



Standard Specification for Cold-Formed Electric-Fusion (Arc) Welded High-Strength Low-Alloy Structural Tubing in Shapes, with 50 ksi [345 MPa] Minimum Yield Point¹

This standard is issued under the fixed designation A1065/A1065M; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers three Types and two Grades of cold formed electric-fusion (arc) welded high-strength low-alloy steel tubing of 50 ksi [345 MPa] minimum yield point for use in welded or bolted construction of buildings and for general structural purposes.

1.2 This tubing is produced in square and rectangular sizes with a periphery of 200 in. [500 cm] or less and a specified wall thickness of 1.00 in. [25 mm] or less. Tubes are joined by two longitudinal electric-fusion (arc) welds. Circumferential welds are disallowed. Sizes outside of those listed in [Tables 4 and 5](#) may be ordered provided all other requirements of the specification are met. Typical lengths are 15–50 ft. [5–15 m].

NOTE 1—Products manufactured to this specification may not be suitable for those applications such as dynamically loaded elements in welded structures, etc. where low-temperature toughness properties may be important. (See Supplementary Requirement S1)

1.3 This specification covers the following Types:

1.3.1 *Type 1*—Welded with backing, backing left in the product,

1.3.2 *Type 2*—Welded with backing, backing removed,

1.3.3 *Type 3*—Welded without backing.

1.4 Tubing is available in Grades 50 [345] and 50W [345W]. Grade 50 [345] is manufactured from high-strength low-alloy steel. Grade 50W [345W] is manufactured from high-strength low-alloy steel with enhanced atmospheric corrosion resistance. (See [10.1.2](#)) The Grades may not be interchanged without approval of the purchaser. ASTM Specifications for plate that may be applied to Grade 50 [345] and 50W [345W] are listed in Reference Documents and in [Table 1](#).

1.5 This specification is expressed in both inch-pound units and in SI units; however, unless the purchase order or contract 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.

¹ This test method 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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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 nonconformance with the standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

[A6/A6M](#) Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

[A242/A242M](#) Specification for High-Strength Low-Alloy Structural Steel

[A572/A572M](#) Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

[A588/A588M](#) Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

[A656/A656M](#) Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability

[A700](#) Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

[A709/A709M](#) Specification for Structural Steel for Bridges

[A941](#) Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

[A945/A945M](#) Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness

[G101](#) Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

² 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.

TABLE 1 ASTM Plate Specifications^A

Grade 50 [345]	A572/A572M, A656/A656M, A709/A709M, A945/A945M
Grade 50W [345]	A242/A242M, A588/A588M, A709/A709M HPS 50W

^AIndividual specifications may have more than one Grade or Type and provide chemical requirements.

TABLE 2 Tensile Requirements

	Grade 50 [345]	Grade 50W [345W]
Tensile strength, min, psi [MPa]	60 000 [415]	70 000 [480]
Yield strength, min, psi [MPa]	50 000 [345]	50 000 [345]
Elongation in 2 in. [50 mm], min. %	21	21

2.2 AWS Standard³

AWS D1.1 Structural Welding Code-Steel

2.3 Military Standard⁴

MIL-STD-129 Marking for Shipment and Storage

2.4 Federal Standard⁴

Fed. Std. No. 123 Marking for Shipment

2.5 Steel Tube Institute⁵

Hollow Structural Sections

2.6 AISC⁶

Manual of Steel Construction

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology **A941**.

3.2 *Definitions of Terms Specific to This Standard:*

3.3 *HSS⁵, n*—a Hollow Structural Section is a cold-formed welded steel tube used for welded or bolted construction of buildings, bridges and other structures.

3.4 *electric fusion (arc) welded, n*—a welding process that uses an electric arc as the source of heat to melt and join metals.

3.5 *weld reinforcement, n*—that portion of the weld seam above the plane of the plate surface.

4. Ordering Information

4.1 Orders for material under this specification shall contain the following mandatory information:

4.1.1 Size (outside dimensions, thickness and length),

4.1.2 Name Cold Formed Arc Welded HSLA Structural Tubing,

4.1.3 Quantity (number of lengths of each size),

4.1.4 Type (1, 2, or 3),

4.1.5 Grade 50 [345] or Grade 50W [345W],

4.1.6 Individual supplementary requirements, if required (Supplementary Requirements S1 to S4, inclusive).

5. Manufacture

5.1 The steel from which the tubing is made shall conform to Specifications **A242/A242M, A572/A572M, A588/A588M,**

³ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

⁴ Available from Global Engineering Documents, 15 Inverness Way, East Englewood, CO 80112-5704, <http://www.global.ihs.com>.

⁵ Available from Steel Tube Institute of North America, 2000 Ponce de Leon, Suite 600, Coral Gables, FL 33134.

⁶ Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601-2001, <http://www.aisc.org>.

A656/A656M, A709/A709M, or A945/A945M. The Specifications are identified in **Table 1** according to Grade 50 [345] or Grade 50W [345W]. The choice of Grade and ASTM Standard steel material is at the manufacturer's option unless identified in the purchase order (See Supplementary Requirement S3).

5.2 Two equally shaped pieces of flat-rolled plate product of the same ASTM plate specification shall be press brake formed into halves of the finished size. Types 1 and 2 tubing shall have continuous backup bars tack welded to each leg of one of the half-sections. The two half sections shall be fitted together and arc welded with two seam welds to complete the tubing. Type 2 tubing shall have the backing removed after seam welding. Type 3 tubing shall be manufactured without backup bars.

5.3 The electric-fusion (arc) weld shall be deposited by the submerged arc welding process, flux cored arc welding process or gas metal arc welding process. The electrode shall be of matching strength.

5.4 Grade 50W [345W] backing shall be enhanced atmospheric corrosion resistant material. The electrode shall comply with atmospheric corrosion resistance requirements.

5.5 The standard weld shall be a partial joint penetration Single-V-groove weld with groove depth not less than eighty percent of the material thickness. For complete joint penetration welds, see Supplementary Requirement S2.

5.6 The seam welds shall join the smaller flat sides of the structural section. (See Supplementary Requirement S4 for the option of joining the larger flat sides).

5.7 Welding shall be in accordance with **AWS D1.1**, latest edition.

6. Material

6.1 **Table 1** identifies ASTM high-strength low-alloy standard specification steel from which the tubing shall be manufactured. Some Specifications have more than one Grade or Type. The Specifications provide chemical compositions.

7. Mechanical Properties

7.1 The material as represented by the steel producer shall conform to the requirements of **Table 2**.

8. Permissible Variations in Dimensions

8.1 *Outside Dimensions*—The outside dimensions measured across the flats at positions at least 2 in. [50 mm] from the ends of the tubing shall not vary from the specified outside dimensions by more than the applicable amount given in **Table 3**. Measurement shall not include the weld reinforcement. **Table 3** includes allowances for convexity and concavity.

8.2 *Thickness*—The permissible variation in wall thickness shall be +0.03/-0.01 in. [+0.76/-0.25 mm] (Table 1 of Specification **A6/A6M**).

8.3 *Length*—The permissible variation for length shall be +6/-0 in. [+150/-25 mm].

8.4 *Straightness*—The permissible variation for straightness shall be 1/8 in. times the number of feet [10.4 mm times the number of metres] of total length divided by 5.

8.5 *Squareness of Sides*—Adjacent sides shall be square (90°), with a permissible variation of ± 2° max.

8.6 *Radius of Corners*—Corners shall be bent with a bend radius three times the thickness (3t) or greater.⁶

TABLE 3 Permissible Variations in Outside Flat Dimensions

Nominal Outside Large Flat Dimension	Permissible Variation Over and Under Nominal Outside Flat Dimensions
Squares and rectangles with a large flat to small flat ratio less than 3.0	0.015 times each flat dimension
Rectangles with a large flat to small flat ratio equal to or greater than 3.0	0.02 times each flat dimension

TABLE 4 Permissible Variations in Outside Flat Dimensions^A

Wall in./mm Outside Dimensions in./mm	0.313 [8]	0.375 [10]	0.500 [13]	0.625 [16]	0.750 [19]	1.000 [25]
12 × 12 [300 × 300]	X	X	X	X	X	X
13 × 13 [330 × 330]	X	X	X	X	X	X
14 × 14 [360 × 360]	X	X	X	X	X	X
15 × 15 [380 × 380]	X	X	X	X	X	X
16 × 16 [410 × 410]	X	X	X	X	X	X
17 × 17 [430 × 430]	X	X	X	X	X	X
18 × 18 [460 × 460]	X	X	X	X	X	X
19 × 19 [480 × 480]	X	X	X	X	X	X
20 × 20 [510 × 510]	X	X	X	X	X	X
21 × 21 [530 × 530]		X	X	X	X	X
22 × 22 [560 × 560]		X	X	X	X	X
23 × 23 [580 × 580]		X	X	X	X	X
24 × 24 [610 × 610]		X	X	X	X	X
25 × 25 [640 × 640]		X	X	X	X	X
26 × 26 [660 × 660]		X	X	X	X	X
27 × 27 [690 × 690]		X	X	X	X	X
28 × 28 [710 × 710]		X	X	X	X	X
29 × 29 [740 × 740]		X	X	X	X	X
30 × 30 [760 × 760]		X	X	X	X	X
31 × 31 [790 × 790]			X	X	X	X
32 × 32 [810 × 810]			X	X	X	X
33 × 33 [840 × 840]			X	X	X	X
34 × 34 [860 × 860]			X	X	X	X
35 × 35 [890 × 890]			X	X	X	X
36 × 36 [910 × 910]			X	X	X	X
37 × 37 [940 × 940]			X	X	X	X
38 × 38 [970 × 970]			X	X	X	X
39 × 39 [990 × 990]				X	X	X
40 × 40 [1020 × 1020]				X	X	X
41 × 41 [1040 × 1040]				X	X	X
42 × 42 [1070 × 1070]				X	X	X
43 × 43 [1090 × 1090]				X	X	X
44 × 44 [1120 × 1120]				X	X	X
45 × 45 [1140 × 1140]				X	X	X
46 × 46 [1170 × 1170]				X	X	X
47 × 47 [1190 × 1190]				X	X	X
48 × 48 [1220 × 1220]				X	X	X

^AConsult the producer for weight per foot calculations.

8.7 *Twist*—The permissible twist shall not exceed 0.125 in. per 3 ft [3 mm per metre] of length. Twist shall be determined by holding one end of the tubing down on a flat surface plate, measuring the height that each corner on the bottom side of the tubing extends above the surface plate near the opposite ends of the tubing, and calculating the twist (difference in heights of the corners). For heavier sections it shall be permissible to use a suitable measuring device to determine twist. Twist measurements shall not be taken within 2 in. [50 mm] of the ends of the tubing.

8.8 *Weld Reinforcement*—The weld reinforcement shall not exceed 0.125 in. [3 mm].

9. Inspection

9.1 All tubing shall be visually inspected (VT) at the place of manufacture to ensure conformance to the requirements of this specification.

9.2 All tubing shall be free of injurious defects and shall have a workmanlike finish.

10. Atmospheric Corrosion Resistance

10.1 Steels meeting this specification provide two levels of atmospheric corrosion resistance:

10.1.1 Steel Grade 50 [345] provides a level of atmospheric corrosion resistance typical of carbon or alloy steel without copper.

10.1.2 Steel Grade 50W [345W] shall have an atmospheric corrosion resistance index of 6.0 or higher, calculated from the heat analysis in accordance with Guide G101 (See Note 2). When properly exposed to the atmosphere, these steels can be used bare (unpainted) for many applications. A242/A242M, A588/A588M and A709/A709M Grades HPS 50W [345W] are 50 ksi [345 MPa] minimum yield steels with enhanced atmospheric corrosion resistance.

TABLE 5 Wall Thicknesses for Rectangular Shapes^A

Wall in./mm Outside Dimensions in./mm	0.313 [8]	0.375 [10]	0.500 [13]	0.625 [16]	0.750 [19]	1.000 [25]
12 × 8 [300 × 200]	X	X	X			
12 × 10 [300 × 250]	X	X	X	X		
14 × 8 [360 × 200]	X	X	X			
14 × 10 [360 × 250]	X	X	X	X		
14 × 12 [360 × 300]	X	X	X	X		
16 × 8 [410 × 200]	X	X	X		X	
16 × 10 [410 × 250]	X	X	X	X		
16 × 12 [410 × 300]	X	X	X	X	X	
16 × 14 [410 × 360]	X	X	X	X	X	
18 × 8 [460 × 200]	X	X	X			
18 × 10 [460 × 250]	X	X	X	X		
18 × 12 [460 × 300]	X	X	X	X	X	
18 × 14 [460 × 360]	X	X	X	X	X	
18 × 16 [460 × 410]	X	X	X	X	X	X
20 × 8 [510 × 200]	X	X	X			
20 × 10 [510 × 250]	X	X	X	X		
20 × 12 [510 × 300]	X	X	X	X	X	
20 × 14 [510 × 360]	X	X	X	X	X	X
20 × 16 [510 × 410]	X	X	X	X	X	X
20 × 18 [510 × 460]	X	X	X	X	X	X
22 × 8 [560 × 200]		X	X			
22 × 10 [560 × 250]		X	X	X		
22 × 12 [560 × 300]		X	X	X	X	
22 × 14 [560 × 360]		X	X	X	X	X
22 × 16 [560 × 410]		X	X	X	X	X
22 × 18 [560 × 460]		X	X	X	X	X
22 × 20 [560 × 510]		X	X	X	X	X
24 × 8 [610 × 200]		X	X			
24 × 10 [610 × 250]		X	X	X		
24 × 12 [610 × 300]		X	X	X	X	
24 × 14 [610 × 360]		X	X	X	X	
24 × 16 [610 × 410]		X	X	X	X	X
24 × 18 [610 × 410]		X	X	X	X	X
24 × 20 [610 × 510]		X	X	X	X	X
24 × 22 [610 × 560]		X	X	X	X	X
26 × 10 [660 × 250]		X	X	X		
26 × 12 [660 × 300]		X	X	X	X	
26 × 14 [660 × 360]		X	X	X	X	
26 × 16 [660 × 410]		X	X	X	X	X
26 × 18 [660 × 460]		X	X	X	X	X
26 × 20 [660 × 510]		X	X	X	X	X
26 × 22 [660 × 560]		X	X	X	X	X
26 × 24 [660 × 610]		X	X	X	X	X
28 × 10 [710 × 250]		X	X	X		
28 × 12 [710 × 300]		X	X	X	X	
28 × 14 [710 × 360]		X	X	X	X	
28 × 16 [710 × 410]		X	X	X	X	X
28 × 18 [710 × 460]		X	X	X	X	X
28 × 20 [710 × 510]		X	X	X	X	X
28 × 22 [710 × 560]		X	X	X	X	X
28 × 24 [710 × 610]		X	X	X	X	X
28 × 26 [710 × 610]		X	X	X	X	X
30 × 12 [760 × 300]		X	X	X	X	
30 × 14 [760 × 360]		X	X	X	X	
30 × 16 [760 × 410]		X	X	X	X	
30 × 18 [760 × 460]		X	X	X	X	X
30 × 20 [760 × 510]		X	X	X	X	X
30 × 24 [760 × 610]		X	X	X	X	X
30 × 28 [760 × 710]		X	X	X	X	X
32 × 12 [810 × 300]			X	X	X	
32 × 14 [810 × 360]			X	X	X	
32 × 16 [810 × 410]			X	X	X	
32 × 18 [810 × 460]			X	X	X	X
32 × 20 [810 × 510]			X	X	X	X
32 × 22 [810 × 560]			X	X	X	X
32 × 24 [810 × 610]			X	X	X	X
32 × 26 [810 × 660]			X	X	X	X
32 × 28 [810 × 710]			X	X	X	X
32 × 30 [810 × 760]			X	X	X	X
34 × 14 [860 × 360]			X	X	X	
34 × 16 [860 × 410]			X	X	X	
34 × 18 [860 × 460]			X	X	X	X

TABLE 5 *Continued*

Wall in./mm Outside Dimensions in./mm	0.313 [8]	0.375 [10]	0.500 [13]	0.625 [16]	0.750 [19]	1.000 [25]
34 × 20 [860 × 510]			X	X	X	X
34 × 22 [860 × 560]			X	X	X	X
34 × 24 [860 × 610]			X	X	X	X
34 × 26 [860 × 660]			X	X	X	X
34 × 28 [860 × 710]			X	X	X	X
34 × 30 [860 × 760]			X	X	X	X
34 × 32 [860 × 810]			X	X	X	X
36 × 14 [910 × 360]			X	X	X	
36 × 16 [910 × 410]			X	X	X	
36 × 18 [910 × 460]			X	X	X	X
36 × 20 [910 × 510]			X	X	X	X
36 × 22 [910 × 560]			X	X	X	X
36 × 24 [910 × 610]			X	X	X	X
36 × 26 [910 × 660]			X	X	X	X
36 × 28 [910 × 710]			X	X	X	X
36 × 30 [910 × 760]			X	X	X	X
36 × 32 [910 × 810]			X	X	X	X
36 × 34 [910 × 860]			X	X	X	X
38 × 16 [970 × 410]			X	X	X	
38 × 18 [970 × 460]			X	X	X	X
38 × 20 [970 × 510]			X	X	X	X
38 × 22 [970 × 560]			X	X	X	X
38 × 24 [970 × 610]			X	X	X	X
38 × 26 [970 × 660]			X	X	X	X
38 × 28 [970 × 710]			X	X	X	X
38 × 30 [970 × 760]			X	X	X	X
38 × 32 [970 × 810]			X	X	X	X
38 × 34 [970 × 860]			X	X	X	X

⁴Consult the producer for weight per foot calculations.

NOTE 2—For methods of estimating the atmospheric corrosion resistance of low-alloy steels, see Guide **G101**. The user is cautioned that the Guide **G101** predictive equation for calculation of an atmospheric corrosion resistance index has only been verified for the composition limits stated in that guide.

11. Certification

11.1 Test reports shall be furnished to the purchaser containing the results of all tests and chemical analyses required by this specification (including year date).

11.2 A signature or notarization is not required on test reports; however, the documents shall clearly identify the organization submitting them. Notwithstanding the absence of a signature, the organization submitting the document is responsible for its content.

11.3 Test reports in electronic data interchange (EDI) format shall be regarded as having the same validity as a counterpart printed in the certifying organization's facility.

12. Product Identification

12.1 Each length of structural tubing shall be legibly marked to show the following information:

- 12.1.1 Manufacturer's name, brand, or trademark,
- 12.1.2 Specification designation (year of issue not required),

- 12.1.3 Grade 50 [345] or 50W [345W],
- 12.1.4 Purchase order,
- 12.1.5 Product size (OD x OD x wall x length),
- 12.1.6 Heat number,
- 12.1.7 Date of manufacture.

13. Government Procurement

13.1 When specified in the contract, material shall be preserved, packaged and packed in accordance with the requirements of Practices **A700**, with applicable levels being specified in the contract. Marking for shipment of such materials shall be in accordance with **Fed. Std. No. 123** for civil agencies or **MIL-STD-129**.

13.2 *Inspection*—Unless otherwise specified in the contract, the manufacturer shall be responsible for the performance of all applicable inspection and test requirements specified herein. Except as otherwise specified in the contract the manufacturer shall use its own or any other suitable facilities for the performance of such inspections and tests.

14. Keywords

14.1 backing; backup bars; partial joint penetration; groove depth

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply when specified in the order or contract.

S1 Charpy V-Notch impact test results shall be required for the as-furnished starting plate material.

S2 Outside agency weld inspection or nondestructive examination other than visual (VT) such as ultrasonic (UT) or radiographic (RT) for Complete Joint Penetration welds. Applicable reports shall be prepared and included with material test reports.

S3 The purchaser shall specify a particular ASTM Standard of steel listed in **Table 1**.

S4 The weld seam welds shall join the larger flat sides of the structural section.

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