

Centrifugally Cast High Alloy Tubes for Fired Heaters Other Than Steam Cracking Reactors

(This practice is appropriate for attachment to Inquiry or Purchase Document)

IP 18-3-3

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Rev. 2

June 1999

Changes shown by ↕

SCOPE

- I 1.1 This practice covers the materials, fabrication, inspection and testing of centrifugally cast, heat resistant high alloy tubes for fired heaters other than steam cracking reactors.
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required, or that additional information shall be furnished by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practices, codes and standards which shall be used with this practice.

TABLE 1

PRACTICES	
IP 18-7-1	Welding Procedures
IP 18-10-1	Additional Requirements for Materials
IP 18-12-1	Positive Materials Identification
IP 19-7-1	Protection of Stainless Steel During Fabrication, Shipping, Storage and Field Construction
IP 20-1-1	Inspection of Equipment and Materials
CODES AND STANDARDS	
ASME Codes	
Section V	Nondestructive Examinations
Section VIII	Pressure Vessels, Division 1
Section IX	Welding and Brazing Qualifications
B31.3	Process Piping
ASME Standard	
B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASTM Standards	
A 488 / A 488M	Steel Castings, Welding, Qualification of Procedures and Personnel
A 608	Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
E 8 / E 8M	Tension Testing of Metallic Materials
E 139	Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
E 433	Reference Photographs for Liquid Penetrant Inspection

DEFINITIONS AND DOCUMENTATION

- I 3.1 **The term Inspector**, as used in this practice, refers to the Owner's Representative.
- I 3.2 **Sound wall thickness** is defined as the thickness remaining after machining or grinding and the elimination of all unacceptable or injurious defects such as porosity, shrinkage, slag, etc.
- I 3.3 **A log of all welds** shall be made and kept for each welder, identifying the tube number, weld number, welding process, consumable used, and date of the weld.
- I * 3.4 **A report of the complete chemical analysis of each heat** shall be **supplied by the foundry** to the Inspector.

MATERIALS

- R * 4.1 **Foundries shall be approved by the Owner's Engineer.**

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- R * 4.2 **Chemical composition of materials** shall conform to the specified standard or specification except as follows (wt%):
- | | |
|------------|------------|
| Copper | 0.100 max |
| Phosphorus | 0.025 max |
| Sulfur | 0.025 max |
| Lead | 0.002 max |
| Tin | 0.005 max |
| Bismuth | 0.0001 max |
- R 4.3 In addition to the requirements of **Par. 4.2**, where the specified material is **HP-45 modified with Columbium (Niobium)**, the composition shall conform to the requirements of **ASTM A608** with the following additions (wt%):
- | | |
|---------------------|-------------|
| Carbon | 0.38 - 0.45 |
| Manganese | 1.50 max |
| Silicon | 1.50 max |
| Chromium | 23.0 - 27.0 |
| Nickel | 33.0 - 35.0 |
| Molybdenum | 0.50 max |
| Columbium (Niobium) | 0.60 - 1.00 |
- R * 4.4 The vendor shall provide sufficient creep property data to statistically determine allowable stresses for design of the tubes. As specified by the Owner, creep testing shall be performed by the vendor to verify the creep properties provided.
- R * 4.5 If patented or proprietary alloys are proposed, composition and high temperature strength properties of such alloys shall be approved by the Owner's Engineer.

FABRICATION

DIMENSIONS, TOLERANCES, AND FINISH

- I * 5.1 **Tube dimensions**, including required minimum "sound wall thickness" will be specified.
- I 5.2 **Tolerances on tube diameter, wall thickness and length** shall be per **ASTM A608**, except that the maximum wall thickness for ID machined tubes shall be the minimum specified wall thickness + 0.090 inch (2.25 mm). **Bowing** in excess of 0.1 percent of length is unacceptable for individual tube sections and completed tube assemblies.
- * **Tolerances other than the above** will be specified.

MACHINING OF TUBE SURFACE AND TUBE ENDS

- R 5.3 **The tube OD** shall be **machined for a minimum distance** of 1/2 in. (13 mm) back from the weld bevels, then tapered 1:4 to the as-cast surface. The **finish** shall not exceed 125 μ in. (3.2 μ m) R_a per **ASME B46.1**.
- R * 5.4 **Machining or honing of the tube ID** for its full length is required unless otherwise specified. A minimum of 1/16 in. (1.6 mm) of internal surface shall be removed. The ID surface roughness shall not exceed 125 μ in. (3.2 μ m) R_a per **ASME B46.1**.
- R 5.5 **Counterbored tube ends**. Where the inside surface of the tube is not machined or honed for the full length, the ID of the tube ends shall be straight counterbored for a minimum distance of 1 in. (25 mm) back from the weld bevel then tapered 1:4 to the as-cast surface.
- I 5.6 **End of tubes shall be machined** to match the **machined ends of mating tubes** or fittings within 0.060 in. (1.5 mm) on inside diameter.

WELDING

- R 5.7 Welds shall be made by the SMAW, GTAW (TIG), GMAW (MIG) or, when approved, EBW process, subject to the following:
- Welding procedure and performance qualifications for each cast alloy shall be in accordance with ASME Section IX except that macroetch specimens may be substituted for bend specimens.
 - Root passes shall be made by an inert gas welding process and the underside of the weld shall be protected by an inert gas backup.
 - Backup rings shall not be used.