



Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled¹

This standard is issued under the fixed designation A109/A109M; 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 cold-rolled carbon steel strip in cut lengths or coils, furnished to closer tolerances than cold-rolled carbon steel sheet, with specific temper, with specific edge or specific finish, and in sizes as follows:

Width, in.	Thickness, in.
Over $\frac{1}{2}$ to $23\frac{15}{16}$	0.300 and under
Over 12.5 to 600 mm	7.6 mm and under

1.2 Cold-rolled strip is produced with a maximum specified carbon not exceeding 0.25 percent.

1.3 Strip tolerance products may be available in widths wider than $23\frac{15}{16}$ in. [600 mm] by agreement between purchaser and supplier. However, such products are technically classified as cold rolled sheet. The tolerances, finishes, tempers, edges, and available widths and thicknesses differentiate cold rolled strip from the product known as cold rolled sheet which is defined by Specification **A568/A568M** and from cold rolled high carbon strip which is defined by Specification **A682/A682M**.

1.4 For the purpose of determining conformance with this specification, 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 The SI portions of the tables contained herein list permissible variations in dimensions and mass (see **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 SI tolerances 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 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.

1.7 This specification is 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.

2. Referenced Documents

2.1 ASTM Standards:²

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

A682/A682M Specification for Steel, Strip, High-Carbon, Cold-Rolled, General Requirements For (Withdrawn 2009)³

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

A1073/A1073M Practice for Using Hand Micrometers to Measure the Thickness of Uncoated Steel Sheet and Nonmetallic and Metallic-Coated Steel Sheet

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

E430 Test Methods for Measurement of Gloss of High-Gloss Surfaces by Abridged Goniophotometry

2.2 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁴

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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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.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://quicksearch.dla.mil>.

2.3 Federal Standard:

123 Marking for Shipments (Civil Agencies)⁴

183 Continuous Identification Marking of Iron and Steel Products⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *annealing*—the process of heating to and holding at a suitable temperature and then cooling at a suitable rate, for such purposes as reducing hardness, facilitating cold working, producing a desired microstructure, or obtaining desired mechanical, physical, or other properties.

3.1.1.1 *box annealing*—involves annealing in a sealed container under conditions that minimize oxidation. The strip is usually heated slowly to a temperature below the transformation range, but sometimes above or within it, and is then cooled slowly.

3.1.1.2 *continuous annealing*—involves heating the strip in continuous strands through a furnace having a controlled atmosphere followed by a controlled cooling.

3.1.2 *carbon steel*—the designation for steel when no minimum content is specified or required for aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium or any other element added to obtain a desired alloying effect; when the specified minimum for copper does not exceed 0.40 % or when the maximum content specified for any of the following elements does not exceed the percentage noted: manganese 1.65, silicon 0.60, or copper 0.60.

3.1.2.1 *Discussion*—In all carbon steels small quantities of certain residual elements unavoidably retained from raw materials are sometimes found which are not specified or required, such as copper, nickel, molybdenum, chromium, and so forth. These elements are considered as incidental and are not normally reported.

3.1.3 *cold reduction*—the process of reducing the thickness of the strip at room temperature. The amount of reduction is greater than that used in skin-rolling (see 3.1.7).

3.1.4 *dead soft*—the temper of strip produced without definite control of stretcher straining or fluting. It is intended for deep drawing applications where such surface disturbances are not objectionable.

3.1.5 *finish*—the degree of smoothness or luster of the strip. The production of specific finishes requires special preparation and control of the roll surfaces employed.

3.1.6 *normalizing*—heating to a suitable temperature above the transformation range and then cooling in air to a temperature substantially below the transformation range. In bright normalizing the furnace atmosphere is controlled to prevent oxidizing of the strip surface.

3.1.7 *skin-rolled*—a term denoting a relatively light cold rolling operation following annealing. It serves to reduce the tendency of the steel to flute or stretcher strain during fabrication. It is also used to impart surface finish, or affect hardness or other mechanical properties, or to improve flatness.

3.1.8 *temper*—a designation by number to indicate the hardness as a minimum, as a maximum, or as a range. The tempers are obtained by the selection and control of chemical composition, by amounts of cold reduction, by thermal treatment, and by skin-rolling.

3.2 Refer to Terminology A941 for additional definitions of terms used in this Specification.

4. Ordering Information

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

- 4.1.1 Quantity,
- 4.1.2 Name of material (cold-rolled carbon steel strip),
- 4.1.3 Condition (oiled or not oiled),
- 4.1.4 Temper (Section 7),
- 4.1.5 Edge (Section 8),
- 4.1.6 Dimensions (Section 9),
- 4.1.7 Workmanship, Finish, and Appearance (Section 10),
- 4.1.8 Coil size requirements (15.2),
- 4.1.9 ASTM designation and year of issue,
- 4.1.10 Copper-bearing steel, if required,
- 4.1.11 Application (part identification or description),
- 4.1.12 Cast or heat analysis (request, if required), and
- 4.1.13 Special requirements, if required.

NOTE 2—A typical ordering description is as follows: 20 000 lb Cold-Rolled Strip, Oiled, Temper 4, Edge 3, Finish 3, 0.035 by 9 in. by coil, 5000 lb max, 16-in. ID ASTM A 109-XX, for Toaster Shells.

5. Materials and Manufacture

5.1 The steel shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

5.2 Cold-rolled carbon steel strip is normally manufactured from continuously cast steel with aluminum used as the deoxidizer. However, some applications are specified as silicon killed. Ingot cast rimmed, capped and semi-killed steels are subject to limited availability.

5.3 Cold-rolled carbon steel strip is manufactured from hot-rolled descaled coils by cold reducing to the desired thickness on a single stand mill or on a tandem mill consisting of several single stands in series. Sometimes an anneal is used at some intermediate thickness to facilitate further cold reduction or to obtain desired temper and mechanical properties in the finished strip. An anneal and skin pass is typically used as the final step for Temper 4 and 5.

6. Chemical Composition

6.1 *Heat Analysis*—An analysis for each heat of steel shall be made by the manufacturer to determine the percentage of elements shown in Table 1. This analysis shall conform to the requirements shown in Table 1. When requested, heat analysis shall be reported to purchaser or his representative.

6.2 *Product, Check, or Verification Analysis* may be made by the purchaser on the finished material.

6.2.1 Capped or rimmed steels are not technologically suited to product analysis due to the nonuniform character of their chemical composition and therefore, the tolerances in

TABLE 1 Heat Analysis ^A

Composition— Wt %		
Element	Temper No. 1, 2, 3	Temper No. 4, 5
Carbon, max	0.25	0.15
Manganese, max	0.90	0.60
Phosphorous, max	0.025	0.025
Sulfur, max	0.025	0.025
Silicon ^A	...	...
Aluminum ^{A,B}	...	...
Copper ^C	0.20	0.20
Nickel, max ^D	0.20	0.20
Chromium, max ^{D, E}	0.15	0.15
Molybdenum, max ^D	0.06	0.06
Vanadium ^F	...	...
Columbium ^F	...	...
Titanium ^F	...	...

^A Where an ellipsis (. . .) appears in this table, there is no requirement, but the analysis shall be reported unless otherwise specified in this specification.

^B The analysis shall be reported. When killed steel is specified and aluminum is the deoxidizing element, the minimum is 0.02, and the analysis shall be reported.

^C When copper steel is specified, the copper limit specified is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.

^D The sum of copper, nickel, chromium, and molybdenum shall not exceed 0.50 % on heat analysis. When one or more of these elements is specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

^E Chromium is permitted, at the producer's option, to 0.25 % maximum when the carbon is less than or equal to 0.05 %. In such case, the limit on the sum of the four elements in Footnote D does not apply.

^F Reporting shall be required when the level for any of these elements exceeds 0.008 wt%.

Table 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.

6.2.2 For steels other than rimmed or capped, when product analysis is made by the purchaser, the chemical analysis shall not vary from the limits specified by more than the amounts in Table 2. The several determinations of any element shall not vary both above and below the specified range.

6.3 For referee purposes, if required, Test Methods, Practices, and Terminology A751 shall be used.

6.4 For applications where cold-rolled strip is to be welded, care must be exercised in selection of chemical composition, as well as mechanical properties, for compatibility with the welding process and its effect on altering the properties.

TABLE 2 Tolerances for Product Analysis

Element	Limit or Maximum of Specified Ele- ment %	Tolerance	
		Under Minimum Limit	Over Maxi- mum Limit
Carbon	to 0.15, incl	0.02	0.03
	over 0.15 to 0.25, incl	0.03	0.04
Manganese	to 0.60, incl	0.03	0.03
Phosphorus		...	0.01
Sulfur		...	0.01
Copper		0.02	...

7. Temper and Bend Test Requirement

7.1 Cold-rolled carbon strip specified to temper numbers shall conform to the Rockwell hardness requirements shown in Table 3.

7.1.1 When a temper number is not specified, Rockwell hardness requirements are established by agreement.

7.2 It is recommended that hardness values be specified in the same scale as that which will be used in testing the strip.

7.3 Bend tests shall be conducted at room temperature and test specimens shall be capable of being bent to the requirements shown in Table 4.

7.4 All mechanical tests are to be conducted in accordance with Test Methods and Definitions A370.

TABLE 3 Hardness Requirements

Temper	INCH-POUND UNITS			
	Thickness, in.		Rockwell Hardness	
	Under	Through	Minimum	Maximum (approx.)
No. 1 (hard)	0.025	...	15T90	...
	0.040	0.025	30T76	...
	0.070	0.040	B90.0	...
	0.300	0.070	B84.0	...
No. 2 ^A (half-hard)	0.025	...	15T83.5	15T88.5
	0.040	0.025	30T63.5	30T73.5
	0.300	0.040	B70.0	B85
No. 3 ^A (quarter-hard)	0.025	...	15T80	15T85
	0.040	0.025	30T56.5	30T67
	0.300	0.040	B60	B75
No. 4 ^{A,B} (skin-rolled)	0.025	...	...	15T82
	0.040	0.025	...	30T60
	0.300	0.040	...	B65
No. 5 ^{A,B} (dead-soft)	0.025	...	...	15T78.5
	0.040	0.025	...	30T53
	0.300	0.040	...	B55
Temper	SI UNITS			
	Thickness, mm		Rockwell Hardness	
	Under	Through	Minimum	Maximum (approx.)
No. 1 (hard)	0.6	...	15T90	...
	1.0	0.6	30T76	...
	1.8	1.0	B90.0	...
	7.6	1.8	B84.0	...
No. 2 ^A (half-hard)	0.6	...	15T83.5	15T88.5
	1.0	0.6	30T63.5	30T73.5
	7.6	1.0	B70.0	B85
No. 3 ^A (quarter-hard)	0.6	...	15T80	15T85
	1.0	0.6	30T56	30T67
	7.6	1.0	B60	B75
No. 4 ^{A,B} (skin-rolled)	0.6	...	...	15T82
	1.0	0.6	...	30T60
	7.6	1.0	...	B65
No. 5 ^{A,B} (dead-soft)	0.6	...	...	15T78.5
	1.0	0.6	...	30T53
	7.6	1.0	...	B55

^A Rockwell hardness values apply at time of shipment. Aging may cause slightly higher values when tested at a later date.

^B Where No. 4 and 5 tempers are ordered with a carbon range of 0.15 to 0.25 %, the maximum hardness requirement is established by agreement.

**TABLE 4 Bend Test Requirement**

NOTE 1—Test specimens shall be capable of being bent as specified above without cracking on the outside of the bent portion. (See applicable figure in Test Methods and Definitions A370.)

Temper	Bend Test Requirement
No. 1 (hard)	Not required to make bends in any direction.
No. 2 (half-hard)	Bend 90° transverse around a radius equal to that of the thickness.
No. 3 (quarter-hard)	Bend 180° transverse over one thickness of the strip and 90° longitudinal around a radius equal to the thickness.
No. 4 (skin-rolled)	Bend flat upon itself in any direction.
No. 5 (dead-soft)	Bend flat upon itself in any direction.

8. Edge

8.1 The desired edge number shall be specified as follows:

8.1.1 *Number 1 Edge* is a prepared edge of a specified contour (round or square), which is produced when a very accurate width is required or when an edge condition suitable for electroplating is required, or both.

8.1.2 *Number 2 Edge* is a natural mill edge carried through the cold rolling from the hot-rolled strip without additional processing of the edge.

8.1.3 *Number 3 Edge* is an approximately square edge, produced by slitting, on which the burr is not eliminated. Normal coiling or piling does not necessarily provide a definite positioning of the slitting burr.

8.1.4 *Number 4 Edge* is a rounded edge produced by edge rolling either the natural edge of hot-rolled strip or slit-edge strip. This edge is produced when the width tolerance and edge condition are not as exacting as for No. 1 edge.

8.1.5 *Number 5 Edge* is an approximately square edge produced from slit-edge material on which the burr is eliminated usually by rolling or filing.

8.1.6 *Number 6 Edge* is a square edge produced by edge rolling the natural edge of hot-rolled strip or slit-edge strip. This edge is produced when the width tolerance and edge condition are not as exacting as for No. 1 edge.

8.1.7 *Skived Edges* are custom shaped edges produced by mechanical edge shaving with special tooling.

9. Dimensional Tolerances

9.1 The dimensional tolerances shall be in accordance with **Tables 5-11** as follows:

TABLE 5 Thickness Tolerances of Cold-Rolled Carbon Steel Strip^{A,B,C}

Cold-Rolled Carbon Strip Steel Including High-Carbon Strip Steel			
Inch-Pound Units (in.)			
Thickness Tolerances (Plus or Minus, in.)			
Nominal Gage (in.)	Over ½ to less than 12 wide	12 to less than 18	18 to 23 ¹⁵ / ₁₆
0.251 - 0.300	0.0030	0.0035	0.0040
0.160 - 0.250	0.0025	0.0032	0.0036
0.125 - 0.1599	0.0022	0.0028	0.0032
0.070 - 0.1249	0.0018	0.0022	0.0028
0.040 - 0.0699	0.0014	0.0018	0.0024
0.030 - 0.0399	0.0012	0.0015	0.0020
0.020 - 0.0299	0.0010	0.0013	0.0015
0.015 - 0.0199	0.0008	0.0010	0.0012
0.010 - 0.0149	0.0005	0.0008	0.0010
<0.010	0.0003	0.0006	0.0008
SI Units (mm)			
Thickness Tolerances (Plus and Minus, mm)			
Nominal Gage (mm)	Over 12.7 to less than 300	300 to less than 450	450 to 600
6.40 - 7.50	0.080	0.090	0.100
4.00 - 6.39	0.065	0.080	0.090
3.20 - 3.99	0.055	0.070	0.080
1.80 - 3.19	0.045	0.055	0.070
1.00 - 1.79	0.035	0.045	0.060
0.75 - 0.99	0.030	0.035	0.050
0.50 - 0.74	0.025	0.030	0.040
0.38 - 0.49	0.020	0.025	0.030
0.25 - 0.37	0.013	0.020	0.025
<0.25	0.007	0.015	0.020

^A Measured ⅜ in. or more in from edge; and on narrower than 1 in., at any place between edges.

^B Measured 10 mm or more in from edge; and on narrower than 25 mm, at any place between edges.

^C Number 3 edge strip with thickness tolerance guaranteed at less than ⅜ in. [10 mm] from the slit edge is available by agreement between the consumer and the strip manufacturer.

**TABLE 6 Width Tolerances of Edge Numbers 1, 4, 5, and 6 of Cold-Rolled Carbon-Steel Strip**

INCH - POUND UNITS					
Edge Number	Specified Width, in. ^A		Specified Thickness, in. ^B		Width Tolerance, Plus and Minus, in. ^C
	Over	Through	min	max	
1	1/2	3/4	...	0.0938	0.005
1	3/4	5	...	0.125	0.005
4	1/2	1	0.025	0.1875	0.015
4	1	2	0.025	0.2499	0.025
4	2	4	0.035	0.2499	0.047
4	4	6	0.047	0.2499	0.047
5	1/2	3/4	...	0.0938	0.005
5	3/4	5	...	0.125	0.005
5	5	9	0.008	0.125	0.010
5	9	20	0.015	0.105	0.010
5	20	23 15/16	0.023	0.080	0.015
6	1/2	1	0.025	0.1875	0.015
6	1	2	0.025	0.2499	0.025
6	2	4	0.035	0.2499	0.047
6	4	6	0.047	0.2499	0.047
SI UNITS					
Edge No.	Specified Width, mm ^A		Specific Thickness, mm ^B		Width Tolerance, Plus and Minus, in. ^C
	Over	Through	min	max	
1	12.5	200	...	3.0	0.13
4	...	25	0.6	5.0	0.38
4	25	50	0.6	6.0	0.65
4	50	150	1.0	6.0	1.20
5	...	100	...	3.0	0.13
5	100	500	0.4	3.0	0.25
5	500	600	0.6	2.0	0.38
6	...	25	0.6	5.0	0.38
6	25	50	0.6	6.0	0.65
6	50	150	1.0	6.0	1.20

^A Specified width must be within ranges stated for specified edge number.^B Specified thickness must be within ranges stated for specified width.^C When edge, width and thickness are not defined by this table, tolerances are by agreement between producer and supplier.**TABLE 7 Width Tolerances of Edge Number 2 of Cold-Rolled Carbon Steel Strip**

INCH - POUND UNITS		
Specified Width, in.		Width Tolerance, Plus and Minus, in.
Over	Through	
1/2	2	1/32
2	5	3/64
5	10	5/64
10	15	3/32
15	20	1/8
20	23 15/16	5/32
SI UNITS		
Specified Width, mm		Width Tolerance, mm
Over	Through	
12.5	50	0.8
50	100	1.2
100	200	1.6
200	400	2.5
400	500	3.0
500	600	4.0

Tolerances for

Thickness, in.
Width, in.
Length, in.
Camber, in.
Flatness, in.

Table Number

5
6,7,8
9
10
11

9.1.1 When thickness is measured using hand held micrometers refer to Practice **A1073/A1073M**.

10. Workmanship, Finish, and Appearance

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

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

10.3 Cold-rolled strip steel finishes are usually specified to one of the following finishes. Typical surface roughness (Ra) ranges for each are included in **Table 12**.

10.3.1 *Number 1 or Matte (Dull) Finish* is a finish without luster produced by rolling on rolls roughened by mechanical or other means. This finish is especially suitable for paint adhesion and may aid in drawing by reducing friction between die and steel surface. The user and the producer should agree on the permissible surface roughness range, based on the intended end-use.

10.3.2 *Number 2 or Regular Bright Finish* is produced by rolling on moderately smooth rolls. It is suitable for many requirements, but not generally applicable to bright plating.

10.3.3 *Number 2 1/2 or Better Bright Finish* is a smooth finish suitable for those plating applications where high luster is not required.

10.3.4 *Number 3 or Best Bright Finish* is generally of high luster produced by special rolling practices, including the use of specially prepared rolls. It is the highest quality finish commonly produced and is particularly suited for bright plating. The production of this finish requires extreme care in processing and extensive inspection. Paper interleaving is frequently used for protection. In addition to the surface roughness values in **Table 12**, the user and producer may agree on goniophotometric measurement values (Rs/DI) in accordance with Test Methods **E430**.

11. Inspection

11.1 When purchaser's order stipulates that inspection and tests (except product analysis) 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 manufactured and furnished in accordance with the specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operation. All tests and inspection (except product analysis) shall be made at the place of manufacture unless otherwise agreed.

12. Rejection and Rehearing

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

12.2 Material that is reported to be defective subsequent to the acceptance at the purchaser's works shall be set aside,



TABLE 8 Width Tolerances for Edge Number 3 (Slit), Cold-Rolled Carbon Steel Strip

INCH-POUND UNITS						
Specified Thickness, in.		Width Tolerance, Plus and Minus, in. For Specified Width, in. ^A				
Over	Through	Over ½ Through 6	Over 6 Through 9	Over 9 Through 12	Over 12 Through 20	Over 20 Through 23 ¹⁵ / ₁₆
...	0.016	0.005	0.005	0.010	0.016	0.020
0.016	0.068	0.005	0.005	0.010	0.016	0.020
0.068	0.099	0.008	0.010	0.010	0.016	0.020
0.099	0.160	0.010	0.016	0.016	0.020	0.020
0.160	0.300	0.016	0.020	0.020	0.031	0.031
S.I. UNITS						
Specified Thickness mm		Width Tolerance, Plus and Minus, mm For Specified Width, mm ^A				
Over	Through	Through 100	Over 100 Through 200	Over 200 Through 300	Over 300 Through 450	Over 450 Through 600
...	1.5	0.13	0.13	0.25	0.40	0.50
1.5	2.5	0.20	0.25	0.25	0.40	0.50
2.5	4.5	0.25	0.40	0.40	0.50	0.50
4.5	7.5	0.40	0.50	0.50	0.80	0.80

^A Width is measured from the shear surface of the slit edge and not from the break.

TABLE 9 Length Tolerances of Cold-Rolled Carbon Steel Strip

INCH-POUND UNITS				
Specified Width, in.		Length Tolerance, Plus Only, in. for Specified Length, in.		
Over	Through	From 24 Through 60	Over 60 Through 120	Over 120 Through 240
½	12	¼	½	¾
12	23 ¹⁵ / ₁₆	½	¾	1
SI UNITS				
Specified Width, mm		Length Tolerance, Plus Only, mm for Specified Length, mm		
Over	Through	From 600 Through 1500	Over 1500 Through 3000	Over 3000
...	300	10	15	25
300	600	15	20	25

adequately protected, and correctly identified. The producer shall be notified as soon as possible so that an investigation may be initiated.

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

13. Test Reports and Certification

13.1 When test reports are required by the purchaser, the supplier shall report the results of all tests required by this specification and any additional tests required by this specification the purchase order, or both.

13.2 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 this specification.

13.3 A signature is not required on test reports. 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.

13.4 When test reports are required, it is acceptable for the supplier to report test data from the original manufacturer, provided such data is not rendered invalid by the stripmaking process.

13.5 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 context of the report.

NOTE 3—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.

14. Product Marking

14.1 As a minimum requirement, the material shall be identified by having the manufacturer's name, ASTM designation, weight, purchaser's order number, and material

**TABLE 10 Camber Tolerances of Cold-Rolled Carbon Steel Strip**

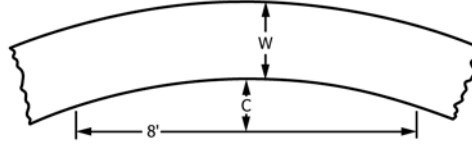
INCH-POUND UNITS

Note 1—Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge.

Note 2—Camber tolerances as shown in the table are for any 8 ft. of length.

For strip length under 8 ft., camber tolerance shall be subject to negotiation.

Note 3—When the camber tolerances shown in Table 10 are suitable for a particular purpose, cold-rolled strip is sometimes machine straightened.



W = Width of strip, in.

C = Camber, in.

Specified Width, in.		Camber Tolerance, in.
Over	Through	
1/2	1 1/2	1/2
1 1/2	23 5/16	1/4

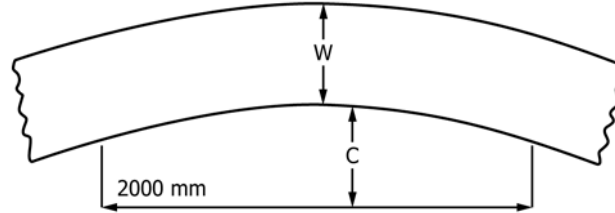
SI UNITS

Note 1—Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge.

Note 2—Camber tolerances as shown in the table are for any 2000 mm length.

For strip length under 2000 mm, camber tolerance shall be subject to negotiation.

Note 3—When the camber tolerances shown in Table 10 are suitable for a particular purpose, cold-rolled strip is sometimes machine straightened.



W = Width of strip, mm

C = Camber, mm

Width, in.		Standard Camber Tolerance, mm
Over	Through	
...	50	10
50	600	5

TABLE 11 Flatness Tolerances of Cold-Rolled Carbon Steel Strip

It has not been practical to formulate flatness tolerances for cold-rolled carbon steel strip to represent the wide range of widths and thicknesses and variety of tempers produced.

TABLE 12 Typical Surface Roughness Ranges^A

Number 1 or Matte (Dull) ^B	Ra 20-80 μ in.
Number 2 or Regular Bright ^C	Ra 20 μ in. max
Number 2 1/2 or Better Bright ^C	Ra 10 μ in. max
Number 3 or Best Bright ^C	Ra 4 μ in. max

^A Due to vagaries in measuring surface roughness, as well as the inherent variability in such rolled surfaces, these values are only typical, and values outside these ranges would not be considered unexpected.

^B Measured either parallel with or across the rolling direction.

^C Measured across the rolling direction.

identification legibly stenciled on the top of each lift or shown on a tag attached to the coils or shipping units.

14.2 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.

15. Packaging and Package Marking

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

15.2 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.

16. Keywords

16.1 carbon steel, strip; cold rolled steel strip; steel strip

APPENDIX

(Nonmandatory Information)

X1. GENERAL INFORMATION AND METALLURGICAL ASPECTS

X1.1 Mechanical Properties

X1.1.1 **Table X1.1** shows the approximate mechanical properties corresponding to the five commercial tempers of cold-rolled carbon steel strip. This table is presented as a matter of general information. The limits of tensile strength, and so forth, are not intended as criteria for acceptance or rejection unless specifically agreed to by the manufacturer when accepting the order. The exact processing by different manufacturers will naturally vary slightly, so that absolute identity cannot be expected in their commercial tempers of cold-rolled strip.

X1.2 Identified Part

X1.2.1 Cold-rolled carbon steel strip can be furnished in the various tempers to make an identified part provided the fabrication of the part is compatible with the grade and temper of the steel specified. Proper identification of parts may include visual examination, prints or descriptions, or a combination of these. It is the general experience that most identified parts can be satisfactorily produced from one of the tempers. There are applications or requirements that necessitate additional controls or limit the choice of processing methods. For most end part application only one kind of mechanical test requirement

is normally employed. This test requirement is generally the Rockwell hardness test.

X1.3 Rockwell Scales and Loads

X1.3.1 Various scales and loads are employed in Rockwell testing, depending on the hardness and thickness of the strip to be tested. It is common practice to make the Rockwell hardness test at a point midway between the side edges on a single thickness only. There is some overlapping among the different scales, but the best scale to use in any given case is the one which will give the maximum penetration, without showing undue evidence of impression on the undersurface and without exceeding B100 or its equivalent on the dial. The use of a lighter load results in a loss of sensitivity, while a heavier load leads to a loss in accuracy. If the Rockwell ball is flattened by using it on a hard sample, it should be replaced, otherwise the subsequent readings will be affected. A tolerance for check testing, of two Rockwell points on the B scale below the minimum and above the maximum of the range specified, is commonly allowed to compensate for normal differences in equipment. It is recommended that hardness numbers be specified to the same scale as that to be used during testing.

TABLE X1.1 Approximate Mechanical Properties for Various Tempers of Cold-Rolled Carbon Strip

NOTE 1—These values are given as information only and are not intended as criteria for acceptance or rejection. S.I. units appear in brackets.

Temper	Tensile Strength, ^A † psi [MPa]	Elongation in 2 in. (50 mm) for 0.050 in. (1.27 mm) Thickness of Strip, ^B %	Remarks
No. 1 (hard)	90 000 ± 10 000 [620 ± 70]	. . .	A very stiff, cold-rolled strip intended for flat blanking only, and not requiring ability to withstand cold forming.
No. 2 (half-hard)	65 000 ± 10 000 [450 ± 70]	10 ± 6	A moderately stiff cold-rolled strip intended for limited bending.
No. 3 (quarter-hard)	55 000 ± 10 000 [380 ± 70]	20 ± 7	A medium soft cold-rolled strip intended for limited bending, shallow drawing and stamping.
No. 4 (skin-rolled)	48 000 ± 6 000 [330 ± 40]	32 ± 8	A soft ductile cold-rolled strip intended for deep drawing where no surface strain or fluting is permissible. ^C
No. 5 (dead-soft)	44 000 ± 6 000 [300 ± 40]	39 ± 6	A soft ductile cold-rolled strip intended for deep drawing where stretcher strains or fluting are permissible. ^C Also for extrusions.

^A Tensile properties are based on the standard tension-test specimen for sheet metals, see appropriate figure in Test Methods and Definitions **A370**.

^B Elongation in 2 in. (50 mm) varies with thickness of strip. For Temper No. 5, dead-soft temper, the percentage of elongation = $41 + 10 \log t$ (t = thickness, in. (mm)). Other tempers vary in a similar way.

^C See **X1.4** for Aging Phenomenon.

† Editorially changed from ksi to psi.



X1.4 Aging Phenomenon

X1.4.1 Although the maximum ductility is obtained in steel strip in its dead soft (annealed last) condition, such strip is unsuited for many forming operations due to its tendency to stretcher strain or flute. A small amount of cold rolling (skin-rolling) will prevent this tendency, but the effect is only temporary due to a phenomenon called aging. The phenom-

enon of aging is accompanied by a loss of ductility with an increase in hardness, yield point, and tensile strength. For those uses in which stretcher straining, fluting, or breakage due to aging of the steel is likely to occur, the steel should be fabricated as promptly as possible after skin-rolling. When the above aging characteristics are undesirable, special killed (generally aluminum killed) steel is used.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A109/A109M – 16) that may impact the use of this standard. (Approved Sept. 1, 2016)

(1) Added width range 301 through 450 to Table 8.

Committee A01 has identified the location of selected changes to this standard since the last issue (A109/A109M – 14) that may impact the use of this standard. (Approved Nov. 1, 2015.)

(1) Added Practice A1073/A1073M to Section 2.

(2) Added 9.1.1.

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