
This standard is issued under the fixed designation A178/A178M; 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 (´) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers minimum-wall-thickness, electric-resistance-welded tubes made of carbon steel and carbon-manganese steel intended for use as boiler tubes, boiler flues, superheater flues, and safe ends.

Note: 1—Type C and D tubes are not suitable for safe-ending for forge welding.

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 0.360 in. [0.9 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 ¼ in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.4 Optional supplementary requirements are 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 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:

A450/A450M Specification for General Requirements for Carbon and Low Alloy Steel Tubes
E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing
E273 Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing

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 (A, C, or D, Table 1),
3.1.4 Size (outside diameter and minimum wall thickness),
3.1.5 Length (specific or random),
3.1.6 Optional requirements (product analysis, Section 7; crush test, Section 10; hydrostatic or nondestructive electric test, 11.6),
3.1.7 Test report required (Certification Section of Specification A450/A450M),
3.1.8 Specification designation,
3.1.9 Individual supplementary requirements, if required, and
3.1.10 Special requirements.

4. Manufacture

4.1 The steel for Grade D shall be killed.
4.2 Tubes shall be made by electric-resistance welding.

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A Summary of Changes section appears at the end of this standard

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5. Heat Treatment

5.1 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.

6. Chemical Composition

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

6.2 When a grade is ordered under this specification, supplying an alloy grade that specifically requires the addition of any element other than those listed in Table 1 is not permitted.

7. Product Analysis

7.1 When requested on the purchase order, a product analysis shall be made by the manufacturer or supplier from one tube per 100 pieces for sizes over 3 in. [76.2 mm], prior to cutting to length. Slight surface checks shall not be cause for rejection.

7.2 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 which do not meet the requirements of the specifications 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.

8. General Requirements

8.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A450/A450M unless otherwise provided herein.

9. Tensile Requirements

9.1 Grade C and D tubes shall conform to the requirements as to tensile properties prescribed in Table 2.

Note 3—Explanatory Note—For purposes of design the following tensile properties may be assumed for Grade A tubes:

10. Crush Test

10.1 When required by the purchaser, crushing tests shall be made on sections of tube 2½ in. [63 mm] in length which shall stand crushing longitudinally without cracking, splitting, or opening at the weld, as follows:

10.2 For tubing less than 1 in. [25.4 mm] in outside diameter, the length of the specimen shall be 2½ times the outside diameter of the tube. Slight surface checks shall not be cause for rejection.

11. Mechanical Tests Required

11.1 Flattening Test:

Note 4—Calculated elongation requirements shall be rounded to the nearest whole number.

TABLE 3 Minimum Elongation Values

<table>
<thead>
<tr>
<th>Wall Thickness</th>
<th>Elongation in 2 in. or 50 mm, min, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.312)</td>
<td>8</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.281)</td>
<td>7.2</td>
</tr>
<tr>
<td>¼ (0.250)</td>
<td>6.4</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.219)</td>
<td>5.6</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.188)</td>
<td>4.8</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.156)</td>
<td>4</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.125)</td>
<td>3.2</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.094)</td>
<td>2.4</td>
</tr>
<tr>
<td>%(\text{\textdegree}) (0.062)</td>
<td>1.6</td>
</tr>
</tbody>
</table>
11.1 For Grade A, one flattening test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof, and from each 2000 ft [600 m] or fraction thereof of safe-end material.

11.1.2 For Grades C and D, one flattening test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof.

11.2 Flange Test:
11.2.1 For Grade A, one flange test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof, and from each 2000 ft [600 m] or fraction thereof of safe-end material.

11.2.2 For Grades C and D, one flange test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof. The width of the flange shall not be less than 75 % of that specified in Specification A450/A450M.

11.3 Crush Test—For Grade A, when required by the purchaser, one crush test shall be made on specimens from each of two tubes from each lot (Note 2) or fraction thereof, and from each 2000 ft [600 m] or fraction thereof of safe-end material.

11.4 Tension Test—For Grades C and D, one tension test shall be made on specimens from each of two tubes from each lot. The term lot for tension test requirements 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 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.

11.5 Reverse Flattening Test—One reverse flattening test shall be made on each 1500 ft [450 m] of finished tubing.

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

12. Forming Operations

12.1 When inserted in the boiler, tubes shall withstand expanding and beading without showing cracks or flaws, or opening at the weld. When properly manipulated, superheater tubes shall withstand 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 A450/A450M, 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.

13.2 The manufacturer’s name or symbol may be placed permanently on each tube by rolling or light stamping before normalizing. If a single stamp is placed on the tube by hand, this mark should not be less than 8 in. [200 mm] from one end of the tube.

14. Keywords

14.1 boiler tube; resistance welded steel tube; steel tube, carbon; welded steel tube

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements may become a part of the specification when specified in the inquiry or invitation to bid, and production order or contract. These requirements shall not be considered, unless specified in the order and the necessary tests shall be made at the mill.

S1. Additional Testing of Welded Tubing for ASME Requirements

S1.1 The weld seam of each tube shall be subjected to an ultrasonic inspection employing Practices E273 or E213 with the rejection criteria referenced in Specification A450/A450M.

S1.2 If Practice E273 is employed, a 100 % volumetric inspection of the entire length of each tube shall also be performed using one of the nondestructive electric tests permitted by Specification A450/A450M.

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 A450/A450M, “S1” shall be added after the grade designation.
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