Designation: A 606/A 606M – 09

Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance[1]

This standard is issued under the fixed designation A 606/A 606M; 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 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 types: Type 2 contains 0.20 % minimum copper based on cast or heat analysis (0.18 % minimum Cu for product check). Type 4 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 can be used bare (unpainted) for many applications.

NOTE 1—For methods of establishing the atmospheric corrosion resistance of low-alloy steels, see Guide G 101.

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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A 109/A 109M Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

A 568/A 568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A 749/A 749M Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for

G 101 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 A 568/A 568M and the dimensional tolerance tables of Specification A 109/A 109M, unless otherwise provided herein.

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),

4.1.3 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).

4.1.6.1 As agreed upon between the purchaser and the producer, material ordered to this specification will be supplied to meet the appropriate standard or restricted thickness tolerance table shown in Specification A 568/A 568M.

NOTE 2—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification A 568/A 568M. The purchaser should contact the producer regarding possible limitations prior to placing an order.

[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 A01.19 on Steel Sheet and Strip.

Current edition approved April 1, 2009. Published April 2009. Originally approved in 1970. Last previous edition approved in 2004 as A 606 – 04.

[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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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 Special requirements (if required), and

4.1.10 Cast or heat (formerly ladle) analysis and mechanical properties report (if required) (see 10.1).

NOTE 3—A typical ordering description is as follows: "ASTM A 606–XX, 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 A 606M–XX, Type 4 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 shall be furnished as rolled. When hot-rolled annealed or hot-rolled normalized material is required, it shall be specified on the purchase order.

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, 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. Such elements shall be included and reported in the specified heat or cast analysis. As indicated in 1.1, these steels have enhanced atmospheric corrosion resistance and are supplied in two types: Type 2 and Type 4. When requested, the producer shall supply acceptable evidence of corrosion resistance to the purchaser. For Type 2 steel, confirmation of the minimum copper content requirement of 1.1 shall be sufficient evidence of corrosion resistance. For Type 4 steel, the basis for this evidence can be a corrosion-resistance index calculated from the chemical composition of the steel in accordance with Guide G 101. To comply with Specification A 606, Type 4 steel shall have a minimum corrosion-resistance index of 6.0, based upon Guide G 101—Predictive Method Based on the Data of Larabee and Coburn (see Note 4.)

NOTE 4—The user is cautioned that the Guide G 101 predictive equation (Predictive Method Based on the Data of Larabee and Coburn) for calculation of an atmospheric corrosion index has been verified only for the composition limits stated in that guide.

TABLE 1 Chemical Requirements

	Composition, max, %	
	Cast or Heat (Formerly Ladle) Analysis	Product Check, or Verification Analysis
Carbon[A]	0.22	0.26
Manganese	1.25	1.30
Sulfur	0.04	0.06

[A] 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).

TABLE 2 Tensile Requirements[A] for Hot-Rolled 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

[A] 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 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[A]

[A] 0.0448 in. [1.1 mm] and under in thickness—20 %.

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 *Tension Tests*:

7.1.1 *Requirements*—Material as represented by the test specimen shall conform to the tensile requirements specified in Table 2 (hot-rolled material) or in Table 3 (cold-rolled material).

7.1.2 *Number of Tests*—Two tensile tests shall be made from each heat or from each lot of 50 tons [45 000 kg]. When the amount of finished material from a heat or lot is less than 50 tons [45 000 kg], one test shall be made. When material rolled from one heat differs 0.050 in. [1.27 mm] or more in thickness, one tensile test shall be made from the thickest and thinnest material regardless of the weight represented.

7.1.3 *Location and Orientation*:

7.1.3.1 Tensile test specimens shall be taken at a point immediately adjacent to the material to be qualified.

7.1.3.2 Tensile test samples shall be taken from the full thickness of the sheet as rolled.

7.1.3.3 Tensile test specimens shall be taken from a location approximately halfway between the center of the sheet and the edge of the material as rolled.

7.1.3.4 Tensile test specimens shall be taken with the axis of the test specimen parallel to the rolling direction (longitudinal test).

7.1.4 *Test Method*—Yield strength shall be determined by either the 0.2 % offset method or by the 0.5 % extension under load method unless otherwise specified.

7.2 *Bending Properties*—The minimum forming radius (radii) that steel covered by this specification can be expected to sustain is listed in the Appendix X1 and is discussed in more detail in Specifications A 568/A 568M and A 749/A 749M. Where tighter bend radii are required, where curved or offset bends are involved, or where stretching or drawing are also a consideration, the producers should be consulted.

8. Workmanship, Finish, and Appearance

8.1 *Edges*:

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8.1.1 *Hot-Rolled*—In the as-rolled condition the material has mill edges. Pickled or blast-cleaned material has cut edges. When required, as-rolled material may be specified to have cut edges. If mill edge material is required it must be specified.

8.1.2 *Cold-Rolled*—Cold-rolled material shall have cut edges only.

8.2 *Oiling*:

8.2.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled as-rolled material shall be furnished dry, and hot-rolled pickled or blast-cleaned material shall be furnished oiled. When required, pickled or blast-cleaned material may be specified to be furnished dry, and as-rolled material may be specified to be furnished oiled.

8.2.2 *Cold-Rolled*—Unless otherwise specified, cold-rolled material shall be oiled. When required, cold-rolled material may be specified to be furnished dry, but is not recommended due to the increased possibility of rusting.

8.3 *Surface Finish*:

8.3.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled material shall have an as-rolled, not pickled surface finish. When required, material may be specified to be pickled or blast-cleaned.

8.3.2 *Cold-Rolled*—Unless otherwise specified, cold-rolled material shall have a matte (dull) finish.

9. Retests and Disposition of Non-Conforming Material

9.1 Retests, conducted in accordance with the requirements of Section 11.1 of Specification A 568/A 568M, are permitted when an unsatisfactory test result is suspected to be the consequence of the test method procedure.

9.2 Disposition of non-conforming material shall be subject to the requirements of Section 11.2 of Specification A 568/A 568M.

10. Certification

10.1 When requested, the manufacturer shall furnish copies of a test report showing the results of the heat or cast analysis and mechanical property tests made to determine compliance with this specification. The report shall include the purchase order number, the ASTM designation number, and the heat or lot number correlating the test results with the material represented.

11. Keywords

11.1 alloy steel sheet; alloy steel strip; cold rolled steel sheet; cold rolled steel strip; high strength low alloy steel; hot rolled steel sheet; hot rolled steel strip; steel sheet; steel strip

APPENDIX

(Nonmandatory Information)

X1. BENDING PROPERTIES

TABLE X1.1 Suggested Minimum Inside Radius for Cold Bending[A]

NOTE 1—*(t)* equals a radius equivalent to the steel thickness.

NOTE 2—The suggested radii should be used as minimums for 90° bends in actual shop practice.

Grade	Minimum Inside Radius for Cold Bending
Hot Rolled or Cold Rolled	2½ *t*

[A] Material which does not perform satisfactorily, when fabricated in accordance with the above requirements, may be subject to rejection pending negotiation with the steel supplier.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 606 – 04) that may impact the use of this standard. (Approved April 1, 2009.)

(*1*) 1.2 replaced.
(*2*) Note 3—Metric example added.
(*3*) 7.1.2—Metric values changed from "soft" to "hard."
(*4*) 9—Entire paragraph replaced with current wording on retesting, resampling, etc.
(*5*) Table 2—Metric values changed from "soft" to "hard."
(*6*) Table 3—Metric values changed from "soft" to "hard."
(*7*) Standard Designation changed to show dual standard.

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