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Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel[1]

This standard is issued under the fixed designation A 572/A 572M; 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 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 A 588/A 588M shall not be substituted for Specification A 572/A 572M 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 A 6/A 6M 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 A 6/A 6M apply.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A 36/A 36M Specification for Carbon Structural Steel

A 514/A 514M Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

A 588/A 588M 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 Specification A 6/A 6M, 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), 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

[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.

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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.

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

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TABLE 1 Maximum Product Thickness or Size

Grade	Yield Point, min		Maximum Thickness or Size					
			Plates and Bars		Structural Shape Flange or Leg Thickness		Sheet Piling	Zees and Rolled Tees
	ksi	[MPa]	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]	1¼[C]	[32][C]	2	[50]	all	all
65 [450]	65	[450]	1¼	[32]	2	[50]	not available	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 A 36/A 36M and 100 ksi [690 MPa], min, yield strength steels covered by Specification A 514/A 514M.
[B] Round bars up to and including 11 in. [275 mm] in diameter are permitted.
[C] Round bars up to and including 3½ 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, max, %	Sulfur, max, %	Silicon	
							Plates to 1½ 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 1½ 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]	0.04	0.05	0.40	0.15–0.40
4 [100][E]	all	50 [345]	0.23	1.35[D]	0.04	0.05	0.40	0.15–0.40
2 [50][F]	all	55 [380]	0.25	1.35[D]	0.04	0.05	0.40	0.15-0.40
1¼ [32][F]	≤2 [50]	60 [415]	0.26	1.35[D]	0.04	0.05	0.40	[G]
>½ – 1¼ [13–32]	>1-2 [25-50]	65 [450]	0.23	1.65	0.04	0.05	0.40	[G]
≤½ [13][H]	≤ 1[H]	65 [450]	0.26	1.35	0.04	0.05	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 ⅜ in. [10 mm] in thickness; a minimum of 0.50 % (0.45 % by product analysis) shall be required for plates ⅜ 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 1½ 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 3½ 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.

be reported for each qualifying coil. Additional requirements regarding structural products produced from coil are described in A 6/A 6M.

4. Materials and Manufacture

4.1 The steel shall be semi-killed or 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 A 6/A 6M.

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 A 6/A 6M, when Specification A 588/A 588M is substituted for Specification A 572/A 572M, the test report shall include the statement "Specification A 588/A 588M substituted" and the heat analysis of all elements required in Specification A 588/A 588M.

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TABLE 3 Alloy Content

Type[A]	Elements	Heat Analysis, %
1	Columbium[B]	0.005–0.05[C]
2	Vanadium	0.01–0.15
3	Columbium[B]	0.005-0.05[C]
	Vanadium	0.01–0.15
	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] Columbium shall be restricted to the following thicknesses and sizes unless killed steel is furnished. Killed steel shall be confirmed by a statement of killed steel on the test report, or by a report on the presence of a sufficient quantity of a strong deoxidizing element, such as silicon at 0.10 % or higher, or aluminum at 0.015 % or higher. See table below.

[C] Product analysis limits = 0.004 to 0.06 %.

[D] Product analysis limits = 0.01 to 0.16 %.

Grades	Maximum Plate, Bar, Sheet Piling, Zees, and Rolled Tee Thicknesses, in. [mm]	Maximum Structural Shape Flange or Leg Thickness, in. [mm]
42, 50, and 55 [290, 345, and 380]	¾ [20]	1.5 [40]
60 and 65 [415 and 450]	½ [13]	1 [25]

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 A 6/A 6M.

[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 A 6/A 6M.

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 A 6/A 6M. 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 ¾ 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.

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 572/A 572M – 06) that may impact the use of this standard. (Approved March 1, 2007.)

(1) Added 1.3 and new Section 7.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 572/A 572M – 04) that may impact the use of this standard. (Approved March 1, 2006.)

(1) The maximum permitted manganese was changed from 1.50 % to 1.60 % for grades 42, 50, 55, and 60 in Table 2.

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