



Designation: **A787/A787M—20 A787/A787M – 20a**

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

This standard is issued under the fixed designation A787/A787M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope\*

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

1.1.1 The product is available in various grades based on chemical requirements (~~Section~~Sections 5 and 9).

1.1.2 The product is available in various Types (Section 3).

1.2 This specification covers mechanical tubing with outside diameters or maximum outside dimensions ranging from 1/2 to 15 in. [12.7 to 380.0 mm] and wall thickness from 0.028 to 0.180 in. [0.70 to 4.60 mm]. Indeterminate wall thicknesses may be ordered. In those cases the more stringent tolerances of Tables 3, 4, 5, 6, 12 and 13 shall apply.

1.3 When sizes within the ranges listed above are ordered, all other requirements of the specification shall be met.

1.4 This specification is expressed in both inch-pound units and in SI units; however, unless the purchase order specifies the applicable M specification designation (SI units), the inch-pound units shall apply. 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.

1.5 *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>

**A463/A463M Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process**

<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.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at 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

- A653/A653M Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- A792/A792M Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- A924/A924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- A1046/A1046M Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process
- B6 Specification for Zinc

### 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
6	AWZAM	electric-resistance-welded carbon steel mechanical tubing, zinc-aluminum-magnesium 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 specification designation number(s), number,~~

4.2.4 Coating designation and type of coating,

4.2.5 Chemically treated 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—chemical requirements of Type 1, 2, 4, 5 or 6, if applicable (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 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 A463/A463M*—Coating designation for aluminum coated-sheet.

5.2.2 *Specification A653/A653M*—Coating designation for galvanized and galvanized steel sheet.

5.2.3 *Specification A792/A792M*—Coating designation for 55 % aluminum-zinc alloy-coated steel sheet.

5.2.4 *Specification A1046/A1046M*—Coating designation for zinc-aluminum-magnesium alloy-coated steel sheet.

5.2.5 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 **A463/A463M**, **A653/A653M**, **A792/A792M**, **A924/A924M**, and **A1046/A1046M** 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 except for Type 3.

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

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.

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

Grade Designation <sup>C</sup>	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

<sup>A</sup> 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.

<sup>B</sup> Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in [Table 7](#).

<sup>C</sup> The letters MT indicate mechanical tubing.

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

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

<sup>A</sup> Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel, is to be in accordance with usual practice as shown in [Table 7](#).

## 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. [2.38 mm], whichever is less.

7.1.2 *Flash Controlled to 0.010 in. [0.25 mm], Maximum*—Tubing in which the height of the remaining welding flash is controlled so as not to exceed 0.010 in. [0.25 mm]. This condition is available in over 0.750 in. [19.0 mm] outside diameter and gauges consistent with [Tables 5 and 6](#).

7.1.3 *Flash Controlled to 0.005 in. [0.13 mm], Maximum*—When the inside diameter flash is controlled to 0.005 in. [0.13 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. [19.0 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 manufacture's option, if not specifically requested by the purchaser.

**TABLE 3 Wall Thickness Tolerance for Premetallic Coated As-Welded Tubing<sup>A</sup> (inch-pound units)  
Outside Diameter, in.**

Wall Thickness BWG <sup>B</sup>	½ to 1, incl		Over 1 to 1 1/16, incl		Over 1 1/16 to 3/4, incl		Over 3/4 to 4 1/2, incl		Over 4 1/2 to 6, incl		Over 6 to 8, incl		Over 8 to 10, incl		Over 10 to 12, incl		Over 12 to 15, incl	
	in.	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	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	0.002	0.010	0.002	0.010	0.002	0.010	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	0.003	0.011	0.003	0.011	0.003
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	0.004	0.014	0.004	0.014	0.004
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	0.004	0.014	0.004	0.014	0.004
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	0.004	0.016	0.004	0.016	0.004
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	0.004	0.016	0.004	0.016	0.004
9	0.148			0.009	0.012	0.008	0.012	0.008	0.012	0.007	0.013	0.007	0.013	0.006	0.014	0.006	0.014	0.006
8	0.165			0.009	0.012	0.008	0.012	0.008	0.012	0.007	0.013	0.007	0.013	0.006	0.014	0.006	0.014	0.006
7	0.180			0.009	0.012	0.008	0.012	0.008	0.012	0.007	0.013	0.007	0.013	0.006	0.014	0.006	0.014	0.006

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

<sup>B</sup> Birmingham Wire Gauge.



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**TABLE 4 Wall Thickness Tolerance for Premetallic Coated As-Welded Tubing<sup>A</sup> (SI Units)  
Outside Diameter, mm**

Wall Thickness mm	13 to 25, incl		Over 25 to 50, incl		Over 50 to 100, incl		Over 100 to 150, incl		Over 150 to 200, incl		Over 200 to 250, incl		Over 250 to 375, incl	
	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
1.0	0.04	0.08	0.08	0.20	0.08	0.20	0.05	0.25	0.05	0.25	0.05	0.25		
1.5	0.10	0.18	0.10	0.15	0.08	0.23	0.05	0.25	0.10	0.25	0.05	0.25	0.08	0.28
2.0	0.15	0.20	0.15	0.20	0.13	0.20	0.10	0.25	0.10	0.25	0.10	0.25	0.08	0.28
2.5	0.20	0.25	0.20	0.25	0.18	0.28	0.15	0.30	0.15	0.30	0.10	0.30	0.10	0.35
3.0	0.22	0.27	0.23	0.28	0.20	0.30	0.18	0.33	0.18	0.33	0.10	0.40	0.10	0.40
3.5	0.23	0.28	0.23	0.28	0.20	0.30	0.18	0.33	0.18	0.33	0.10	0.40	0.10	0.40
4.0			0.23	0.30	0.20	0.30	0.18	0.33	0.18	0.33	0.15	0.40	0.15	0.40
4.5			0.23	0.30	0.20	0.30	0.18	0.33	0.18	0.33	0.15	0.40	0.15	0.40

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



**TABLE 5 Diameter Tolerances for Metallic-Coated Round Tubing (inch-pound units)**

Outside Diameter Range <sup>F</sup> , in.	Wall Thickness		Tubing with Any Inside Flash Condition	Flash-Controlled to 0.005 in. Tubing Only <sup>A</sup>
	BWG <sup>B</sup>	in.	Outside <sup>C,D</sup> Diameter, Plus and Minus	Inside Diameter, Plus and Minus
Tolerances, in. <sup>E</sup>				
½ to 1⅛, incl	22 to 16	0.028/0.065	0.0035	0.019
Over 1⅛ to 2, incl	22 to 14	0.028/0.083	0.005	0.021
Over 1⅛ to 2, incl	13 to 10	0.095/0.134	0.005	0.027
Over 2 to 2½, incl	20 to 14	0.035/0.083	0.006	0.023
Over 2 to 2½, incl	13 to 10	0.095/0.134	0.006	0.029
Over 2½ to 3, incl	20 to 14	0.035/0.083	0.008	0.025
Over 2½ to 3, incl	13 to 10	0.095/0.134	0.008	0.031
Over 3 to 3½, incl	20 to 14	0.035/0.083	0.009	0.026
Over 3 to 3½, incl	13 to 10	0.095/0.134	0.009	0.032
Over 3½ to 4, incl	20 to 14	0.035/0.083	0.010	0.027
Over 3½ to 4, incl	13 to 10	0.095/0.134	0.010	0.033
Over 4 to 5, incl	16 to 14	0.065/0.083	0.020	0.037
Over 4 to 5, incl	13 to 10	0.095/0.134	0.020	0.043
Over 5 to 6, incl	16 to 14	0.065/0.083	0.020	0.037
Over 5 to 6, incl	13 to 10	0.095/0.134	0.020	0.043
Over 6 to 8, incl	16 to 10	0.065/0.134	0.025	0.048
Over 6 to 8, incl	9 to 7	0.148/0.180	0.025	0.059
Over 8 to 10, incl	16 to 10	0.065/0.134	0.030	0.043
Over 8 to 10, incl	9 to 7	0.148/0.180	0.030	0.059
Over 10 to 12, incl	16 to 10	0.065/0.134	0.035	0.041
Over 10 to 12, incl	9 to 7	0.148/0.180	0.035	0.045
Over 12 to 15, incl	12 to 10	0.109/0.134	0.040	0.058
Over 12 to 15, incl	9 to 7	0.148/0.180	0.040	0.060

<sup>A</sup> Flash controlled to 0.005 in. maximum tubing is produced to outside diameter tolerances and wall thickness tolerances, inside diameter tolerances and wall thickness tolerances, or outside diameter tolerances and inside diameter tolerances, in which the height of the remaining inside welding flash is controlled not to exceed 0.005 in. Any remaining flash is considered to be part of the applicable inside diameter tolerances.

<sup>B</sup> Birmingham Wire Gauge.

<sup>C</sup> Flash-in tubing is produced to outside diameter tolerances and wall thickness tolerances only, and the height of the inside welding flash does not exceed the wall thickness or ⅜ in., whichever is less.

<sup>D</sup> Flash controlled to 0.010 in. maximum tubing consists of tubing over ⅝ in. outside diameter which is commonly produced to outside diameter tolerances and wall thickness tolerances only, in which the height of the remaining inside welding flash is controlled not to exceed 0.010 in.

<sup>E</sup> The ovality shall be within the above tolerances except when the wall thickness is less than 3 % of the outside diameter, in which cases see 12.5.

<sup>F</sup> Measured at least 2 in. from the cut end of the tubing.

## 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](#), [Table 2](#), or the applicable chemical requirement of Type 1, 2, 4, 5 or 6 product.

9.2 Copper-bearing steel, with 0.20 % minimum copper, 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](#).