



Designation: A572/A572M – 18

American Association State
Highway and Transportation
Officials Standard
AASHTO No.: M223

Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel¹

This standard is issued under the fixed designation A572/A572M; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers five grades of high-strength low-alloy structural steel shapes, plates, sheet piling, and bars. Grades 42 [290], 50 [345], and 55 [380] are intended for riveted, bolted, or welded structures. Grades 60 [415] and 65 [450] are intended for riveted or bolted construction of bridges, or for riveted, bolted, or welded construction in other applications.

1.2 For applications, such as welded bridge construction, where notch toughness is important, notch toughness requirements are to be negotiated between the purchaser and the producer.

1.3 Specification **A588/A588M** shall not be substituted for Specification A572/A572M without agreement between the purchaser and the supplier.

1.4 The use of columbium, vanadium, titanium, nitrogen, or combinations thereof, within the limitations noted in Section 5, is required; the selection of type (1, 2, 3, or 5) is at the option of the producer, unless otherwise specified by the purchaser. (See Supplementary Requirement S90.)

1.5 The maximum thicknesses available in the grades and products covered by this specification are shown in **Table 1**.

1.6 When the steel is to be welded, a welding procedure suitable for the grade of steel and intended use or service is to be utilized. See Appendix X3 of Specification **A6/A6M** for information on weldability.

1.7 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each

system are not exact equivalents; therefore, each system is to be used independently of the other, without combining values in any way.

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

1.9 For structural products produced from coil and furnished without heat treatment or with stress relieving only, the additional requirements, including additional testing requirements and the reporting of additional tests, of Specification **A6/A6M** apply.

1.10 *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

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A36/A36M Specification for Carbon Structural Steel

A514/A514M Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

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

3. General Requirements for Delivery

3.1 Structural products furnished under this specification shall conform to the requirements of the current edition of

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 A01.02 on Structural Steel for Bridges, Buildings, Rolling Stock and Ships.

Current edition approved May 1, 2018. Published May 2018. Originally approved in 1966. Last previous edition approved in 2015 as A572/A572M – 15. DOI: 10.1520/A0572_A0572M-18.

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.

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

TABLE 1 Maximum Product Thickness or Size

Grade	Yield Point, min		Maximum Thickness or Size					
	ksi	[MPa]	Plates and Bars		Structural Shape Flange or Leg Thickness		Sheet Piling	Zees and Rolled Tees
			in.	[mm]	in.	[mm]		
42 [290] ^A	42	[290]	6	[150]	all	all	all	all
50 [345] ^A	50	[345]	4 ^B	[100] ^B	all	all	all	all
55 [380]	55	[380]	2	[50]	all	all	all	all
60 [415] ^A	60	[415]	1 1/4 ^C	[32] ^C	2	[50]	all	all
65 [450]	65	[450]	1/4	[32]	2	[50]	all	all

^A In the above tabulation, Grades 42, 50, and 60 [290, 345, and 415], are the yield point levels most closely approximating a geometric progression pattern between 36 ksi [250 MPa], min, yield point steels covered by Specification **A36/A36M** and 100 ksi [690 MPa], min, yield strength steels covered by Specification **A514/A514M**.

^B Round bars up to and including 11 in. [275 mm] in diameter are permitted.

^C Round bars up to and including 3 1/2 in. [90 mm] in diameter are permitted.

**TABLE 2 Chemical Requirements^A
(Heat Analysis)**

Diameter, Thickness, or Distance Between Parallel Faces, in. [mm] Plates and Bars	Structural Shape Flange or Leg Thickness, in. [mm]	Grade	Carbon, max, %	Manganese, ^B max, %	Phosphorus, ^I max, %	Sulfur, ^I max, %	Silicon	
							Plates to 1 1/2 in. [40 mm] Thick, Shapes with Flange or Leg Thickness to 3 in. [75 mm] inclusive, Sheet Piling, Bars, Zees, and Rolled Tees ^C	Plates Over 1 1/2 in. [40 mm] Thick and Shapes with Flange Thickness Over 3 in. [75 mm]
							max, %	range, %
6 [150]	all	42 [290]	0.21	1.35 ^D	0.030	0.030	0.40	0.15–0.40
4 [100] ^E	all	50 [345]	0.23	1.35 ^D	0.030	0.030	0.40	0.15–0.40
2 [50] ^F	all	55 [380]	0.25	1.35 ^D	0.030	0.030	0.40	0.15–0.40
1 1/4 [32] ^F	≤2 [50]	60 [415]	0.26	1.35 ^D	0.030	0.030	0.40	^G
>1/2 – 1 1/4 [13–32]	>1–2 [25–50]	65 [450]	0.23	1.65	0.030	0.030	0.40	^G
≤1/2 [13] ^H	≤1	65 [450]	0.26	1.35 ^D	0.030	0.030	0.40	^G

^A Copper when specified shall have a minimum content of 0.20 % by heat analysis (0.18 % by product analysis).

^B Manganese, minimum, by heat analysis of 0.80 % (0.75 % by product analysis) shall be required for all plates over 3/8 in. [10 mm] in thickness; a minimum of 0.50 % (0.45 % by product analysis) shall be required for plates 3/8 in. [10 mm] and less in thickness, and for all other products. The manganese to carbon ratio shall not be less than 2 to 1.

^C Bars over 1 1/2 in. [40 mm] in diameter, thickness, or distance between parallel faces shall be made by a killed steel practice.

^D For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum is permitted, up to a maximum of 1.60 %.

^E Round bars up to and including 11 in. [275 mm] in diameter are permitted.

^F Round bars up to and including 3 1/2 in. [90 mm] in diameter are permitted.

^G The size and grade is not described in this specification.

^H An alternative chemical requirement with a maximum carbon of 0.21 % and a maximum manganese of 1.65 % is permitted, with the balance of the elements as shown in **Table 2**.

^I A maximum phosphorus content of 0.04 % and a maximum sulfur content of 0.05 % are permitted for the following materials:

- Structural shapes
- Sheet piling
- Bars
- Plates with widths up to and including 15 in. [380 mm]

TABLE 3 Alloy Content

Type ^A	Elements	Heat Analysis, %
1	Columbium	0.005–0.05 ^B
	Vanadium	0.01–0.15 ^C
3	Columbium	0.005–0.05 ^B
	Vanadium	0.01–0.15 ^C
	Columbium plus vanadium	0.02–0.15 ^D
5	Titanium	0.006–0.04
	Nitrogen	0.003–0.015
	Vanadium	0.06 max

^A Alloy content shall be in accordance with Type 1, 2, 3, or 5 and the contents of the applicable elements shall be reported on the test report.

^B Product analysis limits = 0.004 to 0.06 %.

^C Product analysis limits = 0.005 to 0.17 %.

^D Product analysis limits = 0.01 to 0.16 %.

Specification **A6/A6M**, for the specific structural product ordered, unless a conflict exists in which case this specification shall prevail.

3.2 Coils are excluded from qualification to this specification until they are processed into a finished structural product. Structural products produced from coil means structural products that have been cut to individual lengths from a coil. The processor directly controls, or is responsible for, the operations involved in the processing of a coil into a finished structural product. Such operations include decoiling, leveling or straightening, hot-forming or cold-forming (if applicable),

TABLE 4 Tensile Requirements^A

Grade	Yield Point, min		Tensile Strength, min		Minimum Elongation, % ^{B, C, D}	
	ksi	[MPa]	ksi	[MPa]	in 8 in. [200 mm]	in 2 in. [50 mm]
42 [290]	42	[290]	60	[415]	20	24
50 [345]	50	[345]	65	[450]	18	21
55 [380]	55	[380]	70	[485]	17	20
60 [415]	60	[415]	75	[520]	16	18
65 [450]	65	[450]	80	[550]	15	17

^A See specimen Orientation under the Tension Tests section of Specification A6/A6M.

^B Elongation not required to be determined for floor plate.

^C For wide flange shapes over 426 lb/ft [634 kg/m], elongation in 2 in. [50 mm] of 19 % minimum applies.

^D For plates wider than 24 in. [600 mm], the elongation requirement is reduced two percentage points for Grades 42, 50, and 55 [290, 345, and 380], and three percentage points for Grades 60 and 65 [415 and 450]. See elongation requirement adjustments in the Tension Tests section of Specification A6/A6M.

cutting to length, testing, inspection, conditioning, heat treatment (if applicable), packaging, marking, loading for shipment, and certification.

NOTE 1—For structural products produced from coil and furnished without heat treatment or with stress relieving only, two test results are to be reported for each qualifying coil. Additional requirements regarding structural products produced from coil are described in Specification A6/A6M.

4. Materials and Manufacture

4.1 The steel shall be killed

5. Chemical Composition

5.1 The heat analysis shall conform to the requirements prescribed in Table 2 and Table 3.

5.2 The steel shall conform on product analysis to the requirements prescribed in Table 2 and Table 3, subject to the product analysis tolerances in Specification A6/A6M.

6. Mechanical Properties

6.1 *Tensile Properties:*

6.1.1 The material as represented by the test specimens shall conform to the tensile properties given in Table 4.

7. Test Reports

7.1 In addition to the Test Reports requirements in Specification A6/A6M, when Specification A588/A588M is substituted for Specification A572/A572M, the test report shall include the statement “Specification A588/A588M substituted.”

8. Keywords

8.1 bars; bolted construction; bridges; buildings; columbium-vanadium; high-strength; low-alloy; plates; riveted construction; shapes; sheet piling; steel; structural steel; welded construction

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not apply unless specified in the order or contract. Standardized supplementary requirements for use at the option of the purchaser are listed in Specification A6/A6M. Those that are considered suitable for use with this specification are listed by title:

S5. Charpy V-Notch Impact Test.

S18. Maximum Tensile Strength

S30. Charpy V-Notch Impact Test for Structural Shapes: Alternate Core Location

S32. Single Heat Bundles.

In addition, the following supplementary requirements are suitable for use:

S81. Tensile Strength

S81.1 For Grade 50 [345] steel of thicknesses $\frac{3}{4}$ in. [20 mm] and less, the tensile strength shall be a minimum of 70 ksi [485 MPa].

S90. Type

S90.1 The specific type of steel shall be as specified by the purchaser in the order or contract.

S99. Interlock Strength

S99.1 The minimum strength of the interlocked joint required for certain services may be specified for straight web (PS type) and arched web (PSA type) sheet piling sections subject to specific agreement between the material purchaser and the manufacturer.



SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A572/A572M – 15) that may impact the use of this standard. (Approved May 1, 2018.)

- (1) Revised **Table 1**, Maximum Product Thickness or Size, from ‘not available’ to ‘all’ for sheet piling Grade 65.
- (2) Revised **Table 2**, Chemical Requirements^A (Heat Analysis) for Manganese max, from ‘1.35’ to ‘1.35^D’ for thicknesses $\leq 1/2$ [13]^H.

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