



Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing¹

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1. Scope

1.1 This specification covers round, square, rectangular, and special shape, electric-resistance-welded mechanical tubing, either zinc-coated (galvanized) after welding or produced from aluminum-coated, zinc-coated (galvanized), zinc-iron alloy-coated (galvannealed), or 55 % aluminum-zinc alloy-coated steel sheet. Tubing for use as electrical conduit (EMT) or intermediate metallic conduit (IMC) is not covered by this specification.

1.2 This specification covers mechanical tubing with outside diameters or maximum outside dimensions ranging from $\frac{1}{2}$ to 8 in. (12.7 to 203.2 mm) and wall thickness from 0.028 to 0.134 in. (0.71 to 3.40 mm).

1.3 Sizes outside the ranges listed above may be ordered provided all other requirements of the specification are met.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings²

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

A 428/A 428M Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles²

A 463/A 463M Specification for Steel Sheet, Aluminum-Coated by the Hot-Dip Process²

A 653/A 653M Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process²

A 792/A 792M Specification for Steel Sheet, 55 Aluminum-Zinc Alloy-Coated by the Hot-Dip Process²

A 924/A 924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process²

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² Annual Book of ASTM Standards, Vol 01.06.

³ Annual Book of ASTM Standards, Vol 01.03.

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3. Classification

3.1 The types of tubing covered by this specification are:

Type Number	Code Letters	Description
1	AWAC	electric-resistance-welded aluminum-coated carbon steel mechanical tubing
2	AWG	electric-resistance-welded galvanized carbon steel mechanical tubing
3	AWPG	electric-resistance-welded carbon steel mechanical tubing, post-hot dipped galvanized
4	AWGA	electric-resistance-welded carbon steel mechanical tubing, zinc-iron alloy-coated (galvannealed)
5	AWGZ	electric-resistance-welded carbon steel mechanical tubing, 55 % aluminum-zinc alloy-coated

4. Ordering Information

4.1 The ordered wall thickness of the tubing shall be the total of the base metal and the metallic coating.

4.2 Orders for material under this specification shall include the following:

- 4.2.1 Quantity (feet, metres, or number of lengths),
- 4.2.2 Type, code letters, and description (Sections 1 and 3),
- 4.2.3 Applicable ASTM designation number(s),
- 4.2.4 Coating designation and type of coating,
- 4.2.5 Chemically treated⁴ or not chemically treated raw material,
- 4.2.6 Oiled or dry (Section 16),
- 4.2.7 Extra smooth coating (if required),
- 4.2.8 Customer application, including fabrication,
- 4.2.9 Flash condition (7.1),
- 4.2.10 Steel grade designation (Sections 5 and 9),
- 4.2.11 Report of chemical analysis if required (Sections 10 and 11),
- 4.2.12 Shape (round, square, rectangular, or special),
 - 4.2.12.1 Dimensions: round—any two of the following: inside diameter, outside diameter, or wall thickness; square or rectangular—outside dimension, wall thickness, and corner radii, if required. (See 12.1 and 13.1 and 13.2.)
- 4.2.13 Length: round tubing—mill lengths or definite cut lengths (see 12.2); square and rectangular tubing—mill cut

⁴ Annual Book of ASTM Standards, Vol 02.04.

lengths and specified length (see 13.4).

4.2.14 Squareness of cut: round tubing, if required (see 12.3); square and rectangular tubing, if required (see 13.7),

4.2.15 Burrs removed, if required (see 15.2),

4.2.16 Special packaging (Section 19),

4.2.17 Customer specification number, if applicable,

4.2.18 Special requirements,

4.2.19 Special marking (Section 18), and

4.2.20 Recoating of outside diameter weld and heat-affected area, on precoated steel, if required.

5. Process

5.1 The steel shall be made from any process.

5.1.1 If a specific type of melting is required by the purchaser, it shall be stated on the purchase order.

5.1.2 The primary melting may incorporate separate degassing or refining and may be followed by secondary melting, using electroslag remelting or vacuum remelting. If secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

5.1.3 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.

5.2 For tubing produced from precoated steel sheet, the composition of the coating shall comply with the applicable specification.

5.2.1 *Specification A 463/A 463M*—Coating designation for aluminum coated-sheet.

5.2.2 *Specification A 653/A 653M*—Coating designation for galvanized and galvanized steel sheet.

5.2.3 *Specification A 792/A 792M*—Coating designation for 55 % aluminum-zinc alloy-coated steel sheet.

5.2.4 Other grades of coated steel sheet, as listed in Table 1 and Table 2, may be used as the precoated material for the steel tubing upon agreement between the manufacturer and the purchaser. Such steel sheet shall meet the requirements of Specification A 463/A 463M, A 653/A 653M, A 792/A 792M, and A 924/A 924M, except for the chemical requirements.

6. Manufacture

6.1 Tubes shall be made by the electric-resistance welding process and shall be made from hot or cold-rolled precoated steel.

TABLE 1 Chemical Requirements for Low-Carbon Steels^{A,B}

Grade Designation ^C	Composition, %			
	Carbon	Manganese	Phosphorus, max	Sulfur, max
MT1010	0.05 to 0.15	0.30 to 0.60	0.035	0.035
MT1015	0.10 to 0.20	0.30 to 0.60	0.035	0.035
MTX1015	0.10 to 0.20	0.60 to 0.90	0.035	0.035
MT1020	0.15 to 0.25	0.30 to 0.60	0.035	0.035
MTX1020	0.15 to 0.25	0.70 to 1.00	0.035	0.035

^A Rimmed or capped steels that 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.

^B Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in Table 5.

^C The letters MT indicate mechanical tubing.

TABLE 2 Chemical Requirements for Other Carbon Steels^A

Grade Designation	Composition, %			
	Carbon	Manganese	Phosphorus, max	Sulfur, max
1008	0.10 max	0.50	0.035	0.035
1010	0.08 to 0.13	0.30 to 0.60	0.035	0.035
1015	0.12 to 0.18	0.30 to 0.60	0.035	0.035
1016	0.12 to 0.19	0.60 to 0.90	0.035	0.035
1017	0.14 to 0.21	0.30 to 0.60	0.035	0.035
1018	0.14 to 0.21	0.60 to 0.90	0.035	0.035
1019	0.14 to 0.21	0.70 to 1.00	0.035	0.035
1021	0.17 to 0.24	0.60 to 0.90	0.035	0.035

^A Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in Table 5.

6.2 Special manufacturing practices allow for post-hot dipped galvanizing of welded tubing. If this product is desired all sections of this specification will apply except Table 3. Wall thickness tolerances shall be determined by agreement between the producer and purchaser.

7. Flash Conditions

7.1 The flash conditions under which tubing may be furnished are as follows: The flash shall be removed from the outside diameter of tubing covered by this specification. Tubing furnished to this specification may have the following conditions of welding flash on the inside diameter.

7.1.1 *Flash-In*— All tubing in which the inside diameter welding flash does not exceed the wall thickness or $\frac{3}{32}$ in. (2.4 mm), whichever is less.

7.1.2 *Flash Controlled to 0.010 in. (0.254 mm), Maximum*— Tubing in which the height of the remaining welding flash is controlled so as not to exceed 0.010 in. This condition is available in over 0.750 in. (19.05 mm) outside diameter and gages consistent with Table 4.

7.1.3 *Flash Controlled to 0.005 in. (0.127 mm), Maximum*—When the inside diameter flash is controlled to 0.005 in. (0.127 mm) maximum in tubing produced to outside diameter and wall thickness, inside diameter and wall thickness, or outside diameter and inside diameter tolerances, the remaining inside diameter flash, if any, is part of the applicable inside diameter tolerance. This controlled flash is available in 0.750 in. (19.05 mm) outside diameter or greater.

7.2 Tubes shall be furnished in the following shapes, as specified by the purchaser: round, square, rectangular, or special shapes (as negotiated).

7.3 Recoating of the outside diameter weld-heat-affected area on precoated steel tubing may be performed at the manufacturer's option, if not specifically requested by the purchaser.

8. Surface Finish

8.1 Special surface finishes as may be required for specific applications shall be provided in the purchase order by agreement between the producer and purchaser.

9. Base Metal Chemical Composition

9.1 The chemical composition of the sheet steel base metal shall conform to the requirements of Table 1.

9.2 Copper-bearing steel, with 0.20 % minimum copper,

**TABLE 3 Wall Thickness Tolerance for Premetallic Coated As-Welded Tubing^A
Outside Diameter, in.**

Wall Thickness	½ to 1, incl		Over 1 to 1½, incl		Over 1½ to 3¾, incl		Over 3¾ to 4½, incl		Over 4½ to 6, incl		Over 6 to 8, incl		
	BWG ^B	in. ^C	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	
	Wall Thickness Tolerance, in., Plus and Minus												
22	0.028	0.002	0.006	0.002	0.006								
20	0.035	0.003	0.006	0.002	0.006	0.002	0.006						
18	0.049	0.004	0.007	0.003	0.008	0.003	0.008						
16	0.065	0.005	0.007	0.004	0.008	0.003	0.009	0.003	0.009	0.002	0.010		
14	0.083	0.006	0.008	0.006	0.008	0.005	0.009	0.005	0.009	0.004	0.010	0.004	0.010
13	0.095	0.008	0.010	0.008	0.010	0.007	0.011	0.007	0.011	0.006	0.012	0.006	0.012
12	0.109	0.008	0.010	0.008	0.010	0.007	0.011	0.007	0.011	0.006	0.012	0.006	0.012
11	0.120	0.009	0.011	0.009	0.011	0.008	0.012	0.008	0.012	0.007	0.013	0.007	0.013
10	0.134	0.009	0.011	0.009	0.011	0.008	0.012	0.008	0.012	0.007	0.013	0.007	0.013

^A Post-hot dipped galvanized welded tubing wall thickness tolerances shall be determined by agreement between the producer and purchaser (6.2).

^B Birmingham Wire Gage.

^C 1 in. = 25.4 mm.

may be ordered in any of the grades shown in Table 1 or Table 2.

9.3 An analysis of each heat of steel shall be made by the basic steel producer to determine the percentage of the elements specified. The heat analysis, as supplied by the steel melter, shall conform to the requirements of Table 1 or Table 2.

9.4 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 and Table 2 is not permitted.

10. Coating Bath Chemical Composition

10.1 When tubing is produced from precoated sheet steel, the tubing manufacturer shall furnish, upon request, a report stating that the tubing has been manufactured from precoated sheet steel meeting one of the following specifications: A 463/A 463M, A 653/A 653M, A 792/A 792M, and A 924/A 924M.

10.2 For post-coated tubing the zinc used for coating shall be any grade of zinc conforming to Specification B 6.

11. Product Analysis

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

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

11.1.2 *Heat Identity Not Maintained*— One product analysis shall be made from each 2000 ft (610 m) or fraction thereof for sizes over 3 in. (76.2 mm) outside diameter, and from each 5000 ft (1524 m) or fraction thereof for sizes 3 in. (76.2 mm) outside diameter and under.

11.2 Samples for product spectrochemical analysis shall be taken in accordance with procedures established with the tube producer and the testing laboratory. The composition thus determined shall correspond to the requirements in Table 1 or Table 2 and be within the composition tolerances shown in Table 5.

11.3 If the original test for product analysis fails, retests of two additional samples of flat-rolled stock or tubes shall be made. Both retests for the elements in question shall meet the requirements of Table 1 or Table 2, and Table 5, of this

specification; otherwise, all remaining material in the heat or lot shall be rejected or, at the option of the producer, each length of flat-rolled stock or tube may be individually tested for acceptance. Any retested material not meeting the requirements of this specification shall be rejected.

12. Permissible Variations in Dimensions for Round Tubing

12.1 *Wall Thickness and Diameter*— Wall thickness tolerances for tubing made from precoated steel are shown in Table 3. All wall thickness tolerances include both the base steel and the coating (inside and outside surfaces). Variations in outside diameter and inside diameter of as-welded tubing made from precoated steel are shown in Table 4.

12.2 *Length*— Mechanical tubing is commonly furnished in mill lengths 5 ft (1.5 m) and over. Mill length tolerances are given in Table 6. Definite cut lengths are furnished when specified by the purchaser. Tolerances for definite length round tubing are given in Table 7.

12.3 *Squareness of Cut*— When specified, the tolerance for squareness of cut of round mechanical tubing is shown in Table 8. Measurements are made with the use of an “L” square and feeler gage. The contact length of the side leg of the square along the tube will be equal to or greater than the tube outside diameter, but not less than 1 in. (25.4 mm) nor greater than 4 in. (101.6 mm). The other leg shall always be equal to or greater than the tube outside diameter.

12.4 Straightness:

12.4.1 *Post-Coated Tubing*— The straightness tolerance for round mechanical tubing shall be 0.030 in. (0.762 mm) maximum in any 3-ft (0.914-m) length of tubing. The straightness tolerance on shorter lengths and on special requirements shall be agreed upon between the purchaser and producer.

12.4.2 *Precoated Tubing*— The straightness requirement for post-coated tubing shall be by agreement between the purchaser and producer.

12.5 *Ovality*— The ovality shall be within the tolerances of Table 4 except when the wall thickness is less than 3 % of the outside diameter. When the tube wall thickness is less than 3 % of the tube outside diameter the ovality may be 50 % greater than the outside diameter tolerances, but the mean diameter (average of maximum outside diameter and minimum outside