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Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes[1]

This standard is issued under the fixed designation A 250/A 250M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification[2] covers several grades, designated T1, T1a, T1b, T2, T11, T12 and T22, of minimum-wall-thickness, electric-resistance-welded, carbon-molybdenum and chromium-molybdenum alloy-steel, boiler and superheater tubes.

1.2 The tubing sizes and thicknesses usually furnished to this specification are ½ to 5 in. [12.7 to 127 mm] in outside diameter and 0.035 to 0.320 in. [0.9 to 8.1 mm], inclusive, in minimum wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.3 Mechanical property requirements do not apply to tubing smaller than ⅛ in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.4 An optional supplementary requirement is provided and, when desired, shall be so stated in the order.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification. The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

2. Referenced Documents

2.1 *ASTM Standards:*

A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes[3]

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing[4]

E 273 Practice for Ultrasonic Examination of Longitudinal Welded Pipe and Tubing[4]

3. Ordering Information

3.1 Orders for material under this specification should include the following, as required, to describe the desired material adequately:

3.1.1 Quantity (feet, metres, or number of lengths),

3.1.2 Name of material (electric-resistance-welded tubes),

3.1.3 Grade (Table 1),

3.1.4 Size (outside diameter or minimum wall thickness),

3.1.5 Length (specific or random),

3.1.6 Optional requirement (11.6),

3.1.7 Test report required (see Certification Section of Specification A 450/A 450M),

3.1.8 Specification designation, and

3.1.9 Special requirements and any supplementary requirements selected.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 450/A 450M, unless otherwise provided herein.

5. Manufacture

5.1 The steel shall be killed.

5.2 The tubes shall be made by electric-resistance welding.

6. Heat Treatment

6.1 After welding, or when cold finished, after the final cold-drawing pass, all tubes shall be heat treated and, except as provided in 6.1.1, furnished in the full annealed, isothermal annealed, normalized, or normalized and tempered condition at the option of the manufacturer. If furnished in the normalized and tempered condition, the minimum tempering temperature shall be 1200°F [650°C], except T22 shall be tempered at 1250°F [676°C] minimum.

6.1.1 When grades T1, T1a, T1b, and T2 are cold finished, the tubes may, at the option of the manufacturer, be heat treated after the final cold-drawing pass at a temperature of 1200°F or higher, provided one of the heat treatments specified in 6.1 was applied after welding.

7. Chemical Composition

7.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys, and is the direct responsibility of Subcommittee A01.10 on Tubing.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-250 in Section II of that Code.

[3] *Annual Book of ASTM Standards*, Vol 01.01.

[4] *Annual Book of ASTM Standards*, Vol 03.03.

TABLE 1 Chemical Requirements

Element	Composition, %						
	Grade T1	Grade T1a	Grade T1b	Grade T2	Grade T11	Grade T12	Grade T22
Carbon	0.10–0.20	0.15–0.25	0.14 max	0.10–0.20	0.05–0.15	0.05–0.15	0.15 max
Manganese	0.30–0.80	0.30–0.80	0.30–0.80	0.30–0.61	0.30–0.60	0.30–0.61	0.30–0.60
Phosphorus, max	0.025	0.025	0.025	0.025	0.025	0.030	0.025
Sulfur, max	0.025	0.025	0.025	0.020	0.020	0.020	0.020
Silicon	0.10–0.50	0.10–0.50	0.10–0.50	0.10–0.30	0.50–1.00	0.50 max	0.50 max
Molybdenum	0.44–0.65	0.44–0.65	0.44–0.65	0.44–0.65	0.44–0.65	0.44–0.65	0.87–1.13
Chromium	. . .	. . .	. . .	0.50–0.81	1.00–1.50	0.80–1.25	1.90–2.60

8. Product Analysis

8.1 An analysis of either one length of flat-rolled stock or one tube shall be made on each heat. The chemical composition thus determined shall conform to the requirements specified.

8.2 If the original test for product analysis fails, retests of two additional lengths of flat-rolled stock or tubes shall be made. Both retests for the elements in question shall meet the requirements of the specification; otherwise all remaining material in the heat or lot (Note 1) shall be rejected or, at the option of the producer, each length of flat-rolled stock or tube may be individually tested for acceptance. Lengths of flat-rolled stock or tubes which do not meet the requirements of the specification shall be rejected.

NOTE 1—For flattening and flange requirements, the term *lot* applies to all tubes prior to cutting of the same nominal size and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and from the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, the number of tubes of the same size and from the same heat in a lot shall be determined from the size of the tubes as prescribed in Table 2.

NOTE 2—For tensile and hardness test requirements, the term *lot* applies to all tubes prior to cutting, of the same nominal diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, a lot shall include all tubes of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed.

9. Tensile Requirements

9.1 The material shall conform to the requirements as to tensile properties prescribed in Table 3.

9.2 Table 4 gives the computed minimum elongation values for each 1/32-in. [0.8 mm] decrease in wall thickness. Where the wall thickness lies between two values shown above, the minimum elongation value shall be determined by the following equation:

TABLE 2 Number of Tubes in a Lot Heat Treated by the Continuous Process

Size of Tube	Size of Lot
2 in. [50.8 mm] and over in outside diameter and 0.200 in. [5.1 mm] and over in wall thickness	not more than 50 tubes
Less than 2 in. [50.8 mm] but over 1 in. [25.4 mm] in outside diameter or over 1 in. [25.4 mm] in outside diameter and under 0.200 in. [5.1 mm] in wall thickness	not more than 75 tubes
1 in. [25.4 mm] or less in outside diameter	not more than 125 tubes

$$E = 48t + 15.00\ [E = 1.87t + 15.00]$$

where:
E = elongation in 2 in. or 50 mm %, and
t = actual thickness of specimen, in.[mm].

10. Hardness Requirements

10.1 The tubes shall have a hardness not exceeding the requirements of Table 5.

11. Mechanical Tests Required

11.1 *Tension Test*—One tension test shall be made on a specimen for lots of not more than 50 tubes. Tension tests shall be made on specimens from two tubes for lots of more than 50 tubes (Note 2).

11.2 *Flattening Test*—One flattening test shall be made on specimens from each end of one finished tube, not the one used for the flange test, from each lot (Note 1).

11.3 *Flange Test*—One flange test shall be made on specimens from each end of one finished tube, not the one used for the flattening test, from each lot (Note 1).

11.4 *Reverse Flattening Test*—One reverse flattening test shall be made on a specimen from each 1500 ft [450 m] of finished tubing.

11.5 *Hardness Test*—Brinell and Rockwell hardness tests shall be made on specimens from two tubes from each lot (Note 2).

11.6 *Hydrostatic or Nondestructive Electric Tests*—Each tube shall be subjected to either the hydrostatic or the nondestructive electric test. The purchaser may specify which is to be used.

12. Forming Operations

12.1 Tubes when inserted in the boiler shall stand expanding and beading without showing cracks or flaws. Superheater tubes when properly manipulated shall stand all forging, welding, and bending operations necessary for application without developing defects.

13. Product Marking

13.1 In addition to the marking prescribed in Specification A 450/A 450M, the marking shall include the words “Electric Resistance-Welded Steel.”

14. Keywords

14.1 boiler tube; resistance welded steel tube; steel tube, alloy; superheater tube; welded steel tube