



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 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 **A6/A6M** apply.

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

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



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] | 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 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 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 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.

^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.

TABLE 3 Alloy Content

| Type ^A | Elements | Heat Analysis, % |
|-------------------|-------------------------|-------------------------|
| 1 | Columbium | 0.005–0.05 ^B |
| 2 | 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 %.

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.