



Designation: **A1085/A1085M – 15 A1085/A1085M – 22**

Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)¹

This standard is issued under the fixed designation A1085/A1085M; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification covers cold-formed welded carbon steel hollow structural sections (HSS) for welded or bolted construction. These shapes are utilized in but not limited to the following applications: buildings, bridges, towers, cranes, sign supports and poles, off-shore production and drilling platforms, roll-over protective structures (ROPS), falling object protective structures (FOPS), and amusement rides.

1.2 This HSS is produced in welded sizes with a periphery of 88 in. [2235 mm] or less, and a specified nominal wall thickness of 0.148 in. [3.8 mm] or greater and ϕ 8751.000 in. [22[25.4 mm] or less.

1.3 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. The inch-pound units shall apply unless the “M” designation of this specification is specified in the order.

1.4 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.

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:²

- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A751 Test Methods and Practices for Chemical Analysis of Steel Products
- A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

2.2 Military Standard:³

- MIL-STD-129 Marking for Shipment and Storage

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.

Current edition approved Nov. 15, 2015; Nov. 1, 2022. Published November 2015; December 2022. Originally approved in 2013. Last previous edition approved in 2013 as A1085/A1085M – 15, –13. DOI: 10.1520/A1085_A1085M-15-10.1520/A1085_A1085M-22.

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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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



2.3 *Federal Standards:*⁴

Fed. Std. No. 123 Marking for Shipment

Fed. Std. No. 183 Continuous Identification Marking of Iron and Steel Products

2.4 *AIAG Standard:*⁵

B-1 Bar Code Symbology Standard

2.5 *Steel Tube Institute:*⁶

[Methods to Check Dimensional Tolerances on Hollow Structural Sections](#)

3. Terminology

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

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 [metres] or number of lengths),

4.1.2 Name of material (cold-formed HSS),

4.1.3 Size (outside diameter and wall thickness for round HSS, and outside dimensions and wall thickness for square and rectangular HSS),

4.1.4 Length (random, multiple, specific; see 12.4),

4.1.5 End condition (see 17.3),

4.1.6 Burr removal (see 17.3),

4.1.7 Certification (see Section 19),

4.1.8 ASTM specification designation and year of issue,

<https://standards.iteh.ai/catalog/standards/sist/009349c2-d048-409b-899a-3a21cbbb03f2/astm-a1085-a1085m-22>

4.1.9 End use,

4.1.10 Special requirements,

4.1.11 Bar coding (see 20.3),

4.1.12 Packing, Marking and Loading (see Section 21), and

4.1.13 Supplementary requirement, if any, including the additional requirement called for in the supplementary requirement.

5. Process

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

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

⁵ Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48033, <http://www.aiag.org>.

⁶ Available from the Steel Tube Institute (STI), 2516 Waukegan Rd., STE 172, Glenview, IL 60025-1774, <https://steeltubeinstitute.org>.

6. Manufacture

6.1 HSS shall be made from flat-rolled steel by the electric-resistance-welding process. The longitudinal butt joint of welded tubing shall be welded across its thickness. No transverse coil splices are permitted in the furnished product.

6.2 Stress relief or annealing is permissible. If heat treatment is performed mechanical testing shall be conducted after heat treatment.

NOTE 1—Welded HSS is normally furnished without removal of the inside flash.

7. Heat Analysis

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

7.2 The maximum permissible carbon equivalent shall be 0.45 %. The carbon equivalent shall be based upon the heat analysis. The required heat analysis and the carbon equivalent shall be reported. The carbon equivalent shall be calculated using the following formula:

$$CE = C + (Mn)6 + (Cr + Mo + V)5 + (Ni + Cu)15$$

$$CE = C + (Mn)6 + (Cr + Mo + V)5 + (Ni + Cu)15$$

8. Product Analysis

8.1 When product tests are conducted the HSS shall conform to the requirements of **Table 1** for product analysis.

8.2 If product analyses are made, they shall be made using test specimens taken from two lengths of HSS 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 **A751**. 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**.

TABLE 1 Chemical Requirements

Element	Composition, %	
	Heat Analysis	Product Analysis
Carbon, max	0.26	0.30
Manganese, max	1.35	1.40
Phosphorus, max	0.035	0.045
Sulfur, max	0.035	0.045
Aluminum, min	.015 acid soluble OR .020 total Al content	...
Silicon	≤0.04 or 0.15 ≤ Si ≤ 0.25	<0.07 or 0.13 ≤ Si ≤ 0.28

Notes:

(1) 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.

(2) Where an ellipsis (...) appears in the table, requirements have not been defined.



TABLE 2 Tensile Requirements

Round and Shaped HSS	
Grade A	
Yield Strength, psi [MPa]	50,000 [345] – 70,000 [485]
Yield Strength, psi [MPa]	50 000 [345] – 70 000 [485]
Tensile Strength, psi [MPa], min.	65,000 [450]
Tensile Strength, psi [MPa], min.	65 000 [450]
Elongation in 2 in. [50 mm], min. % ^A	21

^A The minimum elongation values specified apply only to tests performed prior to shipment of the tubing.

10. Charpy V-Notch (CVN) Impact Requirements

10.1 The material, as represented by the test specimen, shall conform to the minimum average CVN Impact Value of 25 ft-lb at 40°F [34 Joules at 4°C], based on full-size longitudinal test specimens. (See Test Methods and Definitions A370 for acceptance criteria for subsize specimens.)

11. Flattening Test

11.1 The flattening test shall be made on round HSS. A flattening test is not required for square and rectangular HSS.

11.2 For round HSS, a test specimen at least 4 in. [100 mm] in length shall be flattened cold between parallel plates in three steps, with the weld located 90° from the line of direction of force. During the first step, which is a test for ductility of the weld, no cracks or breaks on the inside or outside surfaces of the test specimen shall be present until the distance between the plates is less than two-thirds of the specified outside diameter of the tubing. For the second step, no cracks or breaks on the inside or outside parent metal surfaces of the test specimen, except as provided for in 11.4, shall be present until the distance between the plates is less than one-half of the specified outside diameter of the tubing. During the third step, which is a test for soundness, the flattening shall be continued until the test specimen breaks or the opposite walls of the test specimen meet. Evidence of laminated or unsound material or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

11.3 Surface imperfections not found in the test specimen before flattening, but revealed during the first step of the flattening test, shall be judged in accordance with Section 17.

<https://standards.iteh.ai/catalog/standards/sist/009349c2-d048-409b-899a-3a21cbbb03d2/astm-a1085-a1085m-22>

11.4 When low *D*-to-*t* ratio HSS are tested, the strain imposed due to geometry is unreasonably high on the inside surface at the 6 and 12 o'clock locations. Cracks at these locations shall not be cause for rejection if the *D*-to-*t* ratio is less than 10.

12. Permissible Variations in Dimensions

12.1 *Outside Dimensions:*

12.1.1 *Round HSS*—The outside diameter shall not vary more than ±0.5 %, rounded to the nearest 0.005 in. [0.1 mm], from the specified outside diameter for specified outside diameters 1.900 in. [48 mm] and smaller, and ±0.75 %, rounded to the nearest 0.005 in. [0.1 mm], from the specified outside diameter for specified outside diameters 2.00 in. [50 mm] and larger. The outside diameter measurements shall be made at positions at least 2 in. [50 mm] from the ends of the HSS.

12.1.2 *Square and Rectangular HSS*—The outside dimensions, measured across the flats at positions at least 2 in. [50 mm] from the ends of the HSS shall not vary from the specified outside dimensions by more than the applicable amount given in Table 3, which includes an allowance for convexity or concavity.

12.2 *Wall Thickness*—The minimum wall thickness shall be 95 % of the specified wall thickness. The maximum wall thickness, excluding the weld seam, shall be not more than 10 % greater than the specified wall thickness. For square and rectangular tubing the wall thickness requirements shall apply only to the centers of the flats.

12.3 *Mass*—On the basis that the density of rolled steel is 0.2836 lb/in.³ [7850 kg/m³] and that the outside radius of corners of rectangular HSS are 2 times the specified thickness, the actual mass of an individual length of HSS shall not deviate from the mass specified by more than –3.5 % or +10 %.

**TABLE 3 Permissible Variations in Outside Flat Dimensions for Square and Rectangular HSS**

Specified Outside Large Flat Dimension, in. [mm]	Permissible Variations Over and Under Specified Outside Flat Dimensions, ^A in. [mm]	
	Over	Under
2½ [65] or under	0.020 [0.5]	
Over 2½ to 3½ [65 to 90], incl	0.025 [0.6]	
Over 3½ to 5½ [90 to 140], incl	0.030 [0.8]	
Over 5½ [140]	0.01 times large flat dimension	

^A The permissible variations include allowances for convexity and concavity. For rectangular HSS having a ratio of outside large to small flat dimension less than 1.5, and for square HSS, the permissible variations in small flat dimension shall be identical to the permissible variations in large flat dimension. For rectangular HSS having a ratio of outside large to small flat dimension in the range of 1.5 to 3.0 inclusive, the permissible variations in small flat dimension shall be 1.5 times the permissible variations in large flat dimension. For rectangular HSS having a ratio of outside large to small flat dimension greater than 3.0, the permissible variations in small flat dimension shall be 2.0 times the permissible variations in large flat dimension.

TABLE 4 Length Tolerances for Specific Lengths of Structural HSS

	22 ft [6.5 m] and Under		Over 22 ft [6.5 m]	
	Over	Under	Over	Under
Length tolerance for specific lengths, in. [mm]	½ [13]	¼ [6]	¾ [19]	¼ [6]

12.4 *Length*—HSS is normally produced in random lengths 5 ft [1.5 m] and over, in multiple lengths, and in specific lengths. Refer to Section 4. When specific lengths are ordered, the length tolerance shall be in accordance with Table 4.

12.5 *Straightness*—The permissible variation for straightness of HSS shall be ¼ in. times the number of feet [10 mm times the number of metres] of total length divided by 5.

12.6 *Squareness of Sides*—For square and rectangular structural HSS, adjacent sides shall be square (90°), with a permissible variation of ±2° max.

12.7 *Radius of Corners*—For square and rectangular structural HSS, the radius of each outside corner of the section shall be as noted in the table below: Table 5.

TABLE 5 Corner Radii

Thickness, t, in. [mm]	Corner Radius
t ≤ 0.400 [10.2 mm]	1.6t to 3.0t
t > 0.400 [10.2 mm]	1.8t to 3.0t

12.8 *Twist*—For square and rectangular structural HSS, the permissible variations in twist shall be as given in Table 6. Twist shall

TABLE 6 Permissible Variations in Twist for Square and Rectangular HSS

Specified Outside Large Flat Dimension, in. [mm]	Maximum Permissible Variations in Twist per 3 ft of Length [Twist per Meter of Length]	
	in.	[mm]
1½ [40] and under	0.050	[1.3]
Over 1½ to 2½ [40 to 65], incl	0.062	[1.6]
Over 2½ to 4 [65 to 100], incl	0.075	[1.9]
Over 4 to 6 [100 to 150], incl	0.087	[2.2]
Over 6 to 8 [150 to 200], incl	0.100	[2.5]
Over 8 [200]	0.112	[2.8]