



SECTION 23 52 39 – FIRE-TUBE BOILERS

APACHE (STEAM)

(Use for 50HP or greater 2-pass dryback)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Scotch Marine Fire-tube boilers.
2. Steam boiler trim.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. BPVC Section I - Rules for Construction of Power Boilers
2. BPVC Section IV - Rules for Construction of Heating Boilers
3. B31.1 - Power Piping
4. CSD-1 - Controls and Safety Devices for Automatically Fired Boilers

B. National Electrical Manufacturers Association (NEMA)

1. NEMA 250 - Enclosures for Electrical Equipment

C. National Fire Protection Association (NFPA):

1. 85 - Boiler and Combustion Systems Hazards Code

D. National Board of Boiler and Pressure Vessel Inspectors

1. National Board Inspection Code (NBIC)

1.3 SUBMITTALS

A. Submittals shall include:

1. Product Data: Full product description including all accessories and control settings.
2. Drawings: Submit general arrangement drawing; including dimensions, weights and ratings, wiring diagrams, and all other shop related drawings.
3. Include materials of construction of major pressure vessel parts and fittings.
4. Controls Cutsheet: Submit complete set of cutsheets for trims and controls.
5. Rigging instruction: Submit detailed instructions on manufacturers recommended lifting and unloading procedures.
6. Warranty: Submit standard form equipment warranty.

B. Closeout Submittals:

1. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, recommended spare parts list, and maintenance and repair information.
2. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
3. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test, as applicable.
4. ASME Data Reports: Submit code paperwork required for field acceptance.

1.4 QUALITY ASSURANCE

- A. The packaged boiler must receive factory tests to check the construction, controls, and operation of the unit.
- B. Allow witnessing of factory inspections and tests at manufacturer's test facility.

- C. At a minimum the testing shall include: Low fire electrical check and gas train leak test, ASME required tests.
- D. **(Optional)** Full firetest- The factory firetest shall be a complete functional test typically conducted at 10 PSIG (Section IV) or 100 PSIG (Section I) and, at a minimum, is to consist of filling the boiler and operating the burner throughout its complete range of operation. Additionally, all of the components wired into the boiler safety control circuit are to be tested by simulating a failure condition. A copy of the firetest report is to be included in the manual.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Cover all openings, leave drain valves in open position, wrap electronics in plastic, shrink wrap burner.
- B. Off load boiler in accordance with boiler rigging instructions.

1.6 WARRANTY

- A. All equipment is to be guaranteed against defects in workmanship and materials for a period of 12 months from the date the equipment is first placed in use, or 18 months from date of completion; whichever shall be less.
- B. 15-year extended warranty for parts and labor on major pressure vessel components.
- C. 15-year extended warranty for parts and labor on front and rear smoke box door.

PART 2 – PRODUCTS

2.1 BOILER

- A. Type: The boiler shall be a 2-pass dryback Scotch marine horizontal fire tube industrial steam boiler manufactured by Superior Boiler. The furnace shall be located in the bottom third of the boiler shell to provide maximum heat transfer. Semi-wetback construction shall not be approved. The heat release in the furnace shall not be greater than (see R&D) btu/ft³. Designed for (natural gas and No. 2 oil) firing.
1. The boiler shall not have less than five square feet of AMSE heating surface, measured on the fireside, per rated boiler horsepower.
 2. Heating Surface: All Section I boilers with 350 or more square feet of fireside heating surface are to have a furnace of the Morrison corrugated design and shall have a furnace volume of not less than [REDACTED] cubic feet.
- B. Service: Continuous long-term generation of steam throughout the burner firing range in conformance to the specified performance requirements.
- C. Performance:
1. Steam Output Quantity and Pressure: The boiler shall be designed for [REDACTED] PSI steam with an operating pressure of [REDACTED] in accordance with the latest edition and addenda of Section (I) or (IV), of the A.S.M.E. Boiler and Pressure Vessel Code.
 2. Steam Output Quality: The steam boiler is designed to produce a steam quality of 99% at all firing rates.
- D. Construction:
1. Codes: Comply with ASME BPVC Section I (Boilers >15 psi mawp), ASME BPVC Section IV (Boilers ≤ 15 psi mawp), and all other applicable sections of the current edition of the ASME code.
 - a. Boilers smaller than 300 HP are to be constructed to meet the requirements of CSD-1; boilers 300 HP and larger are to comply with the requirements of NFPA 8501.

2. Tubes: All tubes are to have a minimum wall thickness of 0.105" and have an OD of 2.5". The second pass shall have turbulators for increase heat transfer efficiency. The tube ends on Section I boilers are to be attached by flare rolling and then beading (Optional) Seal welding after tube is rolled and beaded. The tubesheets on Section I boilers Model 8-750 and larger are to be a minimum 3/4" thick. On Section IV boilers, tubesheets will be a minimum thickness of 5/8". All ligament spacing shall be a minimum of 3/4". Tubes shall be constructed of ASTM A178 Grade A.
3. Manway: Boiler shall have a 12" x 16" manway located along the top centerline of the boiler to facilitate water side cleaning and inspection. The top of the furnace is to be visible when the manway cover is removed from boiler shell.
4. Handholes: All necessary handholes shall be provided in accordance with the A.S.M.E. Code. Provide two additional handholes to improve the ease of waterside inspection and cleaning. Locate additional handholes in the front tubesheet near the bottom of the boiler on either side of the furnace.
5. Access to Tubes and Furnace: The front and rear tubesheets must be fully accessible for inspections or cleaning when the front doors or rear doors is open. Fuel lines, linkages, and electrical connections shall not impede opening of the doors. Front and rear doors shall be davited. Provide a minimum of 17" inside diameter removable furnace plug to access the furnace.
6. Shell Piping and Connections:
 - a. (Section I) Steam nozzle shall be (<100HP) threaded. (≥100HP) 300 psig ASME flanged. Nozzle and shell assembly to be designed to withstand forces and moments imposed by connected piping. Nozzles and shell assembly shall not be used as primary anchor points for connected piping.

(Section IV) Steam nozzle shall be 150 psig ASME flanged. Nozzle and shell assembly to be designed to withstand forces and moments imposed by connected piping. Nozzles and shell assembly shall not be used as primary anchor points for connected piping.

- b. Manual steam vent connection on top of boiler shell shall be located to permit access to vent gate valve.
- c. Safety valve outlets shall permit straight run of vents through roof.
- d. Two (size) feedwater connections on the horizontal center line shall be provided, one on each side of the boiler. If boiler shell diameter exceeds 116 inches feedwater connections shall be lowered to provide access to feedwater connection. Each connection shall be furnished with an internal baffle.
 1. One set of feedwater valves (one gate valve and one check valve) the same size as the boiler feedwater connection is to be factory piped and installed on one of the feedwater connections. The piping is to be documented on the Manufacturer's ASME Data Report Form.
- e. A (size) flue gas connection shall be located at the rear of the boiler on the top centerline. The stack shall be designed for easy attachment of the exhaust flue by flange connection. The flue gas connection will be designed to support a minimum of 2,000 lbs. dead weight. The stack shall have a 1/2" connection for a stack thermometer.
- f. Connections for water level controls, water level alarms and indication devices, chemical diffuser.
- g. Pressure gauge and switch connections.
- h. Bottom blowoffs: Located in rear of boiler to permit complete collection of sediment and complete drainage. (200 BHP or greater) A second blowdown connection shall be located in the front of the boiler.

7. Support System:

- a. Base Frame: The boiler shall be mounted on a heavy structural steel base with extended runners on the front to provide burner support and protection. The



rear legs are to be slotted to provide for expansion when the boiler goes from a cold to a hot condition. All doors are to be held in place by lugs that are secured by replaceable brass nuts. The doors are to be sealed with a gas tight, non-proprietary ceramic fiber rope with a minimum density of 20 lbs. per cubic feet and a continuous use limit of 1800 F.

- b. Rigging and Jacking: The boiler is to be equipped with front and rear lifting eyes, located on the top center line. Provisions for jacking. Jacking locations shall be clearly marked.
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- 8. Refractory and Insulation: The boiler shell is to be insulated with two-inch-thick, eight pounds per cubic foot density mineral wool with a k factor of .27. The insulation is to be held in place by bands and then covered with a 22-gauge phosphate coated galvanized steel jacket. All openings in the jacket are to have trim rings. The smokebox doors are to be insulated with a 1" thick ceramic fiber blanket. The insulating blanket is to have a K-factor of .44 and is to be coated with a hardener to prevent erosion from the flue gases. Smokebox doors on all boilers with 350 square feet or more in heating surface are to be of the davit design.
 - 9. Casing: Sheet steel covering all areas of boiler shell. Flash or seal all openings at top of boiler at piping and flue connections to prevent leakage of water into insulation.
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- E. Factory Inspection and Certification: Inspect the completed boiler assembly in accordance with the requirements of the ASME BPVC Section I. The boiler inspection shall be certified.
 - F. Finish: The entire boiler is to be painted with a high temperature, 400 degrees Fahrenheit minimum, silicone-based enamel. The front and rear doors are to be sand

blasted before painting and the jacket is to be primed with a vinyl wash primer before painting.

2.2 BOILER TRIM (ACCESSORIES)

A. Conform to ASME BPVC, Section (I or IV)

B. Steam Safety Valves:

1. Capacities certified by the National Board of Boiler and Pressure Vessel Inspectors (NBBI)
2. Type: Bronze or cast-iron bodies, side outlet, flanged or threaded inlet and outlet, lifting lever, dual control rings, stainless steel trim, O-ring EPDM seats on bronze valves.
3. Setting and Adjustments: Relief valves set at a minimum of 17% higher than the operating pressure of the boiler, but no higher than the boiler design pressure shall be provided.
4. (Optional) - Drip Pan Ells: Cast iron factory-built safety valve discharge fitting with pipe-within-pipe slip-type connection to vertical vent pipe, basin for collecting condensate from vent pipe, drain connections on basin and at base of ell.

C. Steam Pressure Gauge:

1. Case: Turret-style, bottom connection, threaded ring, blowout disc in rear.
2. Dial: (4 ½", 6", 8") diameter, aluminum, black markings on white background.
3. Measuring Element: Bourdon tube designed for steam service.
4. Movement: Rotary; Stainless steel.
5. Pointer: Micrometer adjustable.
6. Window: Glass or plastic.
7. Accuracy: ½ percent of full scale
8. Range: (0-300 psig) gauge.

D. Water Level Safety and Operating Controls Indicators:

1. Primary and auxiliary low water burner cutoffs, gauge glass, (optional) automatic electronic modulating feedwater level control system, (optional) provide high and low water warning alarms.
 - a. Primary and auxiliary low water burner cutoff devices shall be in two separate water columns, piped individually to the boiler water spaces. One device shall be float-type, the other device shall be conductivity probes. Primary and auxiliary cutoffs shall require separate manual reset. Non-latching shunt switches shall allow blowdown of water columns without shutting down the burner.
 - b. Water level set points for all devices shall be as recommended by the boiler manufacturer.
 - c. (If used) High and low water warnings shall operate bell and separate high and low water level indicating lights on boiler control panel and shall not shut down the boiler.
 - d. (If used) Water level control system shall maintain the water level within limits established by boiler manufacturer for normal water level with no tripping of high and low-level alarms with instantaneous load swings of 25 percent of boiler capacity. Feedwater pump will operate continuously.

2. Water Column Unit:
 - a. A float type primary low water cut-off shall be provided with gauge glass, ball check gauge glass valves, and ball type water column blowdown valve.
 - b. A probe type auxiliary low water cut-off shall be provided.
 - c. (Optional) A probe type high water alarm shall be provided.
 - d. Feedwater control system shall be (Option #1 – On/off integral to low water cutoff.) (Option #2 modulating and integral to low water cutoff.) (Option #3 modulation controlled by drum level transmitter.)
 - e. Gauge Glass and Gauge Valves: Single vertical tubular gauge glass, tempered borosilicate, rated for 315 degrees C (600 degrees F)

- f. Provide automatic off-set gauge valves with ball checks to prevent fluid flow if gauge breaks. Provide gauge rods to protect glass
 - g. Water columns shall be rated for boiler design pressure saturated steam and have boiler and drain connections.
3. Electrical: Provide circuit breakers, transformers, all devices for complete control system. All control electronics and relays shall be in NEMA (1, 12, 4, 4x) panels.
4. Modulating Feedwater Control Valve: Operated by electric drive unit actuator with top mount integrated digital positioner.
- a. Recommended: Actuated 3-piece ball valve
 - 1. Body: Carbon Steel
 - 2. Ball & Stem: 316 Stainless Steel
 - 3. Seat: Polyfill
 - 4. Body Seals: TFE coated 316 stainless steel seals
 - 5. Ends: Screwed Pipe Ends (NPT)
 - b. Performance: Size valve to 125 percent of evaporation rate.
5. Low Water Cutout Operation: Primary low water cutoff shall be of the automatic reset type and in the burner safety loop. Auxiliary low water cutoff shall be of the manual reset type and in the burner safety loop.
6. (Optional) - Shunt Switches for float style low water cutoff(s): Provide separate non-latching shunt switches for each of the low water cutouts to allow manual blowdown of water column without tripping burner.
- E. Stack Thermometer:
- 1. Case: Stainless steel, hermetically sealed.
 - 2. Dial: (3" 5") diameter, stainless steel, black markings on white background.

3. Measuring Element: Bimetal.
4. Movement: Rotary; Stainless steel.
5. Pointer: Black.
6. Window: Heavy-duty glass, plastic, or shatter-proof glass.
7. Accuracy: 1 percent of full scale
8. Range: 100°F to 800°F gauge.

F. High Steam Pressure Burner Cutouts:

1. Provide two UL listed, FM approved units with different set points. Unit with lowest set point shall be automatic reset; unit with highest set point shall be manual reset.
2. Bellows or bourdon tube actuated sealed snap-acting switch with adjustable set point and adjustable differential pressure (automatic reset unit); switch position indicator.
3. Provide indicators with graduated scales for set point and differential pressure.
4. Mounting: Connect to water column piping. There shall be no valves between cutoff and boiler shell. Provide siphons at each switch to protect bellows from high temperature.

G. (Optional) - Sample Cooler:

1. Type: Factory-built shell and coiled tube heat exchanger with sample in tube, cooling water in shell, designed for wall mounting.
2. Shell and Head: Stainless-steel shell, bolted or threaded into head. Head shall have wall mounting brackets and piping connections for sample in and out and cooling water out. Minimum design pressure for shell and head, 250 psi. Shell removable without disturbing piping connections.
3. Sample Coil: Shall be 1/4-inch outside diameter stainless steel tubing, 1.0 square feet minimum heat exchange surface. Minimum design for 250 psi, 370-degree F. Design coil to relieve stresses due to thermal expansion.

H. (Optional) – Automatic Continuous Boiler Blowdown Control System:



1. Type: One factory-assembled system per boiler to automatically sense boiler water conductivity and operate automatic electric-powered blowdown valve to maintain desired total dissolved solids content in boiler water. Micrometer-type adjustable manual blowdown valve piped to bypass the automatic blowdown valve and conductivity sensor.
2. Service: Design valves, sensors and piping for steam and water at boiler design pressure. Controller shall be suitable for 120 degree F ambient and resist splashing water. System shall automatically maintain boiler water total dissolved solids at customer determined set point.
3. Operation: Programmable timer cycles to intermittently operate the blowdown valve to obtain conductivity samples, and to maintain the valve open for a time period until the conductivity of the boiler water reaches the set point. Provide an automatic temperature compensating circuit.
4. Controller: Shall be microprocessor-based sealed unit mounted at the boiler.

END OF SECTION