauge valve and test connection
* Gauge glass with try cocks
* Operating pressure controls
* High limit control
* Combination water column, feed-water pump control and low water cut‑off with blow down. LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain valve
* Stack thermometer
* Second Float Type low water cut‑off with blow down for boilers 200,000 BTUH input and above or over 15 psig design working pressure.

Feed-water pump control shall be on-off type and automatically actuate feed-water pump maintaining boiler water level within normal limits.

## NON-CONDENSING BOILER

## FLEXIBLE WATER TUBE BOILER

Boiler Characteristics

* Capacity Range: 500,000 – 25,200,000 BTU/HR Input
* Turn Down: 4:1 (Gas)
* Efficiency: 84%
* Warranty: 25-year Thermal Shock warranty
* Advantages: Great performer. Thermal shock protection. Good efficiency.
* Disadvantages: Requires a rated Mechanical room
* Recommended use: Large buildings requiring steam, and where water special project circumstance exist that prohibit a boiler installations with the high efficiency, or special installation circumstances and/or operating parameters result in a seasonal low number of hours of operation in the condensing mode, reducing a reasonable payback.)

Manufacturers:

Unilux, Bryan or Cleaver Brooks.

General:

Provide flexible water tube type boiler or flexible cast iron with capacity and operating characteristics indicated on schedules.

Furnish unit complete with boiler, boiler fittings, burner equipment, forced draft fan, combustion and safety controls, insulation and refractory, boiler trim and accessories; all piped, wired, and assembled on structural steel base frame.

Boiler and burner unit shall be UL listed and labeled, fire tested at manufacturers production facility prior to shipment. Minimum 84% efficiency when fire tested at 30 to 100% of rated capacity with fuels specified.

Constructed and stamped in accordance with the latest ASME Code for 150 psi working pressure (72 psi for Flexible Cast Iron) and inspected by authorized boiler inspection agency and registered with National Board.

Not less than 5 sq. ft of heating surface per rated boiler horsepower, measured on fireside (ASME method).

Furnish boilers with flanges and/or threaded openings for trimmings and external connections, sufficient hand-holes for thorough inspection and cleaning per ASME requirements and lifting loops.

Furnish unit with electrical entrance cabinet, NEMA 1, to accept single service of **[208] [480]** volt, 3-phase, 60 cycle power to accommodate motors and control circuit power. Step-down transformer shall be included to provide control circuit power of 120 volt, single-phase, 60 cycle.

Burner:

Furnish unit with burner, forced draft fan with combustion air damper, fuel control, limit control, operating control and flame sensing device.

Furnish burner with on-off firing sequence for boilers up to 50 HP, with high-low fire with low fire start for boilers 60 to 80 HP, and full modulation with low fire start for boilers over 80 HP.

Provide permanent observation port at each end of boiler to allow observation of both pilot and main flame.

Burner to be suitable for firing **[natural gas] [No. 2 fuel oil] [natural gas and No. 2 fuel oil]**, mechanical pressure atomizing on burners with inputs under 50 GPH and air atomizing on burner over 50 GPH.

Provide pressure regulators at burners to reduce pressure suitable to burner operation.

Furnish units with fuel trains conforming to the latest UL requirements **[and FM requirements] [and IRI requirements]** and be factory assembled, wired, mounted and tested.

Controls:

Furnish unit with control cabinet, NEMA 1A enclosure with lock and exterior resets for blower motor starter and flame failure.

Provide control cabinet to include magnetic motor starters with thermal overload protection, electronic flame safeguard, programming timer for pre‑purge and post‑purge, burner switch, control circuit switch and fuse, necessary switching relays, low water and flame failure alarm, manual automatic selector switch, damper motor positioning control dial, indicating lights for major operations, numbered terminal strips, numbered wiring and engraved nameplates.

Include high limit **[manual reset],** operating limit **[auto][ reset],** and firing rate controls.

Controls shall permit automatic firing in accordance with load demand and manual control of firing rate at any desired position throughout turndown range.

Provide boiler with low fire hold control to keep boiler at low fire on start-up until boiler reaches preset minimum temperature.

Provide status and alarm indication auxiliary contacts to BAS. Alarm condition shall be reported to BAS whenever alarm condition is indicated at boiler packaged control panel.

Provide dry contacts and/or relays in control cabinet for interfacing with Building Automation System. Contacts shall be single pole, double throw and shall switch when boiler starts or stops.

Provide terminals to interlock boiler with combustion air fan to prevent burner operation unless combustion air fan is operating.

Edit the following paragraphs for multiple boiler installations.

Furnish unit with lead‑lag sequence control panel.

Furnish 2 operating limit controls and one dual potentiometer modulating control for field installation in common boiler water supply header.

Furnish selector switch for lead boiler selection and it is to be factory mounted and wired for boiler number on entrance box.

Control shall include assured low fire cutoff.

Provide standard boiler-mounted modulating, operating and high limit control. These shall be wired through three-position selector switch mounted in each boiler panel. This arrangement shall allow boiler local/manual, local/auto and remote lead-lag/auto firing rate control.

Furnish temperature sensor required for lead-lag control.

Boiler controls shall sequence lead-lag boilers in response to temperature sensor, located in hot water supply header, to maintain supply water temperature set point of \_\_\_ºF (FA). On drop in water temperature below set point, lead boiler shall be brought on-line at low fire. On continued drop below set point, lead boiler shall be modulated to high fire. If lead boiler, at high fire is unable to maintain supply water temperature set-point, lag boiler shall start at low fire. When lag boiler flame has been established and minimum temperature reached, lag boiler shall modulate to high fire and share load equally with lead boiler. As load is met, both boilers shall modulate in unison down to low fire. On continued drop in load, lag boiler shall shut off and lead boiler shall be modulated according to system demand. On further drop in load, lead boiler shall reduce firing rate to minimum and shut off.

Furnish units with factory installed enameled steel jacket over 2" thick fiberglass blanket.

Provide cover rings at openings in insulation jacket. Assemble jackets in neat workmanlike manner.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ psi
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Second Float Type low water cut‑off with blow down for boilers 80 HP input an above
* Drain valve
* Stack thermometer

Steam Boiler Trim:

Furnish complete steam trim including:

* ASME safety relief valves set at \_\_\_ psi
* Steam pressure gauge
* Gauge glass with tri-cocks
* Operating pressure controls
* Combination water column pump control and low water cut-off with blow-down
* High Limit Control
* Drain valve
* Stack thermometer
* Second Float Type low water cut‑off with blow down for boilers 200,000 BTUH input and above or over 15 psig design working pressure.

## NON-CONDENSING BOILER

## FORCED DRAFT BOILER

(Suitable for applications where a capacity of greater than 400,000 BTUH is required, and a special project circumstance exist that prohibit a boiler installations with the high efficiency, or special installation circumstances and/or operating parameters result in a seasonal low number of hours of operation in the condensing mode, reducing a reasonable payback.)

Manufacturers:

De Dietrich, Viessmann, or Smith Boiler

General:

Provide units with capacity and operating characteristics indicated on schedules.

Furnish units as an engineered package complete with burner and all controls, wiring, insulated jacket, boiler trim, drain valve. Provide unit complete for connection to fuel, electrical sources, and water or steam piping. Unit to be delivered to site in knockdown configuration for installation through existing boiler room door/stairs.

Category II, III, or IV flu vent connection as appropriate for installation, for vertical, horizontal and sidewall venting. The vent outlet shall be compatible with installation. Furnished boiler and associated burner and draft controller must be verified compatible with the new boiler room venting design and existing chimney.

Cast iron or Stainless Steel construction in accordance with the latest ASME Code for 80 psi working pressure.

Provide factory installed minimum 1" thick fiberglass insulation covered with a steel jacket having factory applied hard coat paint finish.

Burner:

Riello RS 190/EV, Industrial Combustion VG-45HT or approved equal.

Forced draft type burner suitable for firing natural gas. Burner to be fully modulating type capable of 10:1 turndown. Provide burner fan with variable frequency drive.

Burner to operate at less than 4% excess oxygen throughout operating range.

Provide linkageless electronic burner control system for control of combustion air, gas flow, and combustion fan VFD for fully modulating burner. Siemens LMV37, Siemens LMV52, Fireye PPC 4000, or approved equal. Provide with flat panel touch screen display for monitoring/adjustment of controls.

* Control system to provide the following functions:
* Configurable curves for fuel and air supplies, at all light off and running conditions
* Complete integration of combustion fan VFD into the burner safety logic sequences.
* PID modulating control algorithm with ability to accept water temperature set point or firing rate input from the building automation system.
* Thermal shock protection on startup via sensor or aquastat.
* Color touchscreen with display of the following functions and data for each boiler:
* Burner phase and status
* Boiler set point
* Burner output
* Flame signal
* Runtime counters and timers
* Fault history
* Local/remote mode

Furnish unit with intermittent pilot burner and all necessary controls for fully modulating type firing.

Division 23 to provide sequencing draft control system for each boiler, including inline draft control dampers/actuators/end switches, stack temperature sensors, controller, display, enclosure and all associated wiring.

Furnish units with fuel trains conforming to the latest UL and FM requirements and be factory assembled, wired, mounted and tested.

The boiler controller shall accept the following inputs for emergency shutdown of the boiler burner:

* E-Stop Switch

Controls:

(Boiler System Controller may not be necessary for a single boiler installation).

Provide a Boiler System Controller for connection to all boiler controllers via Modbus or other digital communication. Display and control panel to be mounted in a NEMA 12 enclosure.

Boiler System Controller sequences the boilers via initiate commands. If the communication to the boiler controllers is interrupted the boilers will control to a failsafe set point within the boiler controller.

* The Boiler System Controller shall incorporate a color touch screen to operate and monitor all boiler functions including:
* Graphical display of all burner functions and data:
* Current Burner Phase and Status
* Boiler Set Point
* Boiler Operating Pressure
* Burner Output
* Flame Signal
* Air, Fuel and FGR valve positions
* Runtime Counters and Timers
* Real-time and Historical trend screens of:
  + Boiler Set Point, Actual Pressure and % Output
  + Optional Water Level Set Point, Actual Level and % Output of feed water valve
  + Flame Signal
  + Boiler Set Point, Actual Pressure and % Output
  + Flue and combustion air temperatures
* User configurable threshold alarms to warn of impending problems
* User configurable and scalable additional analog inputs
* On screen history of alarms and faults
* E-Mailing of alarms and faults to five separate accounts
* Pop-up window of alarm or fault with troubleshooting help
* Multiple password security levels
* Night and Weekend Setbacks

The Boiler System Controller will provide Lead-Lag functioning to sequence the boilers on a predetermined basis.

Individual view of all boilers with the same data and trending screen and information available at the individual boilers

* Boiler overview screen showing all boilers and data
* Lead/Lag Operation
* Manual or Automatic lead stage rotation
* Boiler circulating pump interlock and flow verification
* Boiler sequencing and burner firing modification
* Selectable Series or Unison Lead/Lag operation
* Available Boilers
* Selected sequence of firing
* Control output of each burner
* System header pressure / temperature
* Set point of header pressure / temperature
* Elapsed time from last rotation
* Individual boiler start and stop points with timers
* Low fire hold
* Lag boiler warming functions – Time Based or Temperature Based

The Boiler System Controller shall accept the following inputs from a BAS:

* Boiler System Enable
* HWS Set point Reset

User Configurable Threshold Alarms:

The Boiler System Controller shall have user configurable threshold alarms. Values can be set to warn of impending problems before the problem can cause a complete shutdown of the boiler. User configurable alarms include; Flame Signal, Flue Gas Temperature, High and Low PV.

User configurable and scalable additional analog inputs:

Provide each boiler with an HWR temperature sensor and wire to the boiler system controller.

Interface to BAS: The Boiler System Controller shall integrate to the BAS via BACnet/MSTP.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valve set at \_\_\_ **psi**
* Combination pressure temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain Valve

## NON-CONDENSING BOILER

## SEALED COMBUSTION BOILER, WATER TUBE

Boiler Characteristics

Capacity Range: 500,000 – 4,000,000 BTU/HR input

Turn Down: 3:1 minimum (Gas) 5:1 available

Efficiency: Up to 88%

Warranty: 21-year Thermal Shock, 1 year overall, no condensate corrosion coverage

Boiler Advantages: First cost, reasonable performance with certain manufacturers, can be located in a non-rated mechanical room,

Boiler Disadvantages: Some manufacturer’s boiler has been troublesome, life expectancy 20 years.

Boiler Recommended use: Light commercial, small to medium out buildings. Upgrade tubes to cu-nickel for improved tube performance (less corrosion).

Other Designer notes:

Manufacturers:

Fulton - Reliance, Thermal Solutions - EVS, Laars - Pennent, RBI – Futera III, Camus – Dyna Flame.

General:

Provide water-tube boiler unit(s) with capacity and operating characteristics indicated on schedules.

Heat exchanger constructed to section IV of ASME code, with vertical cu-nickel tubes and top & bottom cast iron or cast bronze headers.

Boiler ASME stamped for 160 psig and designed per ASME section IV. Furnish a relief valve in compliance with ASME section IV and set at **[30] [50] [75] [100] [160]** psig. Provide condensate drain to discharge any combustion chamber condensate buildup during cold starts.

Boiler efficiency 85% per BTS-2000, and operation in the non-condensing mode with inlet temperatures as low as 140 F.

Category II, III, or IV flu vent connection as appropriate for installation, for vertical, horizontal and sidewall venting. The vent outlet shall be compatible with installation.

Baked enamel finish boiler sheet metal jacket with removal panels for maintenance access.

Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures.

Provide single point wiring for controls and fan.

Burner:

Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer. Maximum Nox emissions under 20 PPM. Pre-mix design to allow modulation of fuel and air for a minimum of 5:1 turndown.

Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval, CSD-1 requirements, **[and FM requirements] [and IRI requirements].** Boiler/burner package shall be factory assembled, wired, mounted, and factory fire tested.

Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe.

Controls:

Omit controller if sequencing panel or external control will be used.

Omit controller if sequencing panel or external control will be used.

Provide a water temperature controller.

Provide each boiler with a low water cutout operationally testable, manually reset on loss of low-water and auto-rest on loss of power in accordance with ASME Section IV and CSD-1.

Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME Section IV and CSD-1.

Provide remote fault alarm contact for flame sensor and high temperature limit failure.

Boiler management system (sequencing panel) may be specified in addition to integral boiler controls for multiple boiler arrangements. The following paragraph must be modified to individual project needs and coordinated with temperature control specification sections.

Boiler management system (sequencing panel) may be specified in addition to integral boiler controls for multiple boiler arrangements. The following paragraph must be modified to individual project needs and coordinated with temperature control specification sections.

Provide a multiple Boiler Sequencing Panel (BMS) or integral boiler control capable of staging boilers to maintain peak seasonal efficiency. BMS shall include a sensor to monitor main loop system temperature, and a sensor to monitor outside air temperature. BMS shall be capable of outdoor reset, loop temperature span, and set loop temperature. BMS shall have the capability to stage boilers based on loop temperature and outdoor reset for highest operating seasonal efficiencies. BMS shall be capable of starting and stopping the system based on a remote contact closure and has the ability to change set-point from a remote location. Manufactures: Honeywell, Heat Timer, Techmar, or equivalent.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valve set at \_\_\_ **psi**
* Combination pressure temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain Valve

## CONDENSING BOILER

## FLEXIBLE STAINLESS-STEEL WATER TUBE BOILER

Boiler Characteristics

* Capacity Range: 500,000 – 25,200,000 BTU/HR Input
* Turn Down: Minimum 4:1 (Gas)
* Efficiency: 94%
* Warranty: 25-year Thermal Shock warranty
* Advantages – Great performer. Thermal shock protection. Good efficiency.
* Disadvantages –. Requires a rated Mechanical room
* Recommended use – Large buildings requiring steam and/or water

Manufacturers:

Thermo Solutions- Artic, Bryan Triple Flex, Riello, or approved equal.

General:

Provide flexible stainless-steel tube type boiler with capacity and operating characteristics indicated on schedules.

Furnish unit complete with boiler, boiler fittings, burner equipment, forced draft fan, combustion and safety controls, insulation and refractory, boiler trim and accessories; all piped, wired, and assembled on structural steel base frame.

Boiler and burner unit shall be UL listed and labeled, fire tested at manufacturers production facility prior to shipment. Minimum 94% efficiency when fire tested at 30 to 100% of rated capacity with fuels specified.

Constructed and stamped in accordance with the latest ASME Code for 150 psi working pressure (72 psi for Flexible Cast Iron) and inspected by authorized boiler inspection agency and registered with National Board.

Not less than 5 sq. ft of heating surface per rated boiler horsepower, measured on fireside (ASME method).

Furnish boilers with flanges and/or threaded openings for trimmings and external connections, sufficient hand-holes for thorough inspection and cleaning per ASME requirements and lifting loops.

Furnish units with factory installed enameled steel jacket over 2" thick fiberglass blanket.

Provide cover rings at openings in insulation jacket. Assemble jackets in neat workmanlike manner.

Furnish unit with electrical entrance cabinet, NEMA 1, to accept single service of **[208] [480]** volt, 3-phase, 60 cycle power to accommodate motors and control circuit power. Step-down transformer shall be included to provide control circuit power of 120 volt, single-phase, 60 cycle.

Burner:

Furnish unit with burner, forced draft fan with combustion air damper, fuel control, limit control, operating control and flame sensing device.

Furnish burner with on-off firing sequence for boilers up to 50 HP, with high-low fire with low fire start for boilers 60 to 80 HP, and full modulation with low fire start for boilers over 80 HP.

Provide permanent observation port at each end of boiler to allow observation of both pilot and main flame.

Burner to be suitable for firing **[natural gas] [No. 2 fuel oil] [natural gas and No. 2 fuel oil]**, mechanical pressure atomizing on burners with inputs under 50 GPH and air atomizing on burner over 50 GPH.

Provide pressure regulators at burners to reduce pressure suitable to burner operation.

Furnish units with fuel trains conforming to the latest UL requirements **[and FM requirements] [and IRI requirements]** and be factory assembled, wired, mounted and tested.

Controls:

Furnish unit with control cabinet, NEMA 1A enclosure with lock and exterior resets for blower motor starter and flame failure.

Control cabinet to include magnetic motor starters with thermal overload protection, electronic flame safeguard, programming timer for pre‑purge and post‑purge, burner switch, control circuit switch and fuse, necessary switching relays, low water and flame failure alarm, manual automatic selector switch, damper motor positioning control dial, indicating lights for major operations, numbered terminal strips, numbered wiring and engraved nameplates.

Include high limit **[manual reset],** operating limit **[auto][ reset],** and firing rate controls.

Controls shall permit automatic firing in accordance with load demand and manual control of firing rate at any desired position throughout turndown range.

Provide boiler with low fire hold control to keep boiler at low fire on start-up until boiler reaches preset minimum temperature.

Provide auxiliary contacts to provide status and alarm indication to BAS. Alarm condition shall be reported to BAS whenever alarm condition is indicated at boiler packaged control panel.

Edit the following paragraphs for multiple boiler installations.

Furnish unit with lead‑lag sequence control panel.

Furnish 2 operating limit controls and one dual potentiometer modulating control for field installation in common boiler water supply header.

Furnish selector switch for lead boiler selection and it is to be factory mounted and wired for boiler number on entrance box.

Control shall include assured low fire cutoff.

Provide standard boiler-mounted modulating, operating and high limit control. These shall be wired through three-position selector switch mounted in each boiler panel. This arrangement shall allow boiler local/manual, local/auto and remote lead-lag/auto firing rate control.

Furnish temperature sensor required for lead-lag control.

Boiler controls shall sequence lead-lag boilers in response to temperature sensor, located in hot water supply header, to maintain supply water temperature set point of \_\_\_ºF (FA). On drop in water temperature below set point, lead boiler shall be brought on-line at low fire. On continued drop below set point, lead boiler shall be modulated to high fire. If lead boiler, at high fire is unable to maintain supply water temperature set-point, lag boiler shall start at low fire. When lag boiler flame has been established and minimum temperature reached, lag boiler shall modulate to high fire and share load equally with lead boiler. As load is met, both boilers shall modulate in unison down to low fire. On continued drop in load, lag boiler shall shut off and lead boiler shall be modulated according to system demand. On further drop in load, lead boiler shall reduce firing rate to minimum and shut off.

Provide dry contacts and/or relays in control cabinet for interfacing with Building Automation System. Contacts shall be single pole, double throw and shall switch when boiler starts or stops.

Provide terminals to interlock boiler with combustion air fan to prevent burner operation unless combustion air fan is operating.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ **psi**
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Second Float Type low water cut‑off with blow down for boilers 80 HP input an above
* Drain valve
* Stack thermometer
* Flue Gas Condensate pH Neutralization

## HIGH EFFICIENCY CONDENSING BOILER

## SEALED COMBUSTION BOILER, STAINLESS STEEL WATER TUBE, MODULAR

Boiler Characteristics

* Capacity Range: 500 MBH to 5000 MBH.
* Turn Down 5:1 Minimum
* Efficiency: Up to 97%
* Warranty: 10-year heat exchanger.
* Advantages: High efficiency, direct vent.
* Disadvantage: Minimum water flow requirements require primary/secondary pumping arrangement. low return water temp required for high eff., first cost.
* Recommended use: As a part of a hybrid hot water heating system, in new construction where a hot water low temp system is designed, where economic analysis justifies use.

Manufactures:

Camus – Dyna Force, Laars - Magnatherm, Lochinvar Knight XL, Thermal Solutions – AMP, or approved equal.

General:

Provide units with capacity and operating characteristics indicated on schedules.

Single pass water tube boiler with stainless tubes & tubesheet. Boiler ASME H stamped and constructed for 125 psig and designed per ASME section IV. Furnish a relief valve in compliance with ASME section IV and set at (30) (50) (75) (100) (160) psig. All internal combustion chamber, and internal burner components, shall be manufactured with stainless steel materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall have a condensate drain to discharge any condensate buildup. CSA certified as an indirect or direct vent boiler and comply with ASME CSD-1.

Boiler minimum efficiency of 94%+ per BTS 2000, and operation in the condensing mode with inlet temperatures as low as 90 F.

Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe. Provide inlet/outlet combustion vent temperature fittings with direct outside air application.

Category II, III, or IV flu vent connection as appropriate for installation, condensing positive pressure, for both horizontal and sidewall venting. The vent outlet shall be compatible with installation.

Baked enamel finish, powder coat finish, or stainless steel insulated boiler sheet metal jacket with removal panels for maintenance access.

Inlet and outlet temperature gauge to monitor and limit inlet and outlet water temperatures.

Pressure gauge mounted on water outlet.

Omit controller if sequencing panel or external control will be used.

Provide a water temperature controller.

Provide each boiler with a low water cutout operationally testable, manually reset on loss of low-water and auto-rest on loss of power in accordance with ASME Section IV and CSD-1.

Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME Section IV and CSD-1.

Provide remote fault alarm contact for flame sensor and high temperature limit failure.

Provide single point wiring for controls and fan.

Burner:

Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer or Alloy Fiber. Maximum NOx emissions under 20 PPM. Pre-mix design to allow modulation of fuel and air for a minimum of 5:1 turndown.

Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval, ASME CSD-1 requirements, Boiler/burner package shall be factory assembled, wired, mounted, and factory fire tested.

Controls:

Provide a Boiler controller with capability of burner sequencing, flame supervision, safety shutdown, burner modulation control, gas pressure supervision, combustion air proving, pump control. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler from an external control system. Provide a dry contact output to signal boiler failure for use by an external control system.

Boiler management system (sequencing panel) may be specified in addition to integral boiler controls for multiple boiler arrangements. The following paragraph must be modified to individual project needs and coordinated with temperature control specification sections.

Boiler Management System Manufactures:

Honeywell, Heat Timer, Techmar, or equivalent.

Provide a Boiler Management System (BMS) panel or integral boiler controller(s) that shall stage and cycle the boilers to maintain the secondary supply water temperature setpoint as required for the highest operating seasonal efficiencies. BMS shall include a temperature sensor to control the secondary supply water temperature and a temperature sensor for monitoring outside air temperature for resetting the secondary supply water temperature setpoint when supply water temperature setpoint adjustment is not specified to be done through an external control system. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler system for all boilers from an external control system. Provide a dry contact output(s) to signal boiler failure for each boiler for use by an external control system.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ psi
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain valve
* Stack thermometer
* Flue Gas Condensate pH Neutralization

## HIGH EFFICIENCY CONDENSING BOILER

## SEALED COMBUSTION BOILER, STAINLESS STEEL WATER TUBE or FIRE TUBE, MODULAR (NON-GIANNONI HEAT EXCHANGER)

Boiler Characteristics

* Capacity Range: Up to 400MBH
* Turn Down: As high as 5:1
* Efficiency: 95%
* Warranty: Exchanger – 12 yr
* Boiler Advantages: High eff., seal combustion
* Boiler Disadvantages: Limited applications, use only on very small capacity applications
* Boiler Recommended use: Lite loads, special applications
* Other Designer notes: Do not use this boiler without prior DFD approval

Manufacture

Lochinvar Knight, NTI – New York Thermal Trinity Fire Tube, Triangle Tube, Viessmann Vitodens 200W,

General:

Provide units with capacity and operating characteristics indicated on schedules.

Boiler ASME stamped. Boiler designed and tested per ANSI Z21.13. Furnish a relief valve in compliance with ASME section IV and set at 30 psig. All internal combustion chamber, and internal burner components, shall be manufactured with stainless steel materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall be sealed and completely enclosed and shall have a condensate drain to discharge any condensate buildup.

Boiler minimum efficiency of 95%+ per BTS 2000, and operation in the condensing mode with inlet temperatures as low as 90 F.

Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe of the length and diameter shown on drawings and of material required by the Boiler manufacturer. Provide inlet/outlet combustion vent temperature fittings with direct outside air application.

Category II, III, or IV flu vent connection as appropriate for installation, for vertical, horizontal and sidewall venting. The vent outlet shall be compatible with installation.

Baked enamel finish Boiler metal jacket with removal panels for maintenance access.

Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures

Burner:

Pre-mix stainless steel burner design to allow modulation of fuel and air for a minimum of 5:1 turndown.

Controls:

Provide a Boiler controller with capability of burner sequencing, flame supervision, safety shutdown, burner modulation control, gas pressure supervision, combustion air proving, pump control. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler from an external control system. Provide a dry contact output to signal boiler failure for use by an external control system.

Boiler management system (sequencing panel) may be specified in addition to integral boiler controls for multiple boiler arrangements. The following paragraph must be modified to individual project needs and coordinated with temperature control specification sections.

Boiler Management System Manufactures:

Honeywell, Heat Timer, Techmar, or equivalent.

Provide a Boiler Management System (BMS) panel or integral boiler controller(s) that shall stage and cycle the boilers to maintain the secondary supply water temperature setpoint as required for the highest operating seasonal efficiencies. BMS shall include a temperature sensor to control the secondary supply water temperature and a temperature sensor for monitoring outside air temperature for resetting the secondary supply water temperature setpoint when supply water temperature setpoint adjustment is not specified to be done through an external control system. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler system for all boilers from an external control system. Provide a dry contact output(s) to signal boiler failure for each boiler for use by an external control system.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ psi
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain valve
* Stack thermometer
* Flue Gas Condensate pH Neutralization

## HIGH EFFICIENCY CONDENSING BOILER

## STAINLESS STEEL, FIRE TUBE, VARIABLE FLOW

Boiler Characteristics

* Capacity Range: 500 MBH to 2500 MBH with a primary pumping arrangement.Turn Down 5:1 Minimum
* Efficiency: Up to 97%
* Warranty: 20-year Thermal shock regardless of min. flow rate or hwr temp.
* Advantages: Variable Flow does not require a primary/secondary pumping arrangement.
* Disadvantage: low return water temp required for high eff., first cost.
* Recommended use: As a part of a hybrid hot water heating system, in new construction where a hot water low temp system is designed, where economic analysis justifies use.

Manufactures:

Aerco – Benchmark, Burdrais – SB, Camus – Advantus, Cleaver Brooks – Clear Fire, Fulton – Endura, Lochinvar – Crest, Magnatherm – FT, RBI – Flexcore, Riello –Array, Superior – Creek, Viessman – Vitocrossal.

General:

Provide units with capacity and operating characteristics indicated on schedules.

Single pass fire tube boiler with stainless tubes & tubesheet. No minimum return water temperature, and or minimum water flow required for proper operation. Boiler ASME H stamped and constructed for 125 psig and designed per ASME section IV. Furnish a relief valve in compliance with ASME section IV and set at **[30] [50] [75] [100] [160]** psig. All internal combustion chamber, and internal burner components, shall be manufactured with stainless steel materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall have a condensate drain to discharge any condensate buildup. CSA certified as an indirect or direct vent boiler and comply with ASME CSD-1.

Boiler minimum efficiency of 94%+ per BTS 2000, and operation in the condensing mode with inlet temperatures as low as 90 F.

Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe. Provide inlet/outlet combustion vent temperature fittings with direct outside air application.

Category II, III, or IV flu vent connection as appropriate for installation, for vertical, horizontal and sidewall venting. The vent outlet shall be compatible with installation.

Baked enamel finish or stainless steel insulated boiler sheet metal jacket with removal panels for maintenance access.

Inlet and outlet temperature gauge to monitor and limit inlet and outlet water temperatures.

Pressure gauge mounted on water outlet.

Provide each boiler with a low water cutout operationally testable, manually reset on loss of low-water and auto-rest on loss of power in accordance with ASME Section IV and CSD-1.

Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME Section IV and CSD-1.

Provide remote fault alarm contact for flame sensor and high temperature limit failure.

Provide single point wiring for controls and fan.

Burner:

Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer or Alloy Fiber. Maximum NOx emissions under 20 PPM. Pre-mix design to allow modulation of fuel and air for a minimum of 5:1 turndown.

Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval, ASME CSD-1 requirements, Boiler/burner package shall be factory assembled, wired, mounted, and factory fire tested.

Controls:

Provide a Boiler controller with capability of burner sequencing, flame supervision, safety shutdown, burner modulation control, gas pressure supervision, combustion air proving, pump control. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler from an external control system. Provide a dry contact output to signal boiler failure for use by an external control system.

Boiler management system (sequencing panel) may be specified in addition to integral boiler controls for multiple boiler arrangements. The following paragraph must be modified to individual project needs and coordinated with temperature control specification sections.

Boiler Management System Manufactures:

Honeywell, Heat Timer, Techmar, or equivalent.

Provide a Boiler Management System (BMS) panel or integral boiler controller(s) that shall stage and cycle the boilers to maintain the secondary supply water temperature setpoint as required for the highest operating seasonal efficiencies. BMS shall include a temperature sensor to control the secondary supply water temperature and a temperature sensor for monitoring outside air temperature for resetting the secondary supply water temperature setpoint when supply water temperature setpoint adjustment is not specified to be done through an external control system. Provide a 0-10 VDC or 4-20 mA input for resetting the hot water supply setpoint from an external control system. Provide a dry contact input to enable the boiler system for all boilers from an external control system. Provide a dry contact output(s) to signal boiler failure for each boiler for use by an external control system.

Water Boiler Trim:

Furnish complete water trim including:

* ASME water relief valves set at \_\_\_ psi
* Pressure and temperature gauge
* Operating temperature controls
* High limit control
* Low water cut out: LWCO to be operationally testable, feature manual reset on loss of low-water and auto-rest on loss of power.
* Drain valve
* Stack thermometer
* Flue Gas Condensate pH Neutralization

## BOILER BLOWDOWN SEPARATORS

Manufacturers:

Pennsylvania Separator Co., Cleaver Brooks, Bryan Steam, Hurst, Sellers, Industrial Combustion, or Wilson Engineering Co.

Construct boiler blow down separator in accordance with ASME Code suitable for associated boiler operating pressure but not less than 150 psig design pressure.

Furnish unit with inlet, vent and drain connections and stainless steel striking plate.

Furnish unit complete with floor supports, after-cooler, automatic temperature water regulator valve, strainer and 2‑1/2" dial remote mounted thermometer.

Unless otherwise indicated, inlet size of blow down separator to be equal to boiler bottom blow down connection size.

## CONTINUOUS BLOWDOWN HEAT RECOVERY SYSTEM

Manufacturers:

Cleaver Brooks, Sentry, or equal with size, capacity, and operation characteristics as indicated on plans and/or as scheduled.

Multi-boiler unit to be pre-piped and mounted with heat exchanger, manual 300 psi bronze flow control valve with strainer for each boiler, automatic temperature controller, sample valves, and sample cooler. Unit shall be designed for use with 150 psi boilers.

Temperature controller to automatically proportion total blow-down to total make-up water to surge tank and maintain leaving blow-down temperature below 100ºF. Inner tube to be of brass, connections ductile iron and steel, and seats hardened stainless steel.

Heat exchanger to be shell and tube type with removable 304 stainless steel U-tube bundle and steel shell, tube sheets, heads, internal supporting devices and external support saddles. U-tube bends to be twice the thickness of tubing. Heat exchanger to be constructed in accordance with the latest ASME code for Unified Pressure Vessels and so stamped. Tube side working pressure of 250 psi and shell side working pressure of 250 psi at 400ºF.

Sample cooler to be shell and tube type with steel shell and stainless steel tubes. Shell and tubes to be removable without disturbing piping or mounting. Tube side working pressure of 250 psi with shell side working pressure of 125 psi and test pressure of 250 psi.

## BOILER KILL SWITCH

Kele WPS-MP-BS-CLM with auxiliary contacts Kele PILNCCB or equal.  Switch shall have a push-pull maintained switch with auxiliary contacts for DDC monitoring and each boiler.  Labeling shall be provided to indicate switch is for Emergency Boiler Shut-Down and action required to reset.

# PART 3 ‑ EXECUTION

## INSTALLATION

Install units as shown on plans, as detailed, and according to manufacturer's installation instructions.

Set units on concrete housekeeping pads.

Install all items shipped loose by equipment manufacturer under supervision of equipment manufacturer's field service personnel.

## BOILERS

After piping system has been flushed, boil out boilers using chemical and procedure as recommended by boiler manufacturer. Perform boil‑out under supervision of boiler manufacturer's representative.

Manufacturer shall verify in writing that boilers have been cleaned according to their recommendations and are ready for operation.

Isolate boilers from piping system during boil‑out.

Pipe vents from gas train to atmosphere. Size of each vent shall not be less than connection size to device.

Show vents from gas train to outdoors on plan. Combine vents to a single vent where appropriate. Cross sectional area of combined vent shall be equal to or more than sum of each vent pipe cross sectional area. Verify number of vents required, vent pipe size, grouping vents, etc. with boiler manufacturer.

Pipe boiler drains to nearest floor drains.

Owner's representative and/or Engineer will observe boil‑out. Contractor must notify Engineer at least 72 hours prior to boil‑out.

Install gas pressure gauges at downstream of gas pressure regulators.

If remote control panels are used, install all interconnecting wiring and pneumatic tubing if used between panels and units.

## BOILER BLOWDOWN SEPARATORS

Install separators on structural steel framework as shown. Extend vent line to atmosphere.

Install aftercooler, valves, piping specialties and associated piping including cold water piping from branch pipe provided by Plumbing Contractor.

## BOILER KILL SWITCH

Install Kill Switch directly inside main Boiler Room door entrance or where indicated on the documents. Wire switch to boiler control panel safety circuit. When activated, switch will enact emergency boiler shutdown.

## CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

## FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

## AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of **[XX]** hours.

END OF SECTION