SPECIFICATION FOR ELECTRIC-RESISTANCE-WELDED CARBON STEEL BOILER AND SUPERHEATER TUBES FOR HIGH-PRESSURE SERVICE

SA-226/SA-226M

(Identical with ASTM Specification A 226/A 226M-95)

1. Scope

1.1 This specification covers minimum-wall-thickness, electric-resistance-welded, carbon steel, boiler and superheater tubes for high-pressure service.

1.2 The tubing sizes and thickness usually furnished to this specification are $\frac{1}{2}$ in. to 5 in. [12.7 to 127 mm] in outside diameter and 0.085 to 0.360 in. [2.2 to 9.1 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 $\frac{1}{8}$ in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.4 When these products are to be used in applications conforming to ISO Recommendations for Boiler Construction, the requirements of Specification A 520 shall supplement and supersede the requirements of this specification.

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

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as 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

A 520 Specification for Supplementary Requirements for Seamless and Electric-Resistance-Welded Carbon Steel Tubular Products for High-Temperature Service Conforming to ISO Recommendations for Boiler Construction

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing

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

3. General Requirements

3.1 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.

NOTE 1 *Explanatory Note* — For purposes of design, the following tensile properties may be assumed:

Tensile strength, min, ksi [MPa]	47 [325]
Yield strength, min, ksi [MPa]	26 [180]
Elongation in 2 in. or 50 mm, min, %	35

4. Ordering Information

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

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

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

4.1.3 Size (outside diameter and minimum wall thickness),

4.1.4 Length (specific or random),

4.1.5 Optional requirements (Section on Product Analysis and Hydrostatic or Nondestructive Electric Test),

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

4.1.7 Specification designation, and

4.1.8 Special requirements and any supplementary requirements selected.

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 all tubes shall be heat treated at a temperature of 1650°F [900°C] or higher and followed by cooling in air or in the cooling chamber of a controlled atmosphere furnace. Cold drawn tubes shall be heat treated after the final cold draw pass at a temperature of 1200°F [650°C] or higher.

7. Chemical Composition

7.1 The steel shall conform to the following requirements as to chemical composition:

Carbon, %	0.06 to 0.18
Manganese, %	0.27 to 0.63
Phosphorus, max, %	0.035
Sulphur, max, %	0.035
Silicon, max, %	0.025

7.2 Supplying an alloy grade of steel that specifically requires the addition of any element other than those listed in 7.1 is not permitted.

8. Hardness Requirements

8.1 The tubes shall have a hardness not exceeding 125 HB or 72 HRB.

9. Product Analysis

9.1 When requested on the purchase order, a product analysis shall be made by the supplier from one tube per 100 pieces for sizes over 3 in. [76.2 mm] and one tube per 250 pieces for sizes 3 in. [76.2 mm] and under; or when identified by heat, one tube per heat shall be analyzed. The chemical composition thus determined shall conform to the requirements specified.

9.2 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 2) 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 that do not meet the requirements of the specification shall be rejected.

NOTE 2 — A lot consists of 250 tubes for sizes 3 in. [76.2 mm] and under and of 100 tubes for sizes over 3 in. [76.2 mm], prior to cutting to length.

10. Mechanical Test Required

10.1 *Flattening Test* — One flattening test shall be made on specimens from each of two tubes from each lot (Note 2) of fraction thereof.

10.2 *Flange Test* — One flange test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof.

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

10.4 *Hardness Test* — Brinell or Rockwell hardness determination shall be made on specimens from two tubes from each lot. The term *lot* applies to all tubes prior to cutting, of the same nominal diameter and wall thickness which 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

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furnace at the same temperature, time at heat, and furnace speed.

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

11. Forming Operations

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

12. Product Marking

12.1 In addition to the marking prescribed in Specification A 450/A 450M, the letters "ERW" shall be legibly stenciled on each tube or marked on a tag attached to the bundle or box in which the tubes are shipped.

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SUPPLEMENTARY REQUIREMENT

The following supplementary requirement shall apply only when specified by the purchaser in the inquiry, contract, or order. Details of this supplemental requirement shall be agreed upon by the manufacturer and the purchaser.

S1. Additional Testing of Welded Tubing per ASME Request

S1.1 Each tube shall be subjected to an ultrasonic inspection employing Practices E 273 or E 213 with the rejection criteria referenced in Specification A 450/A 450M.

S1.2 If Practice E 273 is employed, a 100% volumetric inspection of the entire length of each tube shall also be performed using one of the non-destructive electric tests permitted by Specification A 450/A 450M.

S1.3 The test methods described in the supplement may not be capable of inspecting the end portions of tubes. This condition is referred to as end effect. This portion, as determined by the manufacturer, shall be removed and discarded.

S1.4 In addition to the marking prescribed in Specification A 450/A 450M, S1 shall be added after the grade designation.

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