SPECIFICATION FOR SEAMLESS MEDIUM-CARBON STEEL BOILER AND SUPERHEATER TUBES

SA-210/SA-210M

(Identical with ASTM Specification A 210/A 210M-95 except for editorial differences in Table 2)

1. Scope

1.1 This specification covers minimum-wall-thickness, seamless medium-carbon steel, boiler tubes and boiler flues, including safe ends (Note 1), arch and stay tubes, and superheater tubes.

NOTE 1 — This type is not suitable for safe ending by forge welding.

1.2 The tubing sizes and thicknesses usually furnished to this specification are $\frac{1}{2}$ in. to 5 in. [12.7 to 127 mm] in outside diameter and 0.035 to 0.500 in. [0.9 to 12.7 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 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

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 (seamless tubes),

3.1.3 Grade,

3.1.4 Manufacture (hot-finished or cold-finished),

3.1.5 Size (outside diameter and minimum wall thickness),

3.1.6 Length (specific or random),

3.1.7 Optional requirements (Sections 7 and 10),

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

3.1.9 Specification designation, and

3.1.10 Special requirements

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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 *Steelmaking Practice* — The steel shall be killed.

5.2 The tubes shall be made by the seamless process and shall be either hot-finished or cold-finished, as specified.

6. Heat Treatment

6.1 Hot-finished tubes need not be heat treated. Cold-finished tubes shall be given a subcritical anneal, a full anneal, or a normalizing heat treatment after the final cold-finishing process.

7. Surface Condition

7.1 If pickling or shot blasting or both are required, this shall be specifically stated in the order.

8. Chemical Composition

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

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

9. Product Analysis

9.1 When requested on the purchase order, a product analysis shall be made by the supplier from one tube or billet per heat. 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 billets 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 billet or tube may be individually tested for acceptance. Billets or tubes which do not meet the requirements of the specification shall be rejected.

NOTE 2 — For flattening and flaring requirements, the term "lot" applies to all tubes prior to cutting of the same nominal size 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 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 3 — For tensile and hardness test requirements, 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 furnace at the same temperature, time at heat, and furnace speed.

10. Tensile Requiremnts

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

10.2 Table 4 gives the computed minimum elongation values for each $\frac{1}{32}$ 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:

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

where:

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

11. Hardness Requirements 01

11.1 The tubes shall have a hardness not exceeding the following: 79 HRB or 143 HB for Grade A-1, 89 HRB or 179 HB for Grade C.

12. Mechanical Tests Required

12.1 *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 3).

12.2 *Flattening Test* — One flattening test shall be made on specimens from each end of one finished tube

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from each lot (Note 2), but not the one used for the flaring test. Tears or breaks occurring at the 12 or 6 o'clock positions on Grade C tubing with sizes of 2.375 in. [60.3 mm] in outside diameter and smaller shall not be considered a basis for rejection.

12.3 *Flaring Test* — One flaring test shall be made on specimens from each end of the one finished tube from each lot (Note 2,) but not the one used for the flattening test.

12.4 *Hardness Test* — Brinell or Rockwell hardness test shall be made on specimens from two tubes from each lot (Note 3).

12.5 *Hydrostatic or Nondestructive Electric Test* — Each tube shall be subjected to the hydrostatic, or, instead of this test, a nondestructive electric test may be used when specified by the purchaser.

13. Forming Operations

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

14. Product Marking

14.1 In addition to the marking prescribed in Specification A 450/A 450M, the marking shall indicate whether the tube is hot-finished or cold-finished.

15. Keywords

15.1 boiler tubes; carbon; seamless steel tube; steel tube; superheater tubes

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TABLE 1
CHEMICAL REQUIREMENTS

Element	Composition, %	
	Grade A-1	Grade C
Carbon[A], max	0.27	0.35
Manganese	0.93 max	0.29–1.06
Phosphorus, max	0.035	0.035
Sulfur, max	0.035	0.035
Silicon, min	0.10	0.10

[A] For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum will be permitted up to a maximum of 1.35%.

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 diameter and 0.200 in. (5.1 mm) and over in wall thickness	not more than 50 tubes
2 in. (50.8 mm) and over in outside diameter and under 0.200 in. (5.1 mm) in wall thickness	not more than 75 tubes
Less than 2 in. (50.8 mm) but over 1 in. (25.4 mm) in outside diameter or over 1 in. in outside diameter and under 0.200 in. (5.08 mm) in wall thickness	not more than 75 tubes
1 in. (25.4 mm) or less in outside diameter	not more than 125 tubes

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TABLE 3
TENSILE REQUIREMENTS

	Grade A-1	Grade C
Tensile strength, min, ksi [MPa]	60 [415]	70 [485]
Yield strength, min, ksi [MPa]	37 [255]	40 [275]
Elongation in 2 in. or 50 mm, min, %	30	30
For longitudinal strip tests, a deduction shall be made for each $^{1}/_{32}$ in. [0.8 mm] decrease in wall thickness under $^{5}/_{16}$ in. [8 mm] from the basic minimum elongation of the following percentage points	1.50[A]	1.50[A]
When standard round 2 in. or 50 mm gage length or smaller proportionally sized specimen with the gage length equal to 4*D* (four times the diameter) is used	22	20

[A] See Table 4 for the computed minimum values.

TABLE 4
COMPUTED MINIMUM ELONGATION VALUES[A]

Wall Thickness, in. [mm]	Elongation in 2 in. or 50 mm, min, %
$^{5}/_{16}$ (0.312) [8]	30
$^{9}/_{32}$ (0.281) [7.2]	28
$^{1}/_{4}$ (0.250) [6.4]	27
$^{7}/_{32}$ (0.219) [5.6]	26
$^{3}/_{16}$ (0.188) [4.8]	24
$^{5}/_{32}$ (0.156) [4]	22
$^{1}/_{8}$ (0.125) [3.2]	21
$^{3}/_{32}$ (0.094) [2.4]	20
$^{1}/_{16}$ (0.062) [1.6]	18
0.062 to 0.035 [1.6 to 0.9], excl	17
0.035 to 0.022 [0.9 to 0.6], excl	16
0.022 to 0.015 [0.6 to 0.4], incl	16

[A] Calculated elongation requirements shall be rounded to the nearest whole number.

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