Designation: A 501 – 07

Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing[1]

This standard is issued under the fixed designation A 501; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers black and hot-dipped galvanized hot-formed welded and seamless carbon steel square, round, rectangular, or special shape structural tubing for welded, riveted, or bolted construction of bridges and buildings, and for general structural purposes.

1.2 Square and rectangular tubing is furnished in sizes 1 to 32 in. (25.4 to 813 mm) across flat sides with wall thicknesses 0.095 to 3.00 in. (2.41 to 76 mm), dependent upon size; round tubing is furnished in NPS ½ to NPS 24 (see Note 1) inclusive, with nominal (average) wall thicknesses 0.109 to 1.000 in. (2.77 to 25.40 mm), dependent upon size. Special shape tubing and tubing with other dimensions is permitted to be furnished, provided that such tubing complies with all other requirements of this specification.

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such traditional terms as "nominal diameter," "size," and "nominal size."

1.3 This specification covers the following grades:

1.3.1 Grade A — 36 000 psi (250 MPa) min yield strength.

1.3.2 Grade B — 50 000 psi (345 MPa) min yield strength.

1.4 An optional supplementary requirement is provided for Grade B and, when desired, shall be so stated on the order.

1.5 The following precautionary statement pertains only to the test method portion of this specification: *This standard does not purport to address all 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.*

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.7 The text of this specification contains notes and footnotes that provide explanatory material. Such notes and footnotes, excluding those in tables and figures, do not contain any mandatory requirements.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 53/A 53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

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

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

2.2 *AIAG Standard:*[3]

B-1 Bar Code Symbology Standard

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology A 941.

4. Ordering Information

4.1 Orders for material under this specification shall contain information concerning as many of the following items as are required to describe the desired material adequately:

4.1.1 Quantity (feet or number of lengths),

4.1.2 Name of material (hot-formed tubing),

4.1.3 Grade (A or B)

4.1.4 Method of manufacture (seamless or welded) (see Section 6),

4.1.5 Finish (black or galvanized),

4.1.6 Size (outside diameter and calculated nominal wall thickness for round tubing and the outside dimensions and calculated nominal wall thickness for square and rectangular tubing (Section 11)),

[1] 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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[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.

[3] Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48033, http://www.aiag.org.

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

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4.1.7 Length (random, multiple, or specific; see 12.3),
4.1.8 End condition (see 17.3),
4.1.9 Burr removal (see 17.3),
4.1.10 Certification (see Section 19),
4.1.11 ASTM specification designation and year of issue,
4.1.12 End use,
4.1.13 Special requirements, and
4.1.14 Bar coding (see 20.3).

5. Process

5.1 The steel shall be made by one or more of the following processes: open-hearth, basic-oxygen, or electric-furnace.

5.2 When steels of different grades are sequentially strand cast, the steel producer shall identify the resultant transition material and remove it using an established procedure that positively separates the grades.

6. Manufacture

6.1 The tubing shall be made by one of the following processes: seamless; furnace-butt welding (continuous welding); electric-resistance welding or submerged arc welding followed by reheating throughout the cross section and hot forming by a reducing or shaping process, or both.

7. Heat Analysis

7.1 Each heat analysis shall conform to the requirements specified in Table 1 for heat analysis.

8. Product Analysis

8.1 The tubing shall be capable of conforming to the requirements specified in Table 1 for product analysis.

8.2 If product analyses are made, they shall be made using test specimens taken from two lengths of tubing from each lot of 500 lengths, or fraction thereof, or two pieces of flat-rolled stock from each lot of a corresponding quantity of flat-rolled stock. Methods and practices relating to chemical analysis shall be in accordance with Test Methods, Practices, and Terminology A 751. Such product analyses shall conform to the requirements specified in Table 1 for product analysis.

8.3 If both product analyses representing a lot fail to conform to the specified requirements, the lot shall be rejected.

8.4 If only one product analysis representing a lot fails to conform to the specified requirements, product analyses shall be made using two additional test specimens taken from the lot. Both additional product analyses shall conform to the specified requirements or the lot shall be rejected.

9. Tensile Requirements

9.1 The material, as represented by the test specimen, shall conform to the requirements as to tensile properties prescribed in Table 2.

9.2 The yield strength corresponding to a permanent offset of 0.2 % of the gauge length of the specimen or to a total extension of 0.5 % of the gauge length under load shall be determined.

10. Charpy V-Notch Impact Test

10.1 The Charpy V-notch impact test applies to Grade B only and wall thickness greater than 0.312 in. (8 mm).

10.1.1 Charpy V-notch tests shall be made in accordance with Test Methods and Definitions A 370

10.1.2 One Charpy V-notch impact test shall be made from a length of tubing representing each lot.

10.1.3 The test results of full-size longitudinal specimens shall meet an average value of 20 ft-lb at 0 °F (-18 °C).

11. Dimensions

11.1 *Square Structural Tubing*—The outside dimensions (across the flats), the weight per foot, and the calculated nominal wall thickness of common sizes of square structural tubing included in this specification are listed in Table 3.

11.2 *Rectangular Structural Tubing*—The outside dimensions (across the flats), the weight per foot, and the calculated nominal wall thickness of common sizes of rectangular structural tubing included in this specification are listed in Table 4.

11.3 *Round Structural Tubing*—The NPS and outside diameter dimensions, the weight per foot, and the calculated nominal wall thickness of common sizes of round structural tubing included in this specification are listed in Table 5.

11.4 *Special Shape Structural Tubing*—The dimensions and tolerances of special shape structural tubing are available by inquiry and negotiation with the manufacturer.

11.5 *Other Sizes*—The dimensional tolerances for hot-formed welded and seamless structural tubing manufactured in accordance with the requirements of this specification, but with ordered dimensions other than those listed in Table 3, Table 4, and Table 5, shall be consistent with those given in this specification for similar sizes and type of product.

12. Permissible Variations in Dimensions of Square, Round, Rectangular, and Special Shape Structural Tubing

12.1 *Outside Dimensions*:

TABLE 1 Chemical Requirements[A]

	Composition, %			
	Grade A		Grade B	
Element	Heat analysis	Product analysis	Heat analysis	Product analysis
Carbon, max	0.26	0.30	0.22[B]	0.26
Manganese, max	...	...	1.40[B]	1.45
Phosphorus, max	0.035	0.045	0.030	0.040
Sulfur, max	0.035	0.045	0.020	0.030
Copper, when copper steel is specified, min	0.20	0.18	0.20	0.18

[A] Where an ellipsis (...) appears in this table, there is no requirement.
[B] For each reduction of 0.01 percentage point below the specified maximum for carbon, an increase of 0.06 percentage point above the specified maximum for manganese is permitted, up to a maximum of 1.50 % by heat analysis and 1.60 % by product analysis.

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TABLE 2 Tensile Requirements

	Grade A	Grade B
Tensile strength, min, psi (MPa)	58 000 (400)	70 000 (483)
Yield strength, min, psi (MPa)	36 000 (250)	50 000 (345)
Elongation in 2 in. (50.8 mm), min, %	23	23

12.1.1 *Round Structural Tubing*—For round hot-formed structural tubing NPS 2 and over, the outside diameter shall not vary more than ±1 % from the specified outside diameter. For NPS 1½ and under, the outside diameter shall not vary more than 1/64 in. (0.40 mm) over or more than 1/32 in. (0.79 mm) under the specified outside diameter.

12.1.2 *Square, Rectangular, and Special Shape Structural Tubing*—The outside dimensions, measured across the flats at positions at least 2 in. (50.8 mm) from the ends of the tubing, shall not vary from the specified outside dimensions by more than the applicable amount given in Table 6, which includes an allowance for convexity or concavity.

12.2 *Weight*—The weight of the structural tubing shall be not more than 3.5 % under its theoretical weight, as calculated using its length and the applicable weight per unit length given in Table 3, Table 4, or Table 5.

12.3 *Length*—Structural tubing is commonly produced in random lengths of 16 to 22 ft. (4.9 to 6.7 m) or 32 to 44 ft. (9.8 to 13.4 m), in multiple lengths, and in specific lengths. When specific lengths are ordered, the permissible variations in length shall be as given in Table 7.

12.4 *Straightness*—The permissible variation for straightness of structural tubing shall be 1/8 in. times the number of feet (10.4 mm times the number of metres) of total length divided by five.

12.5 *Squareness of Sides*—For perpendicular and rectangular tubing, adjacent sides shall be square (90°), with a permissible variation of ±2°.

12.6 *Radius of Corners*—For square and rectangular structural tubing, the radius of each outside corner of the section shall not exceed three times the calculated nominal wall thickness.

12.7 *Twist*—For square, rectangular, and special shape structural tubing, the permissible variations in twist shall be as given in Table 8. 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 end of the tubing, and calculating the twist (the difference in the measured heights of such corners), except that 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. (50.8 mm) of the ends of the tubing.

13. Number of Tests

13.1 One tension test as specified in 15.2 shall be made from a length of tubing representing each lot.

13.2 The term "lot" shall apply to all tubes of the same specified size that are produced from the same heat of steel.

14. Retests

14.1 If the results of the mechanical tests representing any lot fail to conform to the applicable requirements specified in Sections 9 and 10, the lot shall be rejected or retested using additional tubing of double the original number from the lot. The lot shall be acceptable if the results of all such retests representing the lot conform to the specified requirements.

14.2 If one or both of the retests specified in 14.1 fail to conform to the applicable requirements specified in Sections 9 and 10, the lot shall be rejected or, subsequent to the manufacturer heat treating, reworking, or otherwise eliminating the condition responsible for the failure, the lot shall be treated as a new lot and tested accordingly.

15. Test Method

15.1 Tension test specimens shall conform to the applicable requirements of Test Methods and Definitions A 370, Annex A2.

15.2 Tension test specimens shall be full-size longitudinal test specimens or longitudinal strip test specimens. For welded tubing, any longitudinal strip test specimens shall be taken from a location at least 90° from the weld and shall be prepared without flattening in the gauge length. Longitudinal strip test specimens shall have all burrs removed. Tension test specimens shall not contain surface imperfections that would interfere with proper determination of the tensile properties.

15.3 The yield strength corresponding to an offset of 0.2 % of the gauge length or to a total extension under load of 0.5 % of the gauge length shall be determined.

16. Galvanized Coatings

16.1 For structural tubing required to be hot-dipped galvanized, such coating shall comply with the requirements contained in Specification A 53/A 53M, except that the manufacturer shall additionally have the option of determining the coating weight using only the values obtained for the coating on the outside surface of the tubing.

17. Inspection

17.1 All tubing shall be inspected at the place of manufacture to ensure conformance with the requirements of this specification.

17.2 The structural tubing shall be free of defects and shall have a commercially smooth finish.

17.2.1 Surface imperfections shall be classed as defects when one or more of the following conditions exist:

17.2.1.1 The depth of the imperfections exceeds 15 % of the calculated nominal wall thickness.

17.2.1.2 The imperfections materially affect the appearance of the structural tubing.

17.2.1.3 At any location, the length of the imperfections, measured in the transverse direction, in combination with their depth materially reduce the total cross sectional area of the structural tubing.

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TABLE 3 Dimensions of Common Sizes of Square Structural Tubing

Size Given in Outside Dimensions Across Flat Sides, in. (mm)	Weight per Unit Length, lb/ft (kg/m)	Calculated Nominal Wall Thickness, in. (mm)
1 by 1	1.09 (1.62)	0.095 (2.41)
(25.4 by 25.4)	1.41 (2.10)	0.133 (3.38)
2 by 2	2.69 (4.00)	0.110 (2.79)
(50.8 by 50.8)	3.04 (4.52)	0.125 (3.18)
	3.65 (5.44)	0.154 (3.91)
	4.31 (6.41)	0.188 (4.78)
2½ by 2½	4.32 (6.43)	0.141 (3.58)
(63.5 by 63.5)	5.59 (8.32)	0.188 (4.78)
	7.10 (10.56)	0.250 (6.35)
3 by 3	5.78 (8.60)	0.156 (3.96)
(76.2 by 76.2)	6.86 (10.21)	0.188 (4.78)
	8.80 (13.09)	0.250 (6.35)
3½ by 3½	6.88 (10.24)	0.156 (3.96)
(88.9 by 88.9)	8.14 (12.11)	0.188 (4.78)
	10.50 (15.62)	0.250 (6.35)
	12.69 (18.88)	0.312 (7.92)
4 by 4	9.31 (13.85)	0.188 (4.78)
(101.6 by 101.6)	12.02 (17.89)	0.250 (6.35)
	14.52 (21.61)	0.312 (7.92)
	16.84 (25.06)	0.375 (9.52)
	20.88 (31.07)	0.500 (12.70)
5 by 5	11.86 (17.65)	0.188 (4.78)
(127.0 by 127.0)	15.42 (22.94)	0.250 (6.35)
	18.77 (27.93)	0.312 (7.92)
	21.94 (32.65)	0.375 (9.52)
	27.68 (41.19)	0.500 (12.70)
6 by 6	14.41 (21.44)	0.188 (4.78)
(152.4 by 152.4)	18.82 (28.00)	0.250 (6.35)
	23.02 (34.25)	0.312 (7.92)
	27.04 (40.28)	0.375 (9.52)
	34.48 (51.31)	0.500 (12.70)
7 by 7	16.85 (25.07)	0.188 (4.78)
(177.8 by 177.8)	22.04 (32.80)	0.250 (6.35)
	26.99 (39.16)	0.312 (7.92)
	31.73 (47.21)	0.375 (9.52)
	40.55 (60.34)	0.500 (12.70)
8 by 8	25.44 (37.85)	0.250 (6.35)
(203.2 by 203.2)	31.24 (46.49)	0.312 (7.92)
	36.83 (54.80)	0.375 (9.52)
	38.33 (57.03)	0.38 (9.65)
	47.35 (70.46)	0.500 (12.70)
	49.16 (73.15)	0.50 (12.70)
	56.98 (84.79)	0.625 (15.88)
	60.20 (89.57)	0.63 (16.00)
	65.73 (97.81)	0.750 (19.05)
10 by 10	32.23 (47.96)	0.250 (6.35)
(254.0 by 254.0)	39.74 (59.13)	0.312 (7.92)
	47.03 (69.98)	0.375 (9.52)
	48.68 (72.43)	0.38 (9.65)
	60.95 (90.69)	0.500 (12.70)
	62.78 (93.41)	0.50 (12.70)
	73.98 (110.08)	0.625 (15.88)
	77.35 (115.10)	0.63 (16.00)
	86.13 (128.16)	0.750 (19.05)
	90.19 (134.19)	0.75 (19.05)
	107.79 (160.39)	1.000 (25.40)
12 by 12	76.39 (113.66)	0.50 (12.70)
(304.8 by 304.8)	94.51 (140.62)	0.63 (16.00)
	110.61 (164.58)	0.75 (19.05)
14 by 14	90.01 (133.92)	0.50 (12.70)
(355.6 by 355.6)	111.66 (166.14)	0.63 (16.00)
	131.04 (194.97)	0.75 (19.05)
	140.49 (209.03)	0.81 (20.57)
	145.40 (216.35)	0.87 (22.00)
	162.18 (241.31)	0.98 (25.00)
16 by 16	103.62 (154.18)	0.50 (12.70)
(406.4 by 406.4)	128.81 (191.66)	0.63 (16.00)
	162.52 (241.81)	0.81 (20.57)
	168.99 (251.44)	0.87 (22.00)
	188.98 (281.19)	0.98 (25.00)
	208.24 (309.84)	1.10 (28.00)
18 by 18	267.09 (397.40)	1.26 (32.00)
(457.2 by 457.2)	294.62 (438.36)	1.42 (36.00)
	320.84 (477.38)	1.57 (40.00)
20 by 20	130.85 (194.70)	0.50 (12.70)
(508.0 by 508.0)	163.12 (242.70)	0.63 (16.00)
	192.31 (286.13)	0.75 (19.05)
	206.66 (307.49)	0.81 (20.57)
	214.68 (319.42)	0.87 (22.00)
	240.67 (358.10)	0.98 (25.00)
	265.88 (395.60)	1.10 (28.00)
	298.26 (443.78)	1.26 (32.00)
	329.25 (489.88)	1.42 (36.00)
	358.83 (533.90)	1.57 (40.00)
	393.84 (585.99)	1.77 (45.00)
	426.66 (634.83)	1.97 (50.00)
22 by 22	177.48 (264.08)	0.63 (16.00)
(558.8 by 558.8)	208.27 (309.88)	0.75 (19.00)
	238.27 (354.51)	0.87 (22.00)
	267.48 (397.98)	0.98 (25.00)
	295.90 (440.26)	1.10 (28.00)
	332.57 (494.83)	1.26 (32.00)
	367.84 (547.31)	1.42 (36.00)
	401.71 (597.70)	1.57 (40.00)
	442.08 (657.77)	1.77 (45.00)
	480.27 (714.58)	1.97 (50.00)
	516.26 (768.14)	2.17 (55.00)
24 by 24	194.64 (289.60)	0.63 (16.00)
(609.6 by 609.6)	228.64 (340.19)	0.75 (19.00)
	261.85 (389.61)	0.87 (22.00)
	294.28 (437.85)	0.98 (25.00)
	325.92 (484.93)	1.10 (28.00)
	366.87 (545.87)	1.26 (32.00)
	406.43 (604.73)	1.42 (36.00)
	444.59 (661.51)	1.57 (40.00)
	490.32 (729.55)	1.77 (45.00)
	533.87 (794.34)	1.97 (50.00)
	575.22 (855.87)	2.17 (55.00)
	614.39 (914.15)	2.36 (60.00)
26 by 26	211.79 (315.12)	0.63 (16.00)
(660.4 by 660.4)	249.01 (370.50)	0.75 (19.00)
	285.44 (424.70)	0.87 (22.00)
	321.08 (477.73)	0.98 (25.00)
	355.93 (529.59)	1.10 (28.00)
	401.18 (596.92)	1.26 (32.00)
	445.03 (662.16)	1.42 (36.00)
	487.48 (725.31)	1.57 (40.00)
	538.57 (801.33)	1.77 (45.00)
	587.47 (874.10)	1.97 (50.00)
	634.19 (943.61)	2.17 (55.00)
	678.72 (1009.86)	2.36 (60.00)
28 by 28	228.94 (340.64)	0.63 (16.00)
(711.2 by 711.2)	269.38 (400.80)	0.75 (19.00)

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TABLE 3 *Continued*

Size Given in Outside Dimensions Across Flat Sides, in. (mm)	Weight per Unit Length, lb/ft (kg/m)	Calculated Nominal Wall Thickness, in. (mm)
	309.02 (459.79)	0.87 (22.00)
	347.88 (517.61)	0.98 (25.00)
	385.95 (574.25)	1.10 (28.00)
	435.49 (647.96)	1.26 (32.00)
	483.62 (719.58)	1.42 (36.00)
	530.36 (789.12)	1.57 (40.00)
	586.81 (873.11)	1.77 (45.00)
	641.07 (953.85)	1.97 (50.00)
	693.15 (1031.34)	2.17 (55.00)
	743.04 (1105.57)	2.36 (60.00)
30 by 30	246.10 (366.17)	0.63 (16.00)
762.0 by 762.0)	289.75 (431.11)	0.75 (19.00)
	332.61 (494.88)	0.87 (22.00)
	374.68 (557.49)	0.98 (25.00)
	415.97 (618.92)	1.10 (28.00)
	469.79 (699.00)	1.26 (32.00)
	522.22 (777.00)	1.42 (36.00)
	573.24 (852.92)	1.57 (40.00)
	635.05 (944.89)	1.77 (45.00)
	694.68 (1033.61)	1.97 (50.00)
	752.12 (1119.07)	2.17 (55.00)
	807.36 (1201.28)	2.36 (60.00)

17.2.2 It shall be permissible for defects having a depth not in excess of 33⅓ % of the calculated nominal wall thickness to be repaired by welding, subject to the following conditions:

17.2.2.1 The defect shall be completely removed by chipping or grinding to sound metal,

17.2.2.2 The repair weld shall be made using a low-hydrogen welding process, and

17.2.2.3 The projecting weld metal shall be removed to produce a workmanlike finish.

17.3 Unless otherwise specified in the purchase order, structural tubing shall be furnished with square cut ends. The burr shall be held to a minimum. When so specified in the purchase order, the burr shall be removed on the outside diameter, inside diameter, or both.

18. Rejection

18.1 It shall be permissible for the purchaser to inspect tubing received from the manufacturer and reject any tubing that does not meet the requirements of this specification, based upon the inspection and test methods outlined herein. The purchaser shall notify the manufacturer of any tubing that has been rejected, and the disposition of such tubing shall be subject to agreement between the manufacturer and the purchaser.

18.2 It shall be permissible for the purchaser to set aside any tubing that is found in fabrication or installation within the scope of this specification to be unsuitable for the intended end use, based on the requirements of this specification. The purchaser shall notify the manufacturer of any tubing that has been set aside. Such tubing shall be subject to mutual investigation as to the nature and severity of the deficiency and the forming or installation conditions, or both, involved. The disposition of such tubing shall be subject to agreement between the manufacturer and the purchaser.

TABLE 4 Dimensions of Common Sizes of Rectangular Structural Tubing

Size Given in Outside Dimensions Across Flat Sides, in. (mm)	Weight per Unit Length, lb/ft (kg/m)	Calculated Nominal Wall Thickness, in. (mm)
3 by 2	4.32 (6.43)	0.141 (3.58)
(76.2 by 50.8)	5.59 (8.32)	0.188 (4.78)
	7.10 (10.56)	0.250 (6.35)
4 by 2	5.78 (8.60)	0.156 (3.96)
(101.6 by 50.8)	6.86 (10.21)	0.188 (4.78)
	8.80 (13.09)	0.250 (6.35)
4 by 3	6.88 (10.24)	0.156 (3.96)
(101.6 by 76.2)	8.14 (12.11)	0.188 (4.78)
	10.50 (15.62)	0.250 (6.35)
	12.69 (18.88)	0.312 (7.92)
5 by 3	9.31 (13.85)	0.188 (4.78)
(127.0 by 76.2)	12.02 (17.89)	0.250 (6.35)
	14.52 (21.61)	0.312 (7.92)
	16.84 (25.06)	0.375 (9.52)
6 by 3	10.58 (15.74)	0.188 (4.78)
(152.4 by 76.2)	13.72 (20.42)	0.250 (6.35)
	16.65 (24.78)	0.312 (7.92)
	19.39 (28.85)	0.375 (9.52)
6 by 4	11.86 (17.65)	0.188 (4.78)
(152.4 by 101.6)	15.42 (22.94)	0.250 (6.35)
	18.77 (27.93)	0.312 (7.92)
	21.94 (32.65)	0.375 (9.52)
	27.68 (41.19)	0.500 (12.70)
7 by 5	14.41 (21.44)	0.188 (4.78)
(177.8 by 127.0)	18.82 (28.00)	0.250 (6.35)
	23.02 (34.25)	0.312 (7.92)
	27.04 (40.28)	0.375 (9.52)
	34.48 (51.31)	0.500 (12.70)
8 by 4	14.41 (21.44)	0.188 (4.78)
(203.2 by 101.6)	18.82 (28.00)	0.250 (6.35)
	23.02 (34.25)	0.312 (7.92)
	27.04 (40.28)	0.375 (9.52)
	34.48 (51.31)	0.500 (12.70)
8 by 6	16.85 (25.07)	0.188 (4.78)
(203.2 by 152.4)	22.04 (32.80)	0.250 (6.35)
	26.99 (39.16)	0.312 (7.92)
	31.73 (47.21)	0.375 (9.52)
	33.20 (49.39)	0.38 (9.65)
	40.55 (60.34)	0.500 (12.70)
	42.41 (60.34)	0.500 (12.70)
10 by 4	42.35 (63.02)	0.50 (12.70)
(254.0 by 101.6)	51.62 (76.81)	0.63 (16.00)
10 by 6	25.44 (37.85)	0.250 (6.35)
(254.0 by 152.4)	31.24 (46.49)	0.312 (7.92)
	36.83 (54.80)	0.375 (9.52)
	38.33 (57.03)	0.38 (9.65)
	47.35 (70.46)	0.500 (12.70)
	49.16 (73.15)	0.50 (12.70)
	60.20 (89.57)	0.63 (16.00)
12 by 8	62.78 (93.41)	0.50 (12.70)
(304.8 by 203.2)	77.35 (115.10)	0.63 (16.00)
16 by 8	76.39 (113.66)	0.50 (12.70)
(406.4 by 203.2)	94.51 (140.62)	0.63 (16.00)
18 by 10	90.01 (133.92)	0.50 (12.70)
(457.2 by 254.0)	111.66 (166.14)	0.63 (16.00)
20 by 12	103.62 (154.18)	0.50 (12.70)
(508.0 by 304.8)	128.81 (191.66)	0.63 (16.00)

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TABLE 4 *Continued*

Size Given in Outside Dimensions Across Flat Sides, in. (mm)	Weight per Unit Length, lb/ft (kg/m)	Calculated Nominal Wall Thickness, in. (mm)
22 by 14 (550.0 by 350.0)	107.66 (160.19)	0.47 (12.00)
	140.75 (209.42)	0.63 (16.00)
	164.64 (244.97)	0.75 (19.00)
	187.75 (279.36)	0.87 (22.00)
	210.07 (312.57)	0.98 (25.00)
	231.61 (344.61)	1.10 (28.00)
24 by 16 (600.0 by 400.0)	120.32 (179.03)	0.47 (12.00)
	157.63 (234.54)	0.63 (16.00)
	184.69 (274.80)	0.75 (19.00)
	210.97 (313.90)	0.87 (22.00)
	236.45 (351.82)	0.98 (25.00)
	261.15 (388.57)	1.10 (28.00)
	292.86 (435.75)	1.26 (32.00)
	323.17 (480.84)	1.42 (36.00)
	352.08 (523.85)	1.57 (40.00)
26 by 18 (650.0 by 450.0)	174.51 (259.66)	0.63 (16.00)
	204.74 (304.63)	0.75 (19.00)
	234.18 (348.44)	0.87 (22.00)
	262.83 (391.07)	0.98 (25.00)
	290.70 (432.53)	1.10 (28.00)
	326.63 (485.99)	1.26 (32.00)
	361.15 (537.36)	1.42 (36.00)
	394.28 (586.65)	1.57 (40.00)
30 by 20 (750.0 by 500.0)	199.84 (297.34)	0.63 (16.00)
	234.81 (349.38)	0.75 (19.00)
	269.00 (400.25)	0.87 (22.00)
	302.40 (449.94)	0.98 (25.00)
	335.02 (498.47)	1.10 (28.00)
	377.27 (561.35)	1.26 (32.00)
	418.13 (622.14)	1.42 (36.00)
	457.59 (680.85)	1.57 (40.00)

19. Certification

19.1 When specified in the purchase order or contract, the manufacturer shall furnish to the purchaser a certificate of compliance stating that the product was manufactured, sampled, tested, and inspected in accordance with this specification and any other requirements designated in the purchase order or contract, and was found to meet all such requirements. Certificates of compliance shall include the specification number and year of issue.

19.2 When specified in the purchase order or contract, the manufacturer shall furnish to the purchaser test reports for the product shipped that contain the heat analyses and the results of the tension tests required by this specification and the purchase order or contract. Test reports shall include the specification number and year of issue.

19.3 A signature or notarization is not required on certificates of compliance or 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.

19.4 A certificate of compliance or test report printed from, or used in electronic form from, an electronic data interchange (EDI) shall be regarded as having the same validity as a counterpart printed in the certifying organization's facility. The content of the EDI transmitted document shall conform to any existing EDI agreement between the purchaser and the manufacturer.

TABLE 5 Dimensions of Common Sizes of Round Structural Tubing

NPS Designator	Outside Diameter, in. (mm)	Weight per Unit Length, lb/ft (kg/m)	Calculated Nominal Wall Thickness, in. (mm)
½	0.840 (21.3)	0.85 (1.27)	0.109 (2.77)
	0.840 (21.3)	1.09 (1.62)	0.147 (3.73)
¾	1.050 (26.7)	1.13 (1.69)	0.113 (2.87)
	1.050 (26.7)	1.47 (2.20)	0.154 (3.91)
1	1.315 (33.4)	1.34 (2.00)	0.104 (2.64)
	1.315 (33.4)	1.68 (2.50)	0.133 (3.38)
	1.315 (33.4)	2.17 (3.24)	0.179 (4.55)
1¼	1.660 (42.2)	1.82 (2.71)	0.110 (2.79)
	1.660 (42.2)	2.27 (3.39)	0.140 (3.56)
	1.660 (42.2)	3.00 (4.47)	0.191 (4.85)
1½	1.900 (48.3)	2.17 (3.25)	0.114 (2.90)
	1.900 (48.3)	2.72 (4.05)	0.145 (3.68)
	1.900 (48.3)	3.63 (5.41)	0.200 (5.08)
2	2.375 (60.3)	2.91 (4.33)	0.121 (3.07)
	2.375 (60.3)	3.65 (5.44)	0.154 (3.91)
	2.375 (60.3)	5.02 (7.48)	0.218 (5.54)
2½	2.875 (73.0)	4.53 (6.74)	0.156 (3.96)
	2.875 (73.0)	5.40 (8.04)	0.188 (4.78)
	2.875 (73.0)	5.79 (8.63)	0.203 (5.16)
	2.875 (73.0)	7.66 (11.41)	0.276 (7.01)
3	3.500 (88.9)	5.57 (8.29)	0.156 (3.96)
	3.500 (88.9)	6.65 (9.92)	0.188 (4.78)
	3.500 (88.9)	7.58 (11.29)	0.216 (5.49)
	3.500 (88.9)	10.25 (15.27)	0.300 (7.62)
3½	4.000 (101.6)	6.40 (9.53)	0.156 (3.96)
	4.000 (101.6)	7.65 (11.41)	0.188 (4.78)
	4.000 (101.6)	9.11 (13.57)	0.226 (5.74)
	4.000 (101.6)	12.50 (18.63)	0.318 (8.08)
4	4.500 (114.3)	7.24 (10.78)	0.156 (3.96)
	4.500 (114.3)	8.66 (12.91)	0.188 (4.78)
	4.500 (114.3)	10.01 (14.91)	0.219 (5.56)
	4.500 (114.3)	10.79 (16.07)	0.237 (6.02)
	4.500 (114.3)	14.98 (22.32)	0.337 (8.56)
5	5.563 (141.3)	14.62 (21.77)	0.258 (6.55)
	5.563 (141.3)	20.78 (30.97)	0.375 (9.53)
	5.563 (141.3)	38.55 (57.43)	0.750 (19.05)
6	6.625 (168.3)	18.97 (28.26)	0.280 (7.11)
	6.625 (168.3)	28.57 (42.56)	0.432 (10.97)
	6.625 (168.3)	53.16 (79.22)	0.864 (21.95)
8	8.625 (219.1)	28.55 (42.55)	0.322 (8.18)
	8.625 (219.1)	43.39 (64.64)	0.500 (12.70)
	8.625 (219.1)	72.42 (107.92)	0.875 (22.23)
10	10.750 (273.0)	40.48 (60.31)	0.365 (9.27)
	10.750 (273.0)	54.74 (81.55)	0.500 (12.70)
	10.750 (273.0)	104.13 (155.15)	1.000 (25.40)
12	12.750 (323.8)	49.56 (73.88)	0.375 (9.53)
	12.750 (323.8)	65.42 (97.46)	0.500 (12.70)
	12.750 (323.8)	125.49 (186.97)	1.000 (25.40)
14	14.000 (355.6)	54.57 (81.33)	0.375 (9.53)
	14.000 (355.6)	72.09 (107.39)	0.500 (12.70)
16	16.000 (406.4)	62.58 (93.27)	0.375 (9.53)
	16.000 (406.4)	82.77 (123.30)	0.500 (12.70)
18	18.000 (457.2)	70.59 (105.16)	0.375 (9.53)
	18.000 (457.2)	93.45 (139.15)	0.500 (12.70)
20	20.000 (508.0)	78.60 (117.15)	0.375 (9.53)
	20.000 (508.0)	104.13 (155.12)	0.500 (12.70)
24	24.000 (609.6)	94.62 (141.12)	0.375 (9.53)
	24.000 (609.6)	125.49 (187.06)	0.500 (12.70)

20. Product Marking

20.1 Except as allowed by 20.2, each length of structural tubing shall be legibly marked by rolling, die-stamping, ink printing, or paint stenciling to show the following information:

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TABLE 6 Permissible Variations in Outside Flat Dimensions for Square, Rectangular, and Special Shape Structural Tubing

Specified Outside Large Flat Dimension, in. (mm)	Permissible Variations Over and Under Specified Outside Flat Dimensions,[A] in. (mm)
2½ (63.5) and under	0.020 (0.51)
Over 2½ to 3½ (63.5 to 88.9), incl	0.025 (0.64)
Over 3½ to 5½ (88.9 to 139.7), incl	0.030 (0.76)
Over 5½ (139.7) to 10 (254), incl	0.01 times large flat dimension
Over 10 (254)	0.02 times large flat dimension

[A] The permissible variations include allowances for convexity and concavity.

TABLE 7 Permissible Variations in Length for Specific Lengths of Structural Tubing

	22 ft (6.7 m) and Under		Over 22 to 44 ft (6.7 to 13.4 m), incl	
	Over	Under	Over	Under
Permissible variations in length for specific lengths, in. (mm)	½ (12.7)	¼ (6.4)	¾ (19.0)	¼ (6.4)

manufacturer's name, brand, or trademark; size; and the specification designation (year of issue not required).

20.2 For structural tubing having a specified outside diameter or large flat dimension less than 2 in. (50.8 mm), it shall be permissible for the information listed in 20.1 to be marked on a tag securely attached to each bundle.

TABLE 8 Permissible Variations in Twist for Square, Rectangular, and Special Shape Structural Tubing

Specified Outside Large Flat Dimension, in. (mm)	Maximum Permissible Variations in Twist per 3 ft of Length (Twist per Metre of Length)	
	in.	mm
1½ (38.1) and under	0.050	1.39
Over 1½ to 2½ (38.1 to 63.5), incl	0.062	1.72
Over 2½ to 4 (63.5 to 101.6), incl	0.075	2.09
Over 4 to 6 (101.6 to 152.4), incl	0.087	2.42
Over 6 to 8 (152.4 to 203.2), incl	0.100	2.78
Over 8 (203.2)	0.112	3.11

20.3 *Bar Coding*—In addition to the requirements in 20.1 and 20.2, the manufacturer shall have the option of using bar coding as a supplementary identification method. When a specific bar coding system is specified in the purchase order, that system shall be used.

NOTE 2—In the absence of another bar coding system being specified in the purchase order, it is recommended that bar coding be consistent with AIAG Standard B-1.

21. Packaging, Marking, and Loading

21.1 When specified in the purchase order, packaging, marking, and loading shall be in accordance with Practices A 700.

22. Keywords

22.1 steel tube; structural steel tubing

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall apply only when specified by the purchaser in the inquiry, contract, or order.

S1. Weld Line Integrity Evaluation

S1.1 The weld line integrity evaluation applies to Grade B only.

If NDT of the weld line is an express requirement of an order, 100 % of the weld line shall be subjected to nondestructive testing via eddy current or ultrasonic techniques. The technique, as well as acceptance criteria, shall be agreed upon by the purchaser and manufacturer, and specified on the order.

NOTE S1—Eddy current equipment usage is limited by its maximum thickness measurement capabilities.

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 501 – 01(2005), that may impact the use of this specification.

(*1*) Revised 1.2. Added new 1.3 and 1.4 and renumbered subsequent paragraphs.
(*2*) Added new 4.1.3 and renumbered subsequent paragraphs. Revised 6.1.
(*3*) Replaced old Section 10 Bend Test with new Section 10 Charpy V-Notch Impact Test.
(*4*) Added Supplementary Requirement.
(*5*) Deleted old Table 3 and renumbered subsequent tables. Revised Table 1, Table 2, Table 3, Table 4, and Table 6.

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