



Designation: A513/A513M – 20a

# Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing<sup>1</sup>

This standard is issued under the fixed designation A513/A513M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers electric-resistance-welded carbon and alloy steel tubing for use as mechanical tubing.

1.2 This specification covers mechanical tubing made from hot- or cold-rolled steel.

1.3 This specification covers round, square, rectangular, and special shape tubing.

Type	Size Range (Round Tubing)
Electric-Resistance-Welded Tubing from Hot-Rolled Steel	outside diameter from ½ to 15 in. [12.7 to 380 mm] wall from 0.065 to 0.650 in. [1.65 to 16.5 mm]
Electric-Resistance-Welded Tubing from Cold-Rolled Steel	outside diameter from ⅜ to 12 in. [9.5 to 300 mm] wall from 0.022 to 0.134 in. [0.56 to 3.40 mm]

1.3.1 Indeterminate wall thicknesses may be ordered. In those cases the more stringent tolerances of Tables 4, 6, 7, 8, 9, 10, 11, 12, 16, and 17 shall apply. When sizes within the allowable ranges are ordered all other requirements of the specification shall be met.

1.4 This specification covers mechanical tubing in various Grades (see Section 5), Types (see 12.1), and Thermal Conditions (12.1).

1.5 Optional supplementary requirements are provided and when desired, shall be so stated in the order.

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

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.09 on Carbon Steel Tubular Products.

Current edition approved July 1, 2020. Published July 2020. Originally approved in 1964. Last previous edition approved in 2020 as A513/A513M – 20. DOI: 10.1520/A0513\_A0513M-20A.

hard or rationalized conversions apply to diameters, lengths and tensile properties. Soft conversion applies to other SI measurements.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- A1008/A1008M Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- A1011/A1011M Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
- A1039/A1039M Specification for Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by Twin-Roll Casting Process
- A1040 Guide for Specifying Harmonized Standard Grade Compositions for Wrought Carbon, Low-Alloy, and Alloy Steels
- E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing
- E273 Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing
- E309 Practice for Eddy Current Examination of Steel Tubular Products Using Magnetic Saturation

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

**E570 Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products**

2.2 *ASME Standard*.<sup>3</sup>

**B46.1 Surface Texture**

2.3 *Military Standards*.<sup>4</sup>

**MIL-STD-129 Marking for Shipment and Storage**

2.4 *Federal Standard*.<sup>4</sup>

**Fed. Std. No. 123 Marking for Shipments (Civil Agencies)**

### 3. Ordering Information

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

- 3.1.1 Quantity (feet, metres, or number of lengths),
- 3.1.2 Name of material (electric resistance-welded carbon or alloy steel mechanical tubing),
- 3.1.3 Types, conditions and code letters, (See Sections 1 and 12),
- 3.1.4 Thermal condition, (See 12.2),
- 3.1.5 Flash condition, (See 12.3),
- 3.1.6 Grade designation, if required, (See Section 5),
- 3.1.7 Report chemical analysis and product analysis, if required (See Sections 6 and 7),
- 3.1.8 Individual supplementary requirements, if required (S1 to S10, inclusive),
- 3.1.9 Cross section (round, square, rectangular and special shapes),
- 3.1.10 Dimensions, round, outside and inside and wall thickness (See 8.1 and 8.2) or square and rectangular, outside dimension and wall thickness and corner radii, if required (See 9.1 and 9.2),
- 3.1.11 Length, round, mill lengths or definite cut length (See 8.3), square and rectangular, specified length (See 9.4),
- 3.1.12 Squareness of cut, round tubing, if required, (See 8.4),
- 3.1.13 Burrs removed, if required (See 11.2),
- 3.1.14 Protective coating (See 14.1),
- 3.1.15 Special packaging (See 17.1),
- 3.1.16 Specification designation,
- 3.1.17 End use,
- 3.1.18 Special requirements,
- 3.1.19 Special marking (See Section 16), and
- 3.1.20 Straightness Test Method (See 8.5 and 9.6).

### 4. Materials and Manufacture

- 4.1 The steel may be made by any process.
- 4.2 If a specific type of melting is required by the purchaser, it shall be as stated on the purchase order.
- 4.3 The primary melting may incorporate separate degassing or refining, and may be followed by secondary melting, such as electroslog or vacuum-arc remelting. If secondary

<sup>3</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

<sup>4</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

4.4 Steel may be cast in ingots or may be strand cast. When steel of different grades is sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by an established procedure that positively separates the grades.

4.5 Tubes shall be made by the electric-resistance-welded process and shall be made from hot- or cold-rolled steel as specified.

4.5.1 The weld shall not be located within the radius of the corners of any shaped tube unless specified by the purchaser.

### 5. Chemical Composition

5.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1 or Table 2 (See Specification A1040). If no grade is specified, Grades MT 1010 to MT 1020 may be furnished. Analyses of steels other than those listed are available. To determine their availability, the purchaser should contact the producer.

5.2 When a carbon steel 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 Tables 1 and 2 is not permitted.

5.3 Mechanical tubing with improved ductility may be produced from Drawing Steel (Types A and B), Deep Drawing Steel, or Extra Deep Drawing Steels identified in Specifications A1008/A1008M, A1011/A1011M, or A1039/A1039M. Those Specifications offer guidance in the form of nonmandatory Typical Ranges of Mechanical Properties.

### 6. Heat Analysis

6.1 An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of the elements specified; if secondary melting processes are employed, the heat analysis shall be obtained from one remelted ingot or the product of one remelted ingot of each primary melt. The heat analysis shall conform to the requirements specified,

**TABLE 1 Chemical Requirements for Standard Low-Carbon Steels<sup>A</sup>**

NOTE 1— Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in Table 3.

Grade Designation	Chemical Composition Limits, %			
	Carbon	Manganese	Phosphorus, max	Sulfur, max
MT <sup>B</sup> 1010	0.02–0.15	0.30–0.60	0.035	0.035
MT 1015	0.10–0.20	0.30–0.60	0.035	0.035
MT X 1015	0.10–0.20	0.60–0.90	0.035	0.035
MT 1020	0.15–0.25	0.30–0.60	0.035	0.035
MT X 1020	0.15–0.25	0.70–1.00	0.035	0.035

<sup>A</sup> Rimmed or capped steels which may be used for the above grades are characterized by a lack of uniformity in their chemical composition, and for this reason product analysis is not technologically appropriate unless misapplication is clearly indicated.

<sup>B</sup> The letters MT under grade designation indicate Mechanical Tubing.

**TABLE 2 Chemical Requirements for Other Carbon and Alloy Steels<sup>A</sup>**

NOTE 1—Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in Table 3.

Grade Designation	Chemical Composition Limits, %							
	Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum
1006	0.08 max	0.45 max	0.030	0.035	...	...	...	...
1008	0.10 max	0.50 max	0.035	0.035	...	...	...	...
1009	0.15 max	0.60 max	0.035	0.035	...	...	...	...
1010	0.08–0.13	0.30–0.60	0.035	0.035	...	...	...	...
1012	0.10–0.15	0.30–0.60	0.035	0.035	...	...	...	...
1015	0.13–0.18	0.30–0.60	0.035	0.035	...	...	...	...
1016	0.13–0.18	0.60–0.90	0.035	0.035	...	...	...	...
1017	0.15–0.20	0.30–0.60	0.035	0.035	...	...	...	...
1018	0.15–0.20	0.60–0.90	0.035	0.035	...	...	...	...
1019	0.15–0.20	0.70–1.00	0.035	0.035	...	...	...	...
1020	0.18–0.23	0.30–0.60	0.035	0.035	...	...	...	...
1021	0.18–0.23	0.60–0.90	0.035	0.035	...	...	...	...
1022	0.18–0.23	0.70–1.00	0.035	0.035	...	...	...	...
1023	0.20–0.25	0.30–0.60	0.035	0.035	...	...	...	...
1024	0.18–0.25	1.30–1.65	0.035	0.035	...	...	...	...
1025	0.22–0.28	0.30–0.60	0.035	0.035	...	...	...	...
1026	0.22–0.28	0.60–0.90	0.035	0.035	...	...	...	...
1027	0.22–0.29	1.20–1.55	0.035	0.035	...	...	...	...
1030	0.28–0.34	0.60–0.90	0.035	0.035	...	...	...	...
1033	0.30–0.36	0.70–1.00	0.035	0.035	...	...	...	...
1035	0.32–0.38	0.60–0.90	0.035	0.035	...	...	...	...
1040	0.37–0.44	0.60–0.90	0.040	0.050	...	...	...	...
1050	0.48–0.55	0.60–0.90	0.040	0.050	...	...	...	...
1060	0.55–0.65	0.60–0.90	0.040	0.050	...	...	...	...
1340	0.38–0.43	1.60–1.90	0.035	0.040	0.15–0.35	...	...	...
1524	0.19–0.25	1.35–1.65	0.040	0.050	...	...	...	...
4118	0.18–0.23	0.70–0.90	0.035	0.040	0.15–0.35	...	0.40–0.60	0.08–0.15
4130	0.28–0.33	0.40–0.60	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
4140	0.38–0.43	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
5130	0.28–0.33	0.70–0.90	0.035	0.040	0.15–0.35	...	0.80–1.10	...
8620	0.18–0.23	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8630	0.28–0.33	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25

<sup>A</sup> Where the ellipsis (...) appears in this table, there is no requirement.

except that where the heat identity has not been maintained or where the analysis is not sufficiently complete to permit conformance to be determined, the chemical composition determined from a product analysis made by the tubular manufacturer shall conform to the requirements specified for heat analysis. When requested in the order or contract, a report of such analysis shall be furnished to the purchaser.

## 7. Product Analysis

7.1 When requested on the purchase order, a product analysis shall be made by the supplier. The number and source of samples for such product analysis shall be based on the individual heat or lot identity of one of the following forms of material:

7.1.1 *Heat Identity Maintained*—One product analysis per heat shall be made on either the flat-rolled stock or tube.

7.1.2 *Heat Identity Not Maintained*—A product from one tube per 2000 ft [600 m] or less for sizes over 3 in. [75 mm], and one tube per 5000 ft [1500 m] or less for sizes 3 in. [75 mm] and under.

7.2 Samples for product analysis shall be taken in accordance with Practice A751. The composition thus determined shall correspond to the requirements of Table 1 or Table 2.

7.3 If the original test for product analysis fails, retests of two additional lengths of flat-rolled stock or tubes shall be

**TABLE 3 Tolerances for Product Analysis for Steels Shown in Tables 1 and 2<sup>A,B</sup>**

Element	Limit, or Maximum of Specified Range, %	Variation, Over the Maximum Limit or Under the Minimum Limit	
		Under min, %	Over max, %
Carbon	to 0.15, incl	0.02	0.03
	over 0.15 to 0.40, incl	0.03	0.04
	over 0.40 to 0.55, incl	0.03	0.05
Manganese	to 0.60, incl	0.03	0.03
	over 0.60 to 1.15, incl	0.04	0.04
	over 1.15 to 1.65, incl	0.05	0.05
Phosphorus	...	...	0.01
Sulfur	...	...	0.01
Silicon	to 0.30, incl	0.02	0.03
	over 0.30 to 0.60	0.05	0.05
Nickel	to 1.00, incl	0.03	0.03
Chromium	to 0.90, incl	0.03	0.03
	over 0.90 to 2.10, incl	0.05	0.05
Molybdenum	to 0.20, incl	0.01	0.01
	over 0.20 to 0.40, incl	0.02	0.02

<sup>A</sup> Individual determinations may vary from the specified heat limits or ranges to the extent shown in this table, except that any element in a heat may not vary both above and below a specified range.

<sup>B</sup> Where the ellipsis (...) appears in this table, there is no requirement.

made. Both retests for the elements in question shall meet the requirements of the specification; otherwise, all remaining material in the heat or lot shall be rejected or, at the option of