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FIRED HEATERS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification covers requirements governing the design, fabrication, and inspection of fired process heaters (hereinafter referred to as heaters).

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. AISC Specification

   Design Fabrication and Erection of Structural Steel For Buildings

2. API Standards

530	Recommended Practice for Calculation of Heater Tube Thickness in Petroleum Refineries
630	Tube and Heater Dimensions for Fired Heaters for Refinery Services
665	Fired Heater Data Sheet

3. ANSI/ASME Standard

B1.20.1	Pipe Threads, General Purpose (Inch)

4. ASTM Standards

A 234/A 234M	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A 403/A 403M	Wrought Austenic Stainless Steel Piping Fittings
A422	Butt Welds in Still Tubes for Refinery Service
C155	Insulating Firebrick
A 106	Seamless Carbon Steel Pipe for High-Temperature Service
A 161	Seamless Low-Carbon and Carbon-Molybdenum Steel Still Tubes for Refinery Service
A 193/A 193M	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

A 200	Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service
A 213/A 213M	Seamless Ferritic and Austenic Alloy-Steel Boiler, Superheater, and Heat Exchanger Tubes
A 216/A 216M	Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service
A 217/A 217M	Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service
A 271	Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service
A 312/A 312M	Seamless and Welded Austenitic Stainless Steel Pipe
A 335/A 335M	Seamless Ferritic Alloy Steel Pipe for High-Temperature Service
A 560/A 560M	Castings, Chromium-Nickel Alloy
B 407	Nickel-Iron-Chromium Alloy Seamless Pipe and Tube

5. ANSI Standards

A12.1	Safety Requirements for Floor and Wall Openings, Railings, and Toeboards
A14.3	Safety Requirements for Fixed Ladders
B16.25	Buttwelding Ends
B31.3	Chemical Plant and Petroleum Refinery Piping

DOCUMENTATION

Proposal Information

A completed data sheet per API 665 shall be furnished for each unit.
Expected leakage rate (% of normal flow) at design draft conditions for isolation dampers in individual air ducts to burners.

Final Records

An “as-built” data sheet per API 665 shall be furnished for each unit.
The castable manufacturer’s recommended procedure for refractory dryout shall be submitted to purchaser prior to mechanical completion of the heater.

MATERIALS

Insulating firebrick shall have flat, uniform surfaces on all faces which have been ground or cut to size within a tolerance of plus or minus 1/16" (1.5 mm) for all dimensions.
Liquid fuel burner atomizers and tips shall be of the following materials:

- Internal atomizers shall be nitrided nitralloy or equivalent, and shall have a 0.005" (0.127 mm) case hardness of 1000 DPN.
- Tips shall be high speed tool steel (18-4-1, W-Cr-V, or equivalent), hardened to 55 Rockwell C.

Tubes and Tube Supports

Wrought pipe and tubing shall be seamless steel, and shall be per the listed ASTM Specifications. 25Cr 12Ni or 25Cr-20Ni tubes shall be per ASTM A 271 except that the chemical analysis shall be per ASTM A 312/A 312M.
Tube support materials shall be selected by temperature ranges as follows:

Flue Gas Temperature		Material
°F	°C	
800 and below	(427)	Carbon Steel
1150 and below	(621)	5Cr 1/2 Mo Grade C5
1400 and below	(760)	18Cr 8Ni Grade CF8
1600 and below	(870)	50Cr 50Ni + Nb (IN 657)
1800 and below	(982)	50Cr 50Ni
1900 and below	(1038)	60Cr 40Ni
2000 and below	(1093)	25Cr 20Ni Grade HK40
Above 2000		*) Requires Owner's Engineer's Approval

*) Alternate proposals for tube support materials shall be submitted to purchaser for approval by Owner's Engineer. Meehanite HR and 25Cr 12Ni are not acceptable alternatives.

Operating temperatures above 1200°F (650°C). Materials for tube supports operating at temperatures in excess of 1200oF shall meet the following requirements:

- If the fuel contains more than 100 ppm (100 mg/kg) vanadium or if the total sodium plus vanadium content exceeds 150 ppm (150 mg/kg), the supports shall be covered with a 2" (50 mm) minimum thickness coating of dense castable refractory, 130 lb/cu ft. (2080 kg/cu meter).
- Alternatively, 60Cr 40Ni, 50Cr 50Ni + Nb may be used without coating.

Bottom tube supports in compression for vertical radiant coil heaters shall be protected by insulating refractory.

HEATER LAYOUT

Tube Layout

Centerline of radiant tubes shall not be located less than the following distances from the components indicated:

Component	Minimum Distance
Radiant wall burners	3 ft. (900 mm)
Radiant walls	1-1/2 nominal tube diameters
Adjacent radiant tubes	2 nominal tube diameters (center-to-center)

Maximum ratio of exposed radiant tube length to tube circle for vertical cylindrical heaters, shall be 2.6 to 1.
Maximum height of radiant section tubes of any heater shall be 50 ft. (15.24 m).
Corbelling shall not be used on the bottom shield row of the convection section.

Natural Draft Upfiring

The requirements of this section apply only to upfiring, natural draft applications of the burners listed in later. Proposals of other installations or burners shall be submitted to the purchaser for approval by the Owner's Engineer.
Centerline of lowest horizontal radiant tube shall be not less than 2 ft. (600 mm) from the floor of the heater.
Refractory, tubes, and stack entrance in line of burner throw, shall be located not less than the following distances from burners:

- Two feet per MBtu/hr. (2 m per MW) maximum heat release per burner plus 6 ft. (1.8 m).
- If special short flame burners are used, the distances required may be reduced; however, any such application must be submitted to the purchaser for approval by the Owner's Engineer.

MAXIMUM HEAT RELEASE PER BURNER		MINIMUM DISTANCE to:							
		CENTERLINE OF RADIANT WALL TUBES				DISTANCE to: CENTERLINE OF RADIANT WALL TUBES UNSHIELDED REFRACTORY WALLS [1]			
MBtu/hr. (net)	(MW)	(Liquid Fuel)		(Gas Fuel)		(Liquid Fuel)		(Gas Fuel)	
2-1/2 or less	(0.73)	39	975	33	825	24	600	12	300
Above 2-1/2 but less than 6	(0.73 - 1.7)	45	1125	39	975	36	900	24	600
6 to 12 inclusive	(1.7 - 3.5)	51	1275	45	1125	39	975	27	675
*Above 12		* Requires approval of Owner'sEngineer							

Note:

1) Including internal dividing walls.

TUBE SUPPORTS

1. The design temperature for supports shall be equal to the maximum temperature of the flue gas in contact with the support at design operation of the heater. No credit may be taken for the insulating effect of refractory coatings applied for corrosion protection.
2. Tube support maximum allowable stresses shall be as follows:
   a. The maximum allowable dead load stresses shall not be greater than 1/2 the stress required to produce one-percent creep in 10,000 hours, or 1/2 the stress to produce rupture in 10,000 hours, whichever is less.
   b. The maximum allowable dead load plus frictional stresses shall not be greater than the full stress required to produce one-percent creep in 10,000 hours or to produce rupture in 10,000 hours, whichever is less.
   c. A casting factor of 0.8 shall be applied to all stress values.
   d. Tube support design shall be based on elastic design principles.
   e. The following maximum allowable stresses shall be used for the listed materials: