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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 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 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, 4, or 5) is at the option of the producer, unless otherwise specified by the purchaser. (See Supplementary Requirement S90.)

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

1.5 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.

1.6 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.

1.7 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.

1.8 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:

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling²

A 36/A 36M Specification for Carbon Structural Steel²

A 514/A 514M Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding²

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

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 Annual Book of ASTM Standards, Vol 01.04.

*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				Zees and Rolled Tees
	ksi	[MPa]	Plates and Bars		Structural Shapes Groups ^A	Sheet Piling	
			in.	[mm]			
42 [290] ^B	42	[290]	6	[150]	all	all	all
50 [345] ^B	50	[345]	4 ^C	[100] ^C	all	all	all
55 [380]	55	[380]	2 ^D	[50] ^D	all	all	all
60 [415] ^B	60	[415]	1¼ ^D	[32] ^D	1, 2, and 3	all	all
65 [450]	65	[450]	1¼	[32]	1, 2, and 3	not available	all

^A See Specification A 6/A 6M.

^BIn 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.

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

^DRound 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 Shapes Groups ^B	Grade	Carbon, max, %	Manganese, ^C max, %	Phosphorus, max, %	Sulfur, max, %	Silicon	
							Plates to 1½ in. [40 mm] in Thickness, Shapes to 426 lb/ft [634 kg/m], Sheet Piling, Bars, Zees, and Rolled Tees ^D	Plates Over 1½ in. [40 mm] in Thickness and Shapes Over 426 lb/ft [634 kg/m]
							max, %	range, %
6 [150]	all	42 [290]	0.21	1.35 ^E	0.04	0.05	0.40	0.15–0.40
4 [100] ^F	all	50 [345]	0.23	1.35 ^E	0.04	0.05	0.40	0.15–0.40
2 [50] ^G	all	55 [380]	0.25	1.35 ^E	0.04	0.05	0.40	0.15–0.40
1¼ [32] ^G	1,2,3	60 [415]	0.26	1.35 ^E	0.04	0.05	0.40	^H
>½ – 1¼ [13–32]	2,3	65 [450]	0.23	1.65	0.04	0.05	0.40	^H
≤½ [13] ^I	1 ^I	65 [450]	0.26	1.35	0.04	0.05	0.40	^H

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

^BSee Specification A 6/A 6M.

^CManganese, minimum, by heat analysis of 0.80 % (0.75 % by product analysis) shall be required for all plates over ¾ in. [10 mm] in thickness; a minimum of 0.50 % (0.45 % by product analysis) shall be required for plates ¾ 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.

^DBars over 1½ in. [40 mm] in diameter, thickness, or distance between parallel faces shall be made by a killed steel practice.

^EFor 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 1.50 %.

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

^GRound bars up to and including 3½ in. [90 mm] in diameter are permitted.

^HThe size and grade is not described in this specification.

^IAn 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.

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. Keywords

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