

Changes shown by ↕

SCOPE

- I 1.1 This practice covers the design, fabrication, and inspection of gas and oil fired water tube (membrane or tangent tube) industrial boilers (other than gas turbine exhaust boilers) having steam outlet conditions not exceeding 1700 psig (11730 kPa) and 950°F (510°C).
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is specified by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practices, codes, standards, and specification which shall be used with this practice.
- I * 2.2 **Table 2** lists the practices, code, and standards which shall be used with this practice as specified by the Purchaser.

TABLE 1

PRACTICES			
IP 1-1-1	Drawings, Diagrams, and Line Lists	IP 15-4-1	Flow Instruments
IP 2-1-1	Plant Noise Design Criteria	IP 15-5-1	Level Instruments
IP 3-4-1	Piping for Fired Equipment	IP 15-6-2	Environmental Protection for Instrumentation
IP 3-6-1	Piping for Instruments	IP 15-7-2	Protective Systems
IP 3-12-1	Valve Selection	IP 15-9-1	Control Valves
IP 3-16-1	Flanged Joints, Gaskets, and Bolting	IP 15-11-1	Instrument Control Panels
IP 3-18-1	Piping Fabrication Shop or Field	IP 18-7-1	Welding Procedures
IP 4-1-2	Structural Steel Design	IP 18-8-1	Precommission Cleaning of Steam Generating Equipment and Piping Systems for Rotating Equipment
IP 4-1-3	Design Loads for Structures	IP 18-10-1	Additional Requirements For Materials
IP 4-2-1	Auxiliary Structures for Operation and Maintenance	IP 18-12-1	Positive Material Identification
IP 7-5-1	Coils for Fired Heaters and Boilers	IP 19-1-1	Paint and Protective Coatings
IP 10-13-1	Special Purpose Centrifugal Fans	IP 19-3-3	Linings for Fired Heaters
IP 14-1-1	External Insulation	IP 20-1-1	Inspection of Equipment and Materials
IP 15-2-1	Temperature Instruments		
IP 15-3-1	Pressure Instruments		
CODES, STANDARDS AND SPECIFICATION			
ASME Codes Section I Power Boilers Section II Materials Section V Nondestructive Examinations B31.3 Power Piping PTC 4.1 Steam Generating Units PTC 19.11 Water and Steam in the Power Cycle AMCA Standard 210 Laboratory Methods of Testing Fans for Rating Purposes ASME Standard B1.20.1 Pipe Threads, General Purpose (Inch)		ASTM Standard C 680 Standard Practice for Determination of Heat Gain or Loss and the Surface Temperatures of Insulated Pipe and Equipment Surfaces NFPA Standards 8501 Single Burner Boiler Operation 8502 Prevention of Furnace Explosion / Implosions in Multiple Burner Boiler SSPC Specification SP7 Brush Off Blast Cleaning	



TABLE 2

PRACTICES	
IP 4-5-1	Steel Stacks
IP 4-5-2	Reinforced Concrete Chimneys
IP 5-1-2	Additional Requirements for Heavy Wall Pressure Vessels, Thickness Over 2 In.
IP 7-3-1	Sootblowers for Fired Equipment
IP 10-7-2	Special Purpose Steam Turbines
IP 15-8-1	Process Stream Analyzers
IP 16-9-1	Low Voltage A-C Motors Up to 200 HP (150 kW)
IP 18-3-2	Statically Cast Steel and Alloy Pressure Containing Parts and Tube Supports for Fired Heaters
CODE AND STANDARDS	
ASME Code	
Section VIII Pressure Vessels, Division 1	
ISO Standard	
R-831	Rules for Construction of Stationary Boilers
ASTM Standards	
A276	Stainless and Heat-Resisting Steel Bars and Shapes
A578/A578M	Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications

- I * 2.3 **Proposals to use codes** other than listed in [Table 1](#) shall be submitted to the Purchaser for approval by Purchaser. To be considered for acceptance, all of the following criteria must be met:
- a. The code must be acceptable to the **inspecting authority of the country** in which the boiler will be installed.
 - b. All provisions of **ISO R-831** are met.
- R 2.4 **A corrosion allowance** of 1/16 in. shall be used for drums, headers and all tube and crossover piping.

DEFINITIONS

- I 3.1 **Radiant heating surface** in the furnace is defined as the flat projected area of all surfaces enclosing the furnace volume exclusive of superheater cavity opening. Calculation of furnace heat release is to be based on this definition.
- I 3.2 **Effective projected radiant surface** in the furnace shall be calculated as the flat projected area of exposed tubes and exposed extended surface integral with tubes. Refractory covered surfaces shall not be included. Calculation of furnace heat absorption is to be based on this definition.

DOCUMENTATION

- I 4.1 **Proposal information.** A technical description, including the following information for the boiler and auxiliaries, shall be supplied:
- a. An itemized descriptive list of valves, instruments, controls, piping, and other boiler accessories included in the scope of supply.
 - b. The system resistance curve, overplotted on the fan characteristic curve for all FD and ID fans, for each operating combination.
 - c. Guaranteed ramp rates (load change) through entire range for:
 - 1. Cold start-up
 - 2. Upward load charge
 - 3. Downward load charge
 - d. A functional logic diagram showing the light-off and shutdown sequence for the burners.
 - e. Heat transfer surface in the furnace and boiler bank reported in accordance with the definitions given in this practice.
 - * f. The applicable performance data shown in [Table 3](#) for the maximum continuous rating and other specified operating points.

DOCUMENTATION (Cont)

- g. A dimensional drawing or drawings showing drum internals, drum and header material, outside diameter, plate thickness; water and steam circuit arrangement, furnace configuration, burner locations, flue and duct arrangements, and dimensions and material of expansion joints, size location of observation, access and inspection doors and sizes and locations of vents and drains.
 - h. Materials of construction.
 - i. Extent of platforming, ladders, and stairways to be supplied.
 - j. A list of exceptions to this practice or, if there are no exceptions, a statement to this effect in the proposal.
 - k. Maximum boiler turndown with all burners in operation and minimum recommended excess air for the specified design fuel and fuel pressure. The maximum capacity of liquid fuel guns shall be stated in lb/hr (kg/h).
 - l. A curve showing the variation of superheater outlet temperature with boiler load over the range of operation of the boiler.
 - m. Method of tube replacement/plugging for each coil.
 - n. Complete description of all field work required. Drawings shall show all break points and weights of individual shop assembled items.
 - o. A curve showing circulation rate versus steam production over the range of boiler operation.
 - p. One copy of the Vendor's quality control manual.
 - q. Proposed chemical cleaning arrangement/procedure. Procedures shall show nozzle/line sizes and locations, blinds, circulation paths and flow rates through each section of the boiler.
- I 4.2 **Post award review.** As a minimum, the Vendor shall provide for review by the Owner's Engineer the following design details:
 - a. All changes to proposal information.
 - b. Burners including general arrangement, air/fuel capacity curves, pilot details including ignitor and burner front piping.
 - c. Air and flue gas ducting including dampers, expansion joints, turning vanes, blinds, pressure drop and heat loss calculations.
 - d. Tubesheets and tube supports including stress calculations.
 - e. Castable manufacturer's recommended procedure for refractory dryout.
 - f. Complete tube to drum/header installation procedures.
 - g. Foundation loading diagram and steel structure and casing.
 - h. Calculation steam/water side pressure drop and of superheater metal temperature and flow balance.
 - i. Lining details including material selection, anchor details, heat loss calculations, installation procedures and expansion provision.
 - j. Observation and access doors.
 - k. Thermocouple details and installation procedure for non-drainable superheater.
 - l. All attemperator design criteria and heat transfer calculations.
 - m. Pressure relief valve calculations.
 - n. Tube vibrational analysis.
 - o. Combustion control, air flow measurement device and feed water control.
 - p. Code calculations for all pressure parts.
 - q. Auxiliary equipment such as air preheaters, induced and forced draft fans, sootblowers, and fuel filters.
 - r. Burner management system.
 - s. Emissions.
- I 4.3 **The final records** to be submitted to the Purchaser are:
 - a. Operating manuals shall be written specifically for the unit being supplied. The manuals shall include all details necessary for commissioning, startup, and operation without the need for vendor's assistance.

DOCUMENTATION (Cont)

- b. All as-built assembly and shop detail drawings and instructions necessary for fabrication, erection, and continued maintenance of the boiler, including adequate details and specifications for fabricating and installing any and all replacement parts.
- c. All proposal information, corrected to the as-built conditions.
- d. Approved procedure for refractory dryout.
- e. Vendor's recommendations and detailed procedure for both boil-out and chemical cleaning.
- f. Vendor's detailed procedure to plug tubes and tube holes. Provide mechanical features of plugs and details of tube expanding equipment required.
- g. An outline drawing shall be furnished for each significant pressure part. This drawing will be used as an overall summary drawing for in-plant inspection and maintenance tasks. This drawing shall show the size and orientation of all nozzles and connections, layout of all appendages to the pressure part, and sufficient data to adequately describe the part. The location of vessel marking or nameplate shall be indicated on this drawing.
- h. Fabrication drawings shall show weld details and materials, and shall reference applicable welding procedures. When impact testing is required, the drawings shall include:
 - 1. Component
 - 2. Material Specification
 - 3. Critical Exposure Temperature (CET)
 - 4. Appropriate Charpy Impact Requirements (Average/Minimum Values)
- i. Additional information shall be supplied as follows:
 - 1. Certified Material Mill Test Reports from the mill of manufacture for all pressure parts.
 - 2. Nameplate Rubbings.
 - 3. Code Calculations.

MATERIALS

- S *5.1 **Drums, headers and tubes.** Material with a maximum tensile strength in excess of 112,500 psi (775 MPa) is not acceptable. Proposals to use proprietary alloy material shall be submitted for approval by the Owner's Engineer.

DESIGN

LAYOUT AND ARRANGEMENT

- R ♦ *6.1 The boiler design and fuel combination shall be commercially demonstrated in a similar service to the satisfaction of the Owner's Engineer.
- *6.2 **Based on design fuel higher heating value, the maximum heat release at Maximum Continuous Rating (MCR) in the furnace shall not exceed the following limits:**

FUEL FIRED	HEAT RELEASE BASED ON:			
	Furnace Volume		Furnace Radiant Heating Surface	
	Btu/hr-ft ³	kW/m ³	Btu/hr-ft ³	kW/m ³
Gaseous fuels and liquid fuels lighter than 15° API (0.966 relative density)	80 000	828	150 000	473
Liquid fuels 15° API and heavier	60 000	620	150 000	473

- O 6.3 **The boiler and auxiliary equipment**, with the exception of the forced draft fans and drivers, shall be designed for a minimum of 10% excess air for firing gas fuel and 15% excess air for firing oil fuel or combination gas and oil fuel.
- O 6.4 All circuits and coils **shall be drainable**. For superheater exception see **Par. 6.15**.