



Designation: **A606/A606M—15 A606/A606M – 18**

## Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance<sup>1</sup>

This standard is issued under the fixed designation A606/A606M; 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 ( $\epsilon$ ) 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 high-strength, low-alloy, hot- and cold-rolled sheet and strip in cut lengths or coils, intended for use in structural and miscellaneous purposes, where savings in weight or added durability are important. These steels have enhanced atmospheric corrosion resistance and are supplied in ~~two~~three types: Type 2 contains 0.20 % minimum copper based on cast or heat analysis (0.18 % minimum Cu for product check). Type 4 and Type 5 contains additional alloying elements and provides a level of corrosion resistance substantially better than that of carbon steels with or without copper addition (**Note 1**). When properly exposed to the atmosphere, Type 4 ~~steel~~and Type 5 steels can be used in the bare (unpainted) condition for many applications.

NOTE 1—For methods of establishing the atmospheric corrosion resistance of low-alloy steels, see Guide **G101**.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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.

1.3 *Welding*—In general, the steels listed in this specification are weldable with commonly obtained welding electrodes. When the steel is to be welded, a suitable welding procedure based on its composition should be used, taking into account intended use and service temperatures.

NOTE 2—For a general discussion of the weldability of steel and carbon equivalents, consult Appendix X3 of **A6/A6M**.

1.4 *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:*<sup>2</sup>

[A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling](#)

[A109/A109M Specification for Steel, Strip, Carbon \(0.25 Maximum Percent\), Cold-Rolled](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for](#)

[A749/A749M Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for](#)  
[G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels](#)

### 3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification **A568/A568M** and the dimensional tolerance tables of Specification **A109/A109M**, unless otherwise provided herein.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee **A01** on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee **A01.19** on Steel Sheet and Strip.

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<sup>2</sup> 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

#### 4. Ordering Information

4.1 Orders for material under this specification shall include the following information, as required, to describe adequately the desired material:

- 4.1.1 ASTM specification number and date of issue, and type,
- 4.1.2 Name of material (high-strength low-alloy hot-rolled sheet or strip or high-strength low-alloy cold-rolled sheet or strip),
  - 4.1.2.1 Hot rolled sheet shall either be CS or ~~grade~~Grade 50 (Grade 50 shall be supplied if not specified).
  - 4.1.2.2 Cold rolled sheet shall either be CS or ~~grade~~Grade 45 (Grade 45 shall be supplied if not specified).
- 4.1.3 Condition (specify oiled or dry, as required),
- 4.1.4 Edges (must be specified for hot-rolled sheet or strip) (see 8.1),
- 4.1.5 Finish—Cold-rolled only (indicate exposed (E) or unexposed (U). Matte (dull) finish will be supplied unless otherwise specified), and
- 4.1.6 Dimensions (thickness, width, and whether cut lengths or coils).

NOTE 3—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification A568/A568M. The purchaser should contact the producer regarding possible limitations prior to placing an order.

- 4.1.7 Coil size (must include inside diameter, outside diameter, and maximum weight);
- 4.1.8 Application (show part identification and description);
- 4.1.9 Cast or heat (formerly ladle) analysis and mechanical properties report (if required) (see 10.1), and
- 4.1.10 Special requirements (if any):
  - 4.1.10.1 When the purchaser requires thickness tolerances for  $\frac{3}{8}$  in. [10 mm] minimum edge distance (see Supplementary Requirement in Specification A568/A568M), this requirement shall be specified in the purchase order or contract.

NOTE 3—A typical ordering description is as follows: “ASTM A606–XX, Grade 50, Type 4 high-strength low-alloy hot-rolled sheet, dry, mill edge 0.106 by 48 by 96 in. for truck frame side members.” Or, “ASTM A606M–XX, Grade 50, Type 4 high-strength low-alloy hot-rolled sheet, dry, mill edge; 2.7 by 1220 mm by coil for truck frame side members.”

- 4.2 The purchaser has the option to specify additional requirements, including but are not limited, to the following:
- 4.2.1 Coil size (must include inside diameter, outside diameter, and maximum weight),
  - 4.2.2 Application (show part identification and description),
  - 4.2.3 Cast or heat (formerly ladle) analysis and mechanical properties report (if required) (see 10.1), and
  - 4.2.4 When the purchaser requires thickness tolerances for  $\frac{3}{8}$  in. [10 mm] minimum edge distance (see Supplementary Requirement in Specification A568/A568M), this requirement shall be specified in the purchase order or contract.
  - 4.2.5 Impact toughness requirements at a specified test temperature, if required.
  - 4.2.6 Other special requirements, if any.

NOTE 4—A typical ordering description is as follows: “ASTM A606–XX, Grade 50, Type 4 high-strength low-alloy hot-rolled sheet, dry, mill edge 0.106 by 48 by 96 in. for truck frame side members.” Or, “ASTM A606M–XX, Grade 345, Type 5 high-strength low-alloy hot-rolled sheet, dry, mill edge; 2.7 by 1220 mm by coil for truck frame side members.”

#### 5. Materials and Manufacture

- 5.1 *Condition*—The material shall be furnished hot-rolled or cold-rolled as specified on the purchase order.
- 5.2 *Heat Treatment*— Unless otherwise specified, ~~hot-rolled~~Type 2 and Type 4 steels shall be furnished as ~~rolled~~hot-rolled. When hot-rolled annealed or hot-rolled normalized material is required, it shall be specified on the purchase order.
  - 5.2.1 For Type 5, although the recommended maximum hot rolling temperature is 2100°F [1150°C], the actual temperature selected is at the discretion of the producer.
  - 5.2.2 Type 5 is normalized by heating to 1600 to 1700°F [870 to 925°C] and then cooled in still air. The yield strength of Type 5 is increased by precipitation hardening at 1000 to 1050°F [535 to 565°C] for 20 to 60 min, depending on the amount of strength increase desired by the producer.

#### 6. Chemical Composition

- 6.1 The maximum limits of carbon, manganese, and sulfur shall be as prescribed in Table 1, unless otherwise agreed upon between the manufacturer and the purchaser.
- 6.2 The manufacturer shall use ~~such alloying elements,~~ alloying elements, such as chromium, nickel, copper, and phosphorus, combined with the carbon, manganese, and sulfur within the limits prescribed in Table 1 to satisfy the mechanical properties prescribed in Table 2 or Table 3. As indicated in 1.1, these steels have enhanced atmospheric corrosion resistance and are supplied in ~~two~~three types: Type 2–2, Type 4, and Type 4–5. When requested, the producer shall supply acceptable evidence of corrosion resistance to the purchaser.
  - 6.2.1 For Type 2 steel, confirmation of the minimum copper content requirement of 1.1 shall be sufficient evidence of corrosion resistance.



TABLE 1 Chemical Requirements

Type of A606 Steel	Composition, max. %max. %; ranges and minimum excepted	
	Cast or Heat (Formerly Ladle) Analysis	Product Check, or Verification Analysis
<b>Type 2 and Type 4<sup>B</sup></b>		
Carbon <sup>A</sup>	0.22	0.26
Manganese	1.25	1.30
Sulfur	0.04	0.06
Copper	0.20 min	0.18 min
<b>Type 5</b>		
Carbon	0.09	0.12
Manganese	0.70–0.95	0.66–1.00
Phosphorus	0.025	0.030
Sulfur	0.010	0.015
Silicon	0.40	0.45
Nickel	0.52–0.76	0.50–0.79
Chromium	0.30	0.34
Copper	0.65–0.98	0.63–1.00
Titanium	0.15	0.16
Vanadium	0.15	0.16
Niobium	0.08	0.09

<sup>A</sup> For compositions with a maximum carbon content of 0.15 % on heat or cast analysis, the maximum limit for manganese on heat or cast analysis may be increased to 1.40 % (with product analysis limits of 0.19 % carbon and 1.45 % manganese).

<sup>B</sup> The addition of other alloying elements to obtain the required atmospheric corrosion resistance is at the discretion of the manufacturer for Type 4.

TABLE 2 Tensile Requirements<sup>A</sup> for Hot-Rolled Grade 50 Material

	As-Rolled	Annealed or Normalized
Tensile strength, min ksi (MPa)	70 [480]	65 [450]
Yield strength, min, ksi (MPa)	50 [340]	45 [310]
Elongation in 2 in. or 50 mm, min %	22	22
—min, %	—	—

<sup>A</sup> For coil products, testing by the producer is limited to the end of the coil. Mechanical properties throughout the coil shall comply with the minimum values specified.

TABLE 3 Tensile Requirements for Cold-Rolled Grade 45 Material

	Cut Lengths and Coils
Tensile strength, min, ksi (MPa)	65 [450]
Yield strength, min, ksi (MPa)	45 [310]
Elongation in 2 in. or 50 mm, min, %	22 <sup>A</sup>

<sup>A</sup> 0.0448 in. [1.1 mm] and under in thickness—20 %.

6.2.2 For Type 4 steel, and Type 5 steels, the basis for this evidence can be a corrosion-resistance index calculated from the chemical composition of the steel in accordance with Guide G101. To comply with Specification A606, Type 4 or Type 5 steel shall have a minimum corrosion-resistance index of 6.0, based upon Guide G101 (see Note 45).

NOTE 5—The user is cautioned that the Guide G101 predictive equation for calculation of an atmospheric corrosion index has been verified only for the composition limits stated in that guide. The composition of Type 4 or Type 5 steels determines which calculation procedure (Larabee-Coburn or Townsend methods) should be used to obtain a minimum index of 6.0 in accordance with Guide G101. The Larabee-Coburn equation of 6.3.1.1 limits the amount of copper to 0.51 % max. Type 5 steels exceed this limit and some Type 4 compositions may contain more than 0.51 % copper, requiring use of the Townsend method of Section 6.3.2.

6.3 When the steel is used in welded applications, welding procedure shall be suitable for the steel chemistry as described in 6.2 and the intended service.

## 7. Mechanical Property Requirements

7.1 Material ordered as CS has no mechanical properties requirements. Specific requirements may be added if agreed upon between the purchaser and the producer.

### 7.2 Tension Tests: