



# Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Alloy, Drawing Steel and Structural Steel, Hot-Rolled<sup>1</sup>

This standard is issued under the fixed designation A1031/A1031M; 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.

## 1. Scope\*

1.1 This specification covers hot-rolled, heavy thickness coils beyond the size limits of Specifications [A506](#) and [A507](#).

1.2 The product is available in three designations: Alloy Steel, Drawing Steel, and Structural Alloy Steel.

1.3 Alloy steel is furnished to chemical composition requirements and is intended primarily for general or miscellaneous use where bending and moderate forming is a requirement.

1.4 Drawing steel is produced principally for applications involving severe cold plastic deformation such as deep drawn or severely formed parts.

1.4.1 Drawing steel may be furnished in several conditions, heat treatments, surface finishes, and edges, as specified herein.

1.5 Structural steel is furnished to chemical composition requirements and to specific mechanical property requirements which may include tension tests, hardness tests, or other commonly accepted mechanical tests.

1.5.1 The formability of structural steel decreases with increasing yield strength or hardness. Therefore, product design in relation to the mechanical properties of the grade used must be considered.

1.6 This material is available only in coils described as follows:

Product	Size Limits, Coils Only	
	Width, in. [mm]	Thickness, in. [mm]
Strip	Over 8 to 12, incl	0.230 to 1.000, incl
	[Over 200 to 300]	[Over 6.0 to 25]
Sheet	Over 12	0.230 to 1.000, incl
	[Over 300]	[from 6.0 through 25]

1.7 Sheet and strip in coils of sizes noted in 1.6 are covered by this specification only with the following provisions:

1.7.1 The material is not to be converted into steel plates for structural or pressure vessel use unless tested in complete accordance with the appropriate sections of Specifications

<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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[A6/A6M](#) (plates provided from coils) or [A20/A20M](#) (plates produced from coils). A plate produced in this manner is no longer governed by this sheet steel specification and since this material is now plate, the appropriate plate standard must now apply.

1.7.2 The dimensional tolerances of Specification [A635/A635M](#) are applicable to material produced to this specification.

1.7.3 The material is to be fed directly from coils into a blanking press, drawing or forming operation, tube mill, rolling mill, or sheared or slit into blanks for subsequent drawing or forming.

1.8 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.

1.8.1 Within the text the SI units are shown in brackets.

## 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](#)

[A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels](#)

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

[A505 Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for](#)

[A506 Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled](#)

[A507 Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled](#)

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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 Standard Steels Commonly Produced for Alloy Steel Sheet and Strip**

Steel Designation No.	Chemical Composition Ranges and Limits, % (Heat Analysis) <sup>A</sup>								
	C	Mn	P	S	Si <sup>B</sup>	Ni	Cr	Mo	V
E3310 <sup>C</sup>	0.08-0.13	0.45-0.60	0.025	0.025	0.15-0.30	3.25-3.75	1.40-1.75	...	...
4012 <sup>C</sup>	0.09-0.14	0.75-1.00	0.025	0.025	0.15-0.30	...	...	0.15-0.25	...
4118	0.18-0.23	0.70-0.90	0.025	0.025	0.15-0.30	...	0.40-0.60	0.08-0.15	...
4130	0.28-0.33	0.40-0.60	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4135	0.33-0.38	0.70-0.90	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4137	0.35-0.40	0.70-0.90	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4140	0.38-0.43	0.75-1.00	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4142	0.40-0.45	0.75-1.00	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4145	0.43-0.48	0.75-1.00	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4147 <sup>C</sup>	0.45-0.50	0.75-1.00	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4150	0.48-0.53	0.75-1.00	0.025	0.025	0.15-0.30	...	0.80-1.10	0.15-0.25	...
4320	0.17-0.22	0.45-0.65	0.025	0.025	0.15-0.30	1.65-2.00	0.40-0.60	0.20-0.30	...
4340	0.38-0.43	0.60-0.80	0.025	0.025	0.15-0.30	1.65-2.00	0.70-0.90	0.20-0.30	...
E4340	0.38-0.43	0.65-0.85	0.025	0.025	0.15-0.30	1.65-2.00	0.70-0.90	0.20-0.30	...
4520 <sup>C</sup>	0.18-0.23	0.45-0.65	0.025	0.025	0.15-0.30	...	...	0.45-0.60	...
4615	0.13-0.18	0.45-0.65	0.025	0.025	0.15-0.30	1.65-2.00	...	0.20-0.30	...
4620	0.17-0.22	0.45-0.65	0.025	0.025	0.15-0.30	1.65-2.00	...	0.20-0.30	...
4718	0.16-0.21	0.70-0.90	0.025	0.025	0.15-0.30	0.90-1.20	0.35-0.55	0.30-0.40	...
4815	0.13-0.18	0.40-0.60	0.025	0.025	0.15-0.30	3.25-3.75	...	0.20-0.30	...
4820	0.18-0.23	0.50-0.70	0.025	0.025	0.15-0.30	3.25-3.75	...	0.20-0.30	...
5015	0.12-0.17	0.30-0.50	0.025	0.025	0.15-0.30	...	0.30-0.50	...	...
5046	0.43-0.50	0.75-1.00	0.025	0.025	0.15-0.30	...	0.20-0.35	...	...
5115	0.13-0.18	0.70-0.90	0.025	0.025	0.15-0.30	...	0.70-0.90	...	...
5120	0.17-0.22	0.70-0.90	0.025	0.025	0.15-0.30	...	0.70-0.90	...	...
5130	0.28-0.33	0.70-0.90	0.025	0.025	0.15-0.30	...	0.80-1.10	...	...
5132	0.30-0.35	0.60-0.80	0.025	0.025	0.15-0.30	...	0.75-1.00	...	...
5140	0.38-0.43	0.70-0.90	0.025	0.025	0.15-0.30	...	0.70-0.90	...	...
5150	0.48-0.53	0.70-0.90	0.025	0.025	0.15-0.30	...	0.70-0.90	...	...
5160	0.56-0.64	0.75-1.00	0.025	0.025	0.15-0.30	...	0.70-0.90	...	...
E51100 <sup>C</sup>	0.95-1.10	0.25-0.45	0.025	0.025	0.15-0.30	...	0.90-1.15	...	...
E52100	0.98-1.10	0.25-0.45	0.025	0.025	0.15-0.30	...	1.30-1.60	...	...
6150	0.48-0.53	0.70-0.90	0.025	0.025	0.15-0.30	...	0.80-1.10	...	0.15 min
6158 <sup>C</sup>	0.55-0.62	0.70-1.10	0.025	0.025	0.15-0.30	...	0.90-1.20	...	0.10-0.20
8615	0.13-0.18	0.70-0.90	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8617	0.15-0.20	0.70-0.90	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8620	0.18-0.23	0.70-0.90	0.035	0.035	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8630	0.28-0.33	0.70-0.90	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8640	0.38-0.43	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8642 <sup>C</sup>	0.40-0.45	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8645	0.43-0.48	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8650 <sup>C</sup>	0.48-0.53	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8655	0.501-0.59	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8660	0.55-0.65	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.15-0.25	...
8720	0.18-0.23	0.70-0.90	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.20-0.30	...
8735 <sup>C</sup>	0.33-0.38	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.20-0.30	...
8740 <sup>C</sup>	0.38-0.43	0.75-1.00	0.025	0.025	0.15-0.30	0.40-0.70	0.40-0.60	0.20-0.30	...
9260	0.56-0.64	0.75-1.00	0.025	0.025	1.80-2.20	...	...	...	...
9262 <sup>C</sup>	0.55-0.65	0.75-1.00	0.025	0.025	1.80-2.20	...	0.25-0.40	...	...
E9310 <sup>C</sup>	0.08-0.13	0.45-0.65	0.025	0.025	0.20-0.35	3.30-35.0	1.00-1.40	0.08-0.15	...

<sup>A</sup> The chemical ranges and limits shown are subject to product analysis tolerances. See Specification A505.

<sup>B</sup> Other silicon ranges are available. Consult the producer.

<sup>C</sup> Not an SAE Steel Designation.

[A635/A635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

### 3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the applicable requirements of Specification A505, current edition, unless otherwise provided herein.

### 4. Ordering Information

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

4.1.1 ASTM specification number and year of issue,

4.1.2 Classification of the material (hot-rolled sheet or hot-rolled strip),

4.1.3 Chemical composition (grade),

4.1.4 Condition—Material in accordance with this specification is furnished in the hot rolled condition. Pickled (or blast cleaned) must be specified if required. Material ordered as pickled (or blast cleaned) will be oiled unless ordered dry,

4.1.5 Heat treatment required, if any,

4.1.6 Type of edge must be specified for hot rolled sheet coils and strip coils, either mill edge or cut edge (sheet), mill edge or slit edge (strip),

4.1.7 Dimensions (thickness and width of material),

NOTE 1—Not all producers are capable of meeting all the limitations of the thickness tolerance tables in Specification **A635/A635M**. The purchaser should contact the producer regarding possible limitations prior to placing an order.

4.1.8 Coil size and weight requirements (must include inside diameter, ID; outside diameter, OD), and maximum weight,

4.1.9 Quantity (weight),

4.1.10 Application (part identification and description),

4.1.11 Test reports (if required),

4.1.12 Cast or heat analysis (if required), and

4.1.13 Special requirements (if any).

4.1.13.1 When the purchaser requires thickness tolerances for  $\frac{3}{8}$  in. [10 mm] minimum edge distance (see Supplementary Requirement in Specification **A635/A635M**), this requirement shall be specified in the purchase order or contract.

NOTE 2—A typical ordering description is as follows: ASTM A1031: Alloy, hot rolled sheet coils, grade SAE 4118, pickled and oiled, cut edge, 0.500 by 40 in. by coil; ID 24 in., OD 72 in. maximum, coil weight 40 000 lb maximum; 200 000 lb for roll forming shapes; or, ASTM A1031M: Alloy, hot rolled sheet coils, grade SAE 4118, pickled and oiled, cut edge, 10 mm by 900 mm by coil; ID 600 mm, OD 1800 mm, maximum, coil weight 18 000 kg maximum; 90 000 kg for roll forming shapes.

## 5. Manufacture

### 5.1 Heat Treatment:

5.1.1 As-rolled,

5.1.2 Annealed,

5.1.2.1 Spheroidized annealed,

(1) *Drawing Steel*—Unless otherwise specified on the order, drawing steel will be furnished with a spheroidized annealed heat treatment.

(2) If the material is to be heat treated by other than the producer, the order shall so state. The material may be ordered in the as-rolled condition, in such cases.

5.1.2.2 Normalized, or

5.1.2.3 Normalized-and-tempered.

## 6. Chemical Requirements

6.1 The heat analysis of the steel shall conform to the requirements for the grade specified on the order.

6.2 *Standard Alloy Steel* grades listed in **Table 1** are those commonly produced for alloy steel sheet and strip.

6.3 *Nonstandard Alloy Steel* grades may be specified using the ranges and limits shown in **Table 2**.

6.4 *Structural Alloy Steel*—The grade shall be specified as outlined in **6.2** or **6.3**. However, since different mechanical properties may be expected for each of the many chemical compositions and conditions (heat treatment) that may be specified, consideration must be given to these factors in selecting the chemical composition to be specified.

**TABLE 2 Heat (Cast) Analysis Ranges for Other than Standard Steel Alloy Sheet and Strip**

Element	When Maximum of Specified Element is, %	Range or Limit, %
Carbon	To 0.55 incl	0.05
	Over 0.55 to 0.70 incl	0.08
	Over 0.70 to 0.80 incl	0.10
	Over 0.80 to 0.95 incl	0.12
	Over 0.95 to 1.35 incl	0.13
	To 0.60 incl	0.20
Manganese	Over 0.60 to 0.90 incl	0.20
	Over 0.90 to 1.05 incl	0.25
	Over 1.05 to 1.90 incl	0.30
	Over 1.90 to 2.10 incl	0.40
	Phosphorus	...
Sulfur	...	0.025 max
Silicon	To 0.15 incl	0.08
	Over 0.15 to 0.20 incl	0.10
	Over 0.20 to 0.40 incl	0.15
	Over 0.40 to 0.60 incl	0.20
	Over 0.60 to 1.00 incl	0.30
	Over 1.00 to 2.20 incl	0.40
Copper	To 0.60 incl	0.20
	Over 0.60 to 1.50 incl	0.30
	Over 1.50 to 2.00 incl	0.35
Nickel	To 0.50 incl	0.20
	Over 0.50 to 1.50 incl	0.30
	Over 1.50 to 2.00 incl	0.35
	Over 2.00 to 3.00 incl	0.40
	Over 3.00 to 5.30 incl	0.50
	Over 5.30 to 10.00 incl	1.00
Chromium	To 0.40 incl	0.15
	Over 0.40 to 0.90 incl	0.20
	Over 0.90 to 1.05 incl	0.25
	Over 1.05 to 1.60 incl	0.30
	Over 1.60 to 1.75 incl	0.35
	Over 1.75 to 2.10 incl	0.40
	Over 2.10 to 3.99 incl	0.50
	Molybdenum	To 0.10 incl
Vanadium	Over 0.10 to 0.20 incl	0.07
	Over 0.20 to 0.50 incl	0.10
	Over 0.50 to 0.80 incl	0.15
	Over 0.80 to 1.15 incl	0.20
	To 0.25 incl	0.05
	Over 0.25 to 0.50 incl	0.10

## 7. Metallurgical Structure

### 7.1 Microstructure:

7.1.1 *Drawing Steel*—A minimum of 75 % of the carbide microstructure shall be of the globular type for material with an ordered thickness of less than or equal to 0.400 in. [10 mm]. For material with an ordered thickness greater than 0.400 in. [10 mm], the percent minimum globular carbide microstructure guarantee shall be by agreement between the purchaser and the producer.

7.1.2 *Number of Tests*—The number of tests shall be in accordance with the producer's standard quality control procedures.

## 8. Mechanical Requirements

8.1 *Alloy Steel*—Mechanical tests are not applicable to regular quality alloy steel sheet and strip.

8.2 Test specimen preparation and mechanical testing shall be in accordance with Test Methods and Definitions **A370**.

### 8.3 Drawing Steel and Structural Alloy Steel:

#### 8.3.1 Tension and Hardness Tests:

8.3.1.1 *Tensile, Hardness Properties*—When tension and/or hardness tests are specified on the order, the test results shall conform to the requirements specified on the order. Yield strength, tensile strength, elongation and hardness requirements may be specified. The properties will vary depending on the chemical composition, condition, and heat treatment. Producers are frequently consulted as to grade, resultant mechanical properties, recommended heat treatment, and other information needed to establish the property parameters to meet end use requirements. Rockwell hardness requirements may be specified, providing the requirements are compatible with the tension test requirements. These requirements do not apply to the uncropped ends of unprocessed coils.

8.3.1.2 *Test Specimen Location and Orientation*—Test specimens shall be taken sufficiently far from the as hot rolled coil ends and edges so that the sample is representative of material which received the designed processing. The test shall be taken approximately midway between the center and edge of the material as rolled. For coils wider than 24 in. [600 mm], test specimens shall be taken such that the longitudinal axis of the specimens is perpendicular to the direction of rolling (transverse test). For coils through 24 in. [600 mm] in width, test specimens shall be taken such that the longitudinal axis of the specimen is parallel to the direction of rolling (longitudinal test).

8.3.1.3 *Number of Tests*—Two tests shall be taken from each heat, heat treatment lot, or 50 tons [45 000 kg]. When the amount of finished material from a heat is less than 50 tons [45 000 kg], only one test shall be taken. When material rolled from one heat differs 0.050 in. [1.3 mm] or more in thickness, one test shall be taken from both the thickest and the thinnest material rolled regardless of the weight represented.

8.3.1.4 To determine conformance with this specification, a test value should be rounded to the nearest 1 ksi [7 MPa] of

tensile strength and yield point, and to the nearest unit in the right-hand place of figures used in expressing the limiting value for other places in accordance with the rounding off methods given in Practice E29.

8.3.2 Material in the spheroidize-annealed condition generally work hardens and may require stress-relief annealing between drawing operations.

## 9. Workmanship, Finish, and Appearance

9.1 The steel shall have a workmanlike appearance and shall not have defects of a nature or degree that will be detrimental to the stamping or fabrication of finished parts.

9.2 Coils may contain some abnormal imperfections that render a portion of the coil unusable since the inspection of coils does not afford the opportunity to remove portions containing imperfections.

9.3 *Edges*—The normal edge condition in heavy-thickness coils is mill edge. If a cut edge (sheet) or slit edge (sheet) is desired, it must be specified.

9.4 *Oiling*—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.

9.5 *Surface Finish*—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.

## 10. Keywords

10.1 alloy steel sheet; alloy steel strip; alloy structural steel; drawing steel; heavy-thickness coils; hot-rolled alloy steel

## SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A1031/A1031M – 10) that may impact the use of this standard. (Approved May 1, 2012.)

(1) Removed UNS and SAE designators, revised five chemical compositions, and added Footnote C to Table 1.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1031/A1031M – 09) that may impact the use of this standard. (Approved May 1, 2010.)

(1) Updated table in Section 1.6.



## A1031/A1031M – 12

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