ASTM - A178/A178M
SPECIFICATION FOR ELECTRIC-RESISTANCEWELDED CARBON STEEL AND CARBON-MANGANESE STEEL BOILER AND SUPERHEATER TUBES

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.

The tubing sizes and thicknesses usually furnished to this specification are 1⁄2 to 5 in. [12.7 to 127 mm] in outside diameter and 0.035 to 0.320 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.

Mechanical property requirements do not apply to tubing smaller than 1⁄8 in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

A. Heat Treatment :-

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.
2. Cold-drawn tubes shall be heat treated after the final cold-draw pass at a temperature of 1200° [650°C] or higher.

B. Chemical Composition :-

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

Table 1

	Composition, %		
Element	**Grade A, Low-Carbon Steel**	**Grade C, Medium-Carbon Steel**	**Grade D, Carbon-Manganese Steel**
Carbon	0.06-0.18	0.35 max	0.27 max
Manganese	0.27-0.63	0.8	1-1.5
Phosphorus, max	0.035	0.035	0.03
Sulfur, max	0.035	0.035	0.015
Silicon	. . .	. . .	0.1 min

C. Tensile Requirements :-

The material shall conform to the requirements as to tensile properties given in Table 2.

D. Elongation :-

The minimum longitudinal elongation in 2 in. [50 mm] given in Table 2.

Table 2

	Grade A	Grade C	Grade D
Tensile strength, min, ksi (MPa)	47 [325]	60 [415]	70 [485]
Yield strength, min, ksi (MPa)	26 [180]	37 [255]	40 [275]
Elongation in 2 in. [50 mm], min, %:	35	30	30
For longitudinal strip tests, a deduction for each 1⁄32 in. [0.8 mm] decrease in wall thickness below 5⁄16 in. [8 mm] from the basic minimum elongation of the following percentage shall be made	. . .	1.5[A]	1.5[A]

[A] *See Table 3 for the computed minimum values.*

E. Mechanical Tests Required 1. Flattening Test.

2. Flange Test.
3. Crush Test :-

i. When required by the purchaser, crushing tests shall be made on sections of tube 2 1⁄2 in. [63 mm] in length

ii. which shall stand crushing longitudinally without cracking, splitting, or opening at the weld, as follows:

Table 3

Wall Thickness of Tubes, in. [mm]	Height of Crushed Section, in. [mm]	
	Grade A Tubes	Grade C and D Tubes
0.135 [3.43] and under	3⁄4 [19] or until outside folds are in contact	Crush tests not required
Over 0.135 [3.43]	1(1⁄4) [32]	. . .

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

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

where: E= elongation in 2 in. or 50 mm, %, and,

t = actual thickness of specimen, in. [mm].

v. For tubing less than 1 in. [25.4 mm] in outside diameter, the length of the specimen shall be 2 1⁄2 times the outside diameter of the tube.

Table 4

Wall Thickness		Elongation in 2 in. or 50 mm, min, %[A]
in.	mm	
5⁄16 (0.312)	8	30
9⁄32 (0.281)	7.2	29

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

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

4. Tension Test.
5. Reverse Flattening Test.
6. Hydrostatic or Non-destructive Electric Test :- Each tube shall be subjected to either the hydrostatic or the non-destructive electric test. The purchaser may specify which test is to be used.

Keyword

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