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Electrical Metallic Tubing—Steel (EMT-S)

National Electrical Manufacturers Association

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American National Standard for Electrical Metallic Tubing—Steel (EMT-S)

Secretariat:

National Electrical Manufacturers Association

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American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard C80.3-2021)

This Standard was developed by the Accredited Standards Committee on Raceways for Electrical Wiring Systems, C80. The objective of the committee is to produce a comprehensive specification that will establish uniform dimensions and Standard construction requirements for Electrical Rigid Steel Conduit, Steel Electrical Metallic Tubing, Electrical Intermediate Metal Conduit, and Electrical Aluminum Rigid Conduit raceway products and their associated components.

This Standard was originally approved in 1950 and revised in 1953, 1959, 1963, 1966, 1977, 1983, 1990, 1994, 2004, 2005, and 2015.

Suggestions for improvement of this Standard are welcome. They should be sent to:

NEMA Technical Operations Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

This Standard was processed and approved for submittal to ANSI by the Accredited Standards Committee (ASC C80), Raceways for Electrical Wiring Systems. Committee approval of the Standard does not necessarily imply that all committee Members voted for its approval. At the time it approved this Standard, the C80 Committee had the following Members:

J. Burris, Chairman
K. Shen, Secretary

Organization Represented:	*Name of Representative:*
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Atkore International	R. Horner
Atkore International	E. Iverson
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Wheatland Tube Company	J. Burris

The following Members of the NEMA Steel Conduit & Electrical Metallic Tubing - Codes/Communications/ Technical Committee worked on this Standard prior to its publication:

J. Burris, Co-Chair
R. Horner, Co-Chair
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Organization Represented:	*Name of Representative:*
ABB Inc.	D. Kendall
Atkore International	B. Deacy
Atkore International	R. Horner
Atkore International	E. Iverson
Consultant (STI)	P. Dobrowsky
Nucor	J. Broussard
Nucor	N. Fraser

Nucor	G. Fuentes
Nucor	C. Wood
Robroy Industries, Inc.	S. Voelzke
Steel Tube Institute of North America	B. Sullivan
STI	J. Andre
Western Tube (Division of Zekelman Industries)	A. Nunez
Wheatland Tube Company	J. Burris
Wheatland Tube Company	G. Maurer

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TABLES

1 Scope

This Standard covers the requirements for steel electrical metallic tubing for use as a raceway for wires or cables of an electrical system. Finished tubing is typically furnished in Standard 10-ft (3.05-m) lengths. The production of lengths shorter or longer than the Standard length shall be allowed. EMT is protected on the exterior surface with a metallic zinc coating or alternate corrosion protection coating (see UL 797 for alternate corrosion protection coating requirements) and on the interior surface with zinc or organic coating.

This Standard also covers electrical metallic tubing elbows.

Properly assembled systems of EMT-S, manufactured in accordance with this Standard, and other identified fitting provide for the electrical continuity required of an equipment grounding conductor.

2 Normative References

The following Standards contain provisions that, through reference in this text, constitute requirements of this American National Standard. At the time of publication, the editions indicated were valid. All Standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the Standards indicated below unless otherwise specified.

ASTM International (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

ASTM A239 – 19	*Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles*
ASTM B117 – 19	*Standard Practice for Operating Salt Spray (Fog) Apparatus*
ASTM B499 – 14	*Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals*
ASTM D638 – 14	*Standard Test Method for Tensile Properties of Plastics*
ASTM D1654–16	*Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*
ASTM D2444–19	*Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*
ASTM D3359–17	*Standard Test Method for Measuring Adhesion by Tape Test*
ASTM G 151– 19	*Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources*
ASTM G 153 –13	*Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*
ASTM G 155 –13	*Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60092

UL 797 – 07	*Electrical Metallic Tubing – Steel*

3 Definitions

Alternate corrosion-resistant coating (ACRC): A coating other than one consisting solely of zinc that, upon evaluation, has demonstrated the ability to provide the level of corrosion resistance required

on the exterior of tubing. It is not prohibited that the coatings include zinc. (See UL 797.)

Elbow: A manufactured curved section of EMT.

Electrical metallic tubing—steel (EMT-S): A steel raceway of circular cross-section designed for the physical protection and routing of conductors and cables for use as an equipment grounding conductor.

4 Units of Measurement

The values stated in English units are to be regarded as the Standard. The metric (SI) units are exact conversions.

5 General Requirements

5.1 Circular Cross Section

EMT-S shall have a circular cross-section sufficiently accurate to permit the application of identified EMT-S fittings.

5.2 Wall Thickness

The wall thickness shall be uniform throughout.

5.3 Interior Surface

The interior surface shall be smooth and free from injurious defects that compromise the intended use of the electrical raceway.

5.4 Welding

The welding of all seams shall be continuous and done in a workmanlike manner.

5.5 Cleaning

The tubing shall be adequately cleaned before the application of the protective coating. The cleaning process shall leave the tubing exterior and interior surfaces in such a condition that the protective coating shall be smooth and adhere firmly.

5.6 Protective Coating for Corrosion Resistance

The exterior surface shall be either thoroughly and evenly coated with metallic zinc or protected with an ACRC.

The interior surface shall be protected by zinc or organic coating. The interior coating shall have a smooth continuous surface. An occasional variation due to the uneven flow of coating shall be acceptable.

5.7 Surface Treatment

Any surface treatment not exceeding 0.00015 in. (0.0038 mm) that is employed as a topcoat or conversion coating is not required to meet the requirements for an ACRC or organic coating.

6 Detailed Requirements

6.1 Exterior Coating

6.1.1 Zinc Coating

The zinc coating thickness on the outside surface shall be equivalent to a minimum thickness of 0.0008 in. (0.02 mm), as tested in accordance with 7.2.

6.1.2 Alternate Corrosion-Resistant Coating (ACRC)

(See UL 797.)

6.2 Interior Coating

6.2.1 The zinc coating shall be tested in accordance with 7.1.2.

6.2.2 The organic coating shall not soften at a temperature of 120°F (49°C) and shall be sufficiently elastic to comply with the requirements described in 7.4.

6.3 Chamfering

Each end of each tube shall be chamfered or otherwise treated before coating to remove any burrs or sharp edges.

6.4 Identification

Each length of EMT-S and each elbow shall be identified with markings in accordance with 9.

6.5 Dimensions

The dimensions and weight of EMT-S shall be in accordance with Table 1.

6.6 Elbows

Elbows shall be made of a grade of steel similar to that employed in straight lengths of EMT-S and shall be treated, coated, and marked for identification in accordance with the applicable requirements for EMT-S. The minimum radius of a 90-degree elbow and the minimum straight length at each end shall be as indicated in Table 2.

7 Test Procedures

7.1 Bending Properties

7.1.1 Ductility of Steel

At ambient temperature, the tubing shall be capable of being bent, with a bending tool designed for the purpose, to 90 degrees, with a centerline radius as shown in Table 2 and the seam in either compression or tension. The tubing shall not develop cracks in the metal or show any visible signs of splits or injurious defects in the weld area.

7.1.2 Ductility of Coatings at Ambient Temperature

The protective coatings used on the exterior and interior surfaces of EMT-S shall be sufficiently elastic to prevent their cracking or flaking off when a finished sample of trade size 1/2 (16) or the smallest trade size manufactured is tested at ambient temperature. The test shall be performed within one year after the time of manufacture by bending the tubing 180 degrees around a mandrel, the radius of which is shown in Table 2. Samples of other trade sizes shall be bent 90 degrees around a mandrel, the radius of which is shown in Table 2.

Compliance of all trade sizes shall be determined by bending the tubing with any suitable bending equipment.

7.2 Thickness of Zinc Coating

One of the following test methods shall be employed for measuring the thickness or extent of the external zinc coating on EMT-S:

a. Magnetic test in accordance with ASTM B499.
b. Copper sulfate test (Preece Test) in accordance with ASTM A239. Material that will withstand four one-minute immersions shall be considered as meeting the requirements of 6.1.1.
c. Copper sulfate test method for zinc coating in accordance with UL 797.

7.3 Alternate Corrosion-Resistant Coatings (ACRC)

See UL 797.

7.4 Performance Requirement of Organic Coating for Use on Interior Surface

Two test pieces of uncoated sheet steel, 3 in. x 5 in. x 0.010 in. (76.2 mm x 127.0 mm x 0.25 mm), shall be cleaned with a suitable solvent to remove all grease and foreign material. Each piece shall be dipped into the material used for the inside coating of the tubing. The coated test pieces shall be allowed to air-dry for 30 minutes before being placed in the baking oven. Each piece shall be suspended by means of short wires in the baking oven, and the samples shall be baked for a period of five hours at the normal baking temperature used in production. If the normal baking temperature is less than 275°F (135°C) or if the coating is regularly air-dried, the oven temperature shall be maintained at 275°F to 302°F (135°C to 150°C).

At the end of the five-hour period, the test samples shall be removed from the oven and allowed to air-cool to room temperature. Each test piece shall be gripped in a vise and then bent from the opposite side back and forth five times through an angle of 180 degrees, the radius of the bend being 1/16 in. (1.59 mm). When so tested, the coating on the sample shall not crack or flake.

8 Examination of Product

8.1 Place of Inspection

All tests and inspections shall be made at the place of manufacture prior to shipment unless otherwise specified and shall be conducted so as not to interfere with normal manufacturing processes.

8.2 Visual Inspection of Tubing

Each length of tubing shall be examined visually, both on the exterior and interior surfaces, to determine if coverage of the coating is complete and if the product is free from slivers, burrs, scales, or other similar, injurious defects.

8.3 Visual Inspection of Elbows

Elbows are to be examined, as described in 8.2, as straight lengths before the lengths are bent. In addition, elbows are to be monitored during the bending operation for evidence of flaking or other damage.

8.4 Retest

If any sample of EMT or elbow tested as prescribed in this specification fails, two additional samples shall be tested, both of which shall comply with the requirements of this specification.

9 Markings

9.1 General

Each length of finished tubing and elbow shall be marked "Electrical Metallic Tubing" or "EMT," in letters

not less than 1/8 in. (3 mm) high and with the manufacturer's name, trade name, or trademark or other descriptive marking by which the organization responsible for the product can be identified. A traceable code can be used to identify the manufacturer when a private labeler uses its own brand or trademark on the product. When a product is produced in more than one factory, each finished length of tubing and elbow shall bear a distinctive marking by which it can be identified as the product of a particular factory. This marking may be in code. Additionally, each piece shall be legibly and durably marked, "Consult manufacturer for proper installation," or similar wording.

9.2 Nonmetallic Alternate Corrosion Resistant Coating Temperature Marking

See UL 797.

9.3 Supplementary Coating Marking

Finished tubing and elbows provided with a supplementary coating or coatings that have not been evaluated for providing corrosion resistance for the tube shall be marked, "Corrosion protection properties of the [supplementary coating type] coating were not investigated," or similar wording.

Table 1
Dimensions and weights for EMT-S

English Units					
Trade size	Inside diameter* (in.)	Outside diameter (in.)	Wall thickness* (in.)	Length (feet)	Minimum weight per 10 unit lengths (lbs)
½	0.622	0.706	0.042	10	28.5
¾	0.824	0.922	0.049	10	43.5
1	1.049	1.163	0.057	10	64
1-1/4	1.380	1.510	0.065	10	95
1-1/2	1.610	1.740	0.065	10	110
2	2.067	2.197	0.065	10	140
2-1/2	2.731	2.875	0.072	10	205
3	3.356	3.500	0.072	10	250
3-1/2	3.834	4.000	0.083	10	325
4	4.334	4.500	0.083	10	370
SI (Metric) Units					
Metric designator	Inside diameter* (mm)	Outside diameter (mm)	Wall thickness* (mm)	Length (mm)	Minimum weight per 10 unit lengths (kg)
16	15.80	17.93	1.067	3050	12.93
21	20.93	23.42	1.245	3050	19.73
27	26.64	29.54	1.448	3050	29.03
35	35.05	38.35	1.651	3050	43.09
41	40.90	44.20	1.651	3050	49.90
53	52.50	55.80	1.651	3050	63.50
63	69.37	73.03	1.829	3050	92.99
78	85.24	88.90	1.829	3050	113.40
91	97.38	101.60	2.108	3050	147.42
103	110.08	114.30	2.108	3050	167.83

Note: Applicable tolerances:

- Length: ± 1/4 in. (± 6.35 mm)
- Outside diameter:
  - For trade sizes 1/2 through 2: ± 0.005 in., (16 through 53: ± 0.13 mm)
  - For trade size 2½: ± 0.010 in., (63: ± 0.25 mm)
  - For trade size 3: ± 0.015 in., (78: ± 0.38 mm)
  - For trade sizes 3½ and 4: ± 0.020 in., (91 and 103: ± 0.51 mm)

*Dimensions are for information only

Table 2
Minimum dimensions for 90-degree elbows

English Units			SI (Metric) Units		
Trade Size	Minimum Radius to Center of Tube (in.)	Minimum Straight Length L_s at each end (in.)	Metric Designator	Minimum Radius to Center of Tube (mm)	Minimum Straight Length L_s at each end (mm)
1/2	4	1-1/2	16	102	38
3/4	4-1/2	1-1/2	21	114	38
1	5-3/4	1-7/8	27	146	48
1-1/4	7-1/4	2	35	184	51
1-1/2	8-1/4	2	41	210	51
2	9-1/2	2	53	241	51
2-1/2	10-1/2	3	63	267	76
3	13	3-1/8	78	330	79
3-1/2	15	3-1/4	91	381	83
4	16	3-3/8	103	406	86

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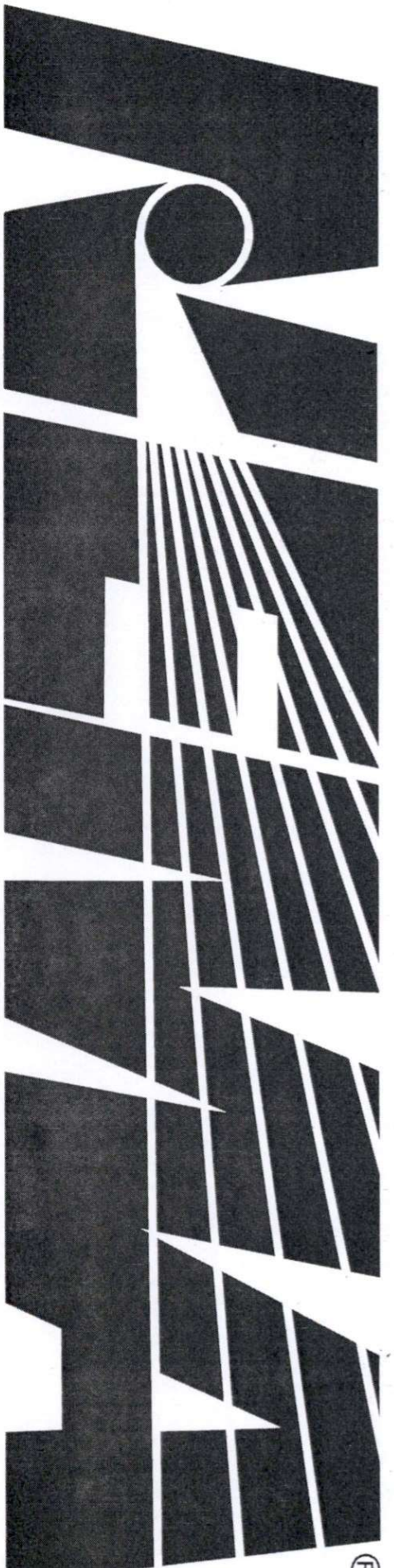

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
1300 NORTH 17TH STREET, SUITE 900 • ROSSLYN. VA 22209
www.NEMA.org