



Designation: A749/A749M – 14 (Reapproved 2021)

Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for¹

This standard is issued under the fixed designation A749/A749M; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers the general requirements for hot-rolled steel strip in coils and cut lengths. It applies to carbon steel and high-strength, low-alloy steel furnished as hot-rolled.

1.2 This specification is not applicable to hot-rolled heavy-thickness carbon sheet and strip coils (Specification [A1018/A1018M](#)), cold-rolled carbon steel strip (Specification [A109/A109M](#)), high-strength, low-alloy cold-rolled steel (Specifications [A606/A606M](#) and [A1008/A1008M](#)) or cold-rolled high carbon steel (Specification [A684/A684M](#)).

1.3 In case of any conflict in requirements, the requirements of the individual material specification shall prevail over those of this general specification.

1.4 For the purposes of determining conformance with this and the appropriate product specification referenced under 2.1, values shall be rounded to the nearest unit in the right hand place of figures used in expressing the limiting values in accordance with the rounding method of Practice [E29](#).

1.5 [Annex A1](#) lists permissible variations in dimensions and mass ([Note 1](#)) in SI [metric] units. The values listed are not exact conversions of the values listed in the inch-pound tables, but instead are rounded or rationalized values. Conformance to [Annex A1](#) is mandatory when the “M” specification is used.

NOTE 1—The term “weight” is used when inch-pound units are the standard; however, under SI, the preferred term is “mass.”

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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.

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1.7 This specification and the applicable material specifications are expressed in both inch-pound units and SI units. However, unless the order specifies the applicable “M” specification designation (SI units), the material shall be furnished to inch-pound units.

1.8 *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:²

- [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 [749m-142021](#)
- [A606/A606M](#) Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
- [A684/A684M](#) Specification for Steel, Strip, High-Carbon, Cold-Rolled
- [A700](#) Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- [A751](#) Test Methods and Practices for Chemical Analysis of Steel Products
- [A941](#) Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
- [A1008/A1008M](#) Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable

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.

A1018/A1018M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E290 Test Methods for Bend Testing of Material for Ductility

2.2 *Military Standards:*³

MIL-STD-129 Marking for Shipment and Storage

2.3 *Federal Standards:*³

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)

Fed. Std. No. 183 Continuous Identification Marking of Iron and Steel Products

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *Product Types:*

3.1.2 *hot-rolled strip*—manufactured by hot rolling billets or slabs to the required thickness; it may be produced single width or by rolling multiple width and slitting to the desired width; it can be supplied in coils or cut lengths as specified.

Width, in.		Thickness, in.	
Over	Through	Over	Through
...	3½	0.044	0.203
3½	6	0.044	0.203
6	12	0.044	0.230 excl

Width, mm		Thickness, mm	
Over	Through	Over	Through
...	100	1.2	5.0
100	200	1.2	5.0
200	300	1.2	6.0, excl

Hot-rolled, high-strength, low-alloy strip is commonly available by size as follows:

Width, in.		Thickness, in.		
Over	Through	From	Through	
			Coils & Cut Lengths	Coils Only
...	6	0.054	0.203	0.230 excl
6	12	0.054	0.230	0.230 excl

Width, mm		Thickness, mm	
Over	Through	Over	Through
...	200	1.8	5.0
200	300	1.8	6.0, excl

4. Materials and Manufacture

4.1 Unless otherwise specified, hot-rolled material shall be furnished hot-rolled, not annealed or pickled.

5. Chemical Composition

5.1 *Limits:*

5.1.1 The chemical composition shall be in accordance with the applicable product specification. However, if other compositions are required for carbon steel, they shall be prepared in accordance with Specification **A568/A568M**, Appendix X2.

5.1.2 Where the material is used for fabrication by welding, care must be exercised in the selection of chemical composition or mechanical properties to ensure compatibility with the welding process and its effect on altering the properties.

5.2 *Cast or Heat (Formerly Ladle) Analysis:*

5.2.1 An analysis of each cast or heat of steel shall be made by the manufacturer to determine the percentage of elements specified or restricted by the applicable specification.

5.2.2 When requested, cast or heat analysis for elements listed or required shall be reported to the purchaser or to its representative.

5.3 *Product, Check, or Verification Analysis:*

5.3.1 Nonkilled steels (such as capped or rimmed) are not technologically suited to product analysis due to the nonuniform character of their chemical composition and therefore, the tolerances referenced in 5.3.2 do not apply. Product analysis is appropriate on these types of steel only when misapplication is apparent or for copper when copper steel is specified.

5.3.2 For steels other than nonkilled (capped or rimmed), product analysis may be made by the purchaser. The chemical analysis shall not vary from the limits specified by more than the amounts in Specification **A568/A568M**, subsection 5.3 (Table 2 in **A568/A568M**). The several determinations of any element in a cast shall not vary both above and below the specified range.

5.4 *Sampling for Product Analysis:*

5.4.1 To indicate adequately the representative composition of a cast by product analysis, it is general practice to select samples to represent the steel, as fairly as possible, from a minimum number of pieces as follows: three pieces for lots up to 15 tons inclusive, and six pieces for lots over 15 tons [15 Mg].

5.4.2 When the steel is subject to tension test requirements, samples for product analysis may be taken either by drilling entirely through the used tension test specimens themselves or in accordance with 5.4.3.

5.4.3 When the steel is not subject to tension test requirements, the samples for analysis must be taken by milling or drilling entirely through the strip in a sufficient number of places so that the samples are representative of the entire strip. The sampling may be facilitated by folding the strip both ways, so that several samples may be taken at one drilling. Steel subjected to certain heating operations by the purchaser may not give chemical analysis results that properly represent its original composition. Therefore, users must analyze chips taken from the steel in the condition in which it is received from the steel manufacturer.

5.5 *Specimen Preparation*—Drillings or chips must be taken without the application of water, oil, or other lubricant, and must be free of scale, grease, dirt, or other foreign substances. They must not be overheated during cutting to the extent of causing decarburization. Chips must be well mixed, and those too coarse to pass a No. 10 (2.00 mm) sieve or too fine to

³ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

remain on a No. 30 (600- μ m) sieve are not suitable for proper analysis. Sieve size numbers are in accordance with Specification E11.

5.6 *Test Methods*—In case a referee analysis is required and agreed upon to resolve a dispute concerning the results of a chemical analysis, the procedure for performing the referee analysis must be in accordance with the latest issue of Test Methods, Practices, and Terminology A751, unless otherwise agreed upon between the manufacturer and the purchaser.

6. Mechanical Properties

6.1 The mechanical property requirements, number of specimens, test locations, and specimen orientation shall be in accordance with the applicable product specification.

6.2 Unless otherwise specified in the applicable product specification, test specimens must be prepared in accordance with Test Methods and Definitions A370.

6.3 Mechanical tests shall be conducted in accordance with Test Methods and Definitions A370.

6.4 Bend tests, where required, shall be conducted in compliance with Test Methods E290.

6.5 To determine conformance with the product specification, a calculated value should be rounded to the nearest 1 ksi [7 MPa] tensile strength and yield point or yield strength, and to the nearest unit in the right hand place of figures used in expressing the limiting value for other values in accordance with the rounding off method given in Practice E29.

6.6 Structural steels are commonly fabricated by cold bending. There are many interrelated factors that affect the ability of a given steel to cold form over a given radius under shop conditions. These factors include thickness, strength level, degree of restraint, relationship to rolling direction, chemistry, and microstructure. Each of the appropriate product specifications lists in the appendix the suggested minimum inside radius for cold bending. These radii should be used as minima for 90° bends. They presuppose “hard way” bending (bend axis parallel to rolling direction) and reasonably good shop forming practices. Where possible, the use of larger radii or “easy way” bends are recommended for improved performance.

6.7 Fabricators should be aware that cracks may initiate upon bending a sheared or burned edge. This is not considered to be a fault of the steel but is rather a function of the induced cold-work or heat-affected zone.

7. Dimensions, Tolerances, and Allowances

7.1 Dimensions, tolerances, and allowances applicable to products covered by this specification are contained in Tables 1-8 [Annex A1, Tables A1.1-A1.7]. The appropriate tolerance tables shall be identified in each individual specification.

8. Workmanship

8.1 Cut lengths shall have a workmanlike appearance and shall not have imperfections of a nature or degree for the product, the grade, and the quality ordered that will be detrimental to the fabrication of the finished part.

TABLE 1 Index of Tables for Dimensions, Tolerances, and Allowances

Dimensions	Table No.	
	Inch-Pound Units	SI Units
Camber tolerances	7	A1.6
Crown tolerances	4	A1.3
Flatness tolerances	8	A1.7
Length tolerances	6	A1.5
Thickness tolerances	2, 3	A1.1, A1.2
Width tolerances	5	A1.4

8.2 Coils may contain some abnormal imperfections that render a portion of the coil unusable since the inspection of coils does not afford the producer the same opportunity to remove portions containing imperfections as in the case with cut lengths.

9. Finish and Condition

9.1 Hot-rolled strip has a surface with an oxide or scale resulting from the hot-rolling operation. The oxide or scale can be removed by pickling or blast cleaning when required for press-work operations or welding. Hot-rolled and hot-rolled descaled strip are not generally used for exposed parts where surface is of prime importance. However, hot-rolled surface might be of importance, as in the case of weathering steels for exposed parts.

9.1.1 Hot-rolled strip can be supplied with mill edges, square edges, or cut (slit) edges as specified.

9.1.1.1 Mill edges are the natural edges resulting from the hot-rolling operation and are generally round and smooth without any definite contour.

9.1.1.2 Square edges are the edges resulting from rolling through vertical edging rolls during the hot-rolling operations. These edges are square and smooth, with the corners slightly rounded.

9.1.1.3 Cut (slit) edges are the normal edges that result from the shearing, slitting, or trimming of mill edges.

9.1.2 The ends of plain hot-rolled mill-edge coils are irregular in shape and are referred to as uncropped ends. Where such ends are not acceptable, the purchaser’s order should so specify. Processed coils such as pickled or blast cleaned are supplied with square-cut ends.

9.2 Oiling:

9.2.1 Plain hot-rolled strip is customarily furnished not oiled. Oiling must be specified when required for hot-rolled strip.

9.2.2 Hot-rolled pickled or descaled strip is customarily furnished oiled. If the pickled/descaled product is not to be oiled, it must be so specified since the cleaned surface is prone to rusting.

10. General Requirements for Delivery

10.1 Products covered by this specification are produced to inch-pound or metric decimal thickness only.

10.2 Steel may be produced as ingot-cast or strand-cast. When different grades of strand-cast steel are sequentially cast, identification and separation of the transition material is required.

TABLE 2 Thickness Tolerances of Hot-Rolled Strip^A (Carbon and High-Strength, Low-Alloy Steel) Ordered to Nominal Thickness (Coils and Cut Lengths, Including Pickled)

NOTE 1—Micrometres used for measurement of thickness shall be constructed with either flat anvils having a minimum diameter of 0.188 in. or rounded anvils having a minimum radius of curvature of 0.100 in. Micrometres with pointed anvils are not suitable for thickness measurement.

Specified Width, in.		Thickness Tolerance, Over and Under, in., for Specified Nominal Thickness, in.				
Over	Through	Through 0.057	Over 0.057 to 0.118, incl	Over 0.118 to 0.187, incl	Over 0.187 to 0.203, incl	Over 0.203 to 0.230, excl
...	3½	0.003	0.004	0.005	0.006	...
3½	6	0.003	0.005	0.005	0.006	...
6	12	0.004	0.005	0.005	0.006	0.006

^A Measurements for the above table are taken ⅜ in. from the edge of a strip on 1 in. or wider; and at any place on the strip when narrower than 1 in. The given tolerances do not include crown and therefore the tolerances for crown as shown in Table 4 are in addition to tolerances in Table 2.

TABLE 3 Thickness Tolerances of Hot-Rolled Strip^A (Carbon and High-Strength, Low-Alloy Steel) Ordered to Minimum Thickness (Coils and Cut Lengths, Including Pickling)

NOTE 1—Micrometres used for measurement of thickness shall be constructed with either flat anvils having a minimum diameter of 0.188 in. or rounded anvils having a minimum radius of curvature of 0.100 in. Micrometres with pointed anvils are not suitable for thickness measurement.

Specified Width, in.		Thickness Tolerance, Over Only, for Specified Minimum Thickness, in.				
Over	Through	Through 0.057	Over 0.057 to 0.118, incl	Over 0.118 to 0.187, incl	Over 0.187 to 0.203, incl	Over 0.203 to 0.230, excl
...	3½	0.006	0.008	0.010	0.012	...
3½	6	0.006	0.010	0.010	0.012	...
6	12	0.008	0.010	0.010	0.012	0.012

^A Measurements for the above table are taken ⅜ in. from the edge of a strip on 1 in. or wider; and at any place on the strip when narrower than 1 in. The given tolerances do not include crown and therefore the tolerances for crown as shown in Table 4 are in addition to tolerances in Table 3.

TABLE 4 Crown Tolerances of Hot-Rolled Strip (Carbon and High-Strength, Low-Alloy Steel) (Coils and Cut Lengths, Including Pickled) Strip may be thicker at the center than at a point ⅜ in. from the edge by the following amounts:

Specified Width, in.		Crown Tolerance, Over Only, for Specified Minimum Thickness, in.		
Over	Through	Through 0.118	Over 0.118 to 0.187, incl	Over 0.187 to 0.230, excl
...	3½	0.002	0.002	0.001
3½	6	0.003	0.002	0.002
6	12	0.004	0.003	0.003

11.2 If the percentage of elongation of any tension test specimen is less than that specified and any part of the fracture is more than ¾ in. [20 mm] from the center of the gauge length of a 2-in. [50 mm] specimen or is outside the middle half of the gauge length of an 8-in. [200 mm] specimen, as indicated by scribe scratches marked on the specimen before testing, a retest is allowed.

11.3 If a bend specimen fails, due to conditions of bending more severe than required by the specification, a retest is permitted either on a duplicate specimen or on a remaining portion of the failed specimen.

TABLE 5 Width Tolerances of Hot-Rolled Strip (Carbon and High-Strength, Low-Alloy Steel) (Coils and Cut Lengths, Including Pickled)

Specified Width, in.		Width Tolerance, Over and Under, in.		
Over	Through	Mill Edge and Square Edge Strip	Cut Edge	
			Through 0.109 in.	Over 0.109 in. Through 0.230 excl
...	2	1/32	0.008	0.016
2	5	3/64	0.008	0.016
5	10	1/16	0.010	0.016
10	12	3/32	0.016	0.016

11. Retests

11.1 If any test specimen shows defective machining or develops flaws, it must be discarded and another specimen substituted.

12. Inspection

12.1 When the purchaser's order stipulates that inspection and test (except product analyses) for acceptance on the steel be made prior to shipment from the mill, the manufacturer shall afford the purchaser's inspector all reasonable facilities to satisfy him that the steel is being produced and furnished in accordance with the specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operation.

13. Rejection and Rehearing

13.1 Unless otherwise specified, any rejection shall be reported to the manufacturer within a reasonable time after receipt of material by the purchaser.

13.2 Material that is reported to be defective subsequent to the acceptance at the purchaser's works shall be set aside, adequately protected, and correctly identified. The manufacturer shall be notified as soon as possible so that an investigation may be initiated.

**TABLE 6 Length Tolerances of Hot-Rolled Strip (Carbon and High-Strength Alloy)
(Cut Lengths, Including Pickled)**

Specified Widths, in.	Length Tolerances over Specified Length, ft for Widths Given, in. No Tolerance Under					
	To 5 ft, incl	Over 5 to 10 ft, incl	Over 10 to 20 ft, incl	Over 20 to 30 ft, incl	Over 30 to 40 ft, incl	Over 40 ft, incl
To 3, incl	¼	⅜	½	¾	1	1½
Over 3 to 6, incl	⅜	½	⅝	¾	1	1½
Over 6 to 12, incl	½	¾	1	1¼	1½	1¾

**TABLE 7 Camber Tolerances^A of Hot-Rolled Strip
(Carbon and High-Strength Low-Alloy)
(Coils and Cut Lengths, Including Pickled, Applicable to Mill
Edge, Square Edge, and Slit or Cut Edge)**

NOTE 1—Camber is the deviation of a side edge from a straight line. The standard for measuring this deviation is based on any 8-ft length.^B It is obtained by placing an 8-ft straightedge on the concave side and measuring the maximum distance between the strip edge and the straight-edge.

For strip wider than 1½ in.—¼ in. in any 8 ft.
For strip 1½ in. and narrower—½ in. in any 8 ft.

^A When the camber tolerances shown in the above table are not suitable for a particular purpose, hot-rolled strip is sometimes machine straightened.

^B For strip less than 8 ft tolerances are to be established in each instance. A formula for calculating camber is as follows:

$$\frac{L^2 \times C_1}{64} = C_2 \text{ in } L$$

where:

- C₁ = Camber in 8 ft, and
- C₂ = Camber in any given length L.

**TABLE 8 Flatness Tolerances of Hot-Rolled Strip
(Carbon and High-Strength Low-Alloy)**

It has not been practicable to formulate flatness tolerances for hot-rolled carbon strip steel because of the wide range of widths and thicknesses, and variety of chemical compositions, mechanical properties and types, produced in coils and cut lengths.

13.3 Samples that are representative of the rejected material shall be made available to the manufacturer. In the event that the manufacturer is dissatisfied with the rejection, he may request a rehearing.

14. Test Reports and Certification

14.1 When test reports are required by the purchase order or the material specification, the supplier shall report the results of all tests required by the material specification and the order.

14.2 When certification is required by the purchase order, the supplier shall furnish a certification that the material has been manufactured and tested in accordance with the requirements of the material specification.

14.3 A signature is not required on test reports or certifications. However, the document shall clearly identify the organization submitting the document. Notwithstanding the absence of a signature, the organization submitting the document is responsible for the content of the document.

14.4 When test reports are required, copies of the original material manufacturer's test report shall be included with any subsequent test report.

14.5 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 2—The industry definition as invoked here is: EDI is the computer to computer exchange of business information in an agreed upon standard format such as ANSI ASC X12.

15. Marking

15.1 As a minimum requirement, the material shall be identified by having the manufacturer's name, ASTM designation, weight, purchaser's order number, and material identification legibly stenciled on top of each lift or shown on a tag attached to each coil or shipping unit.

15.2 When specified in the contract or order, and for direct procurement by or direct shipment to the government, marking for shipment, in addition to requirements specified in the contract or order, shall be in accordance with MIL-STD-129 for military agencies and in accordance with Fed. Std. No. 123 for civil agencies.

15.3 For Government procurement by the Defense Supply Agency, strip material shall be continuously marked for identification in accordance with Fed. Std. No. 183.

15.4 Bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with the Automotive Industry Action Group (AIAG) standard prepared by the primary metals subcommittee of the AIAG bar code project team.

16. Packaging

16.1 Unless otherwise specified, the strip shall be packaged and loaded in accordance with Practices **A700**.

16.2 When coils are ordered it is customary to specify a minimum or range of inside diameter, maximum outside diameter, and a maximum coil weight, if required. The ability of manufacturers to meet the maximum coil weights depends upon individual mill equipment. When required, minimum coil weights are subject to negotiation.

17. Keywords

17.1 carbon; steel; strip