



Designation: A 1018/A 1018M – 05a

# Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability<sup>1</sup>

This standard is issued under the fixed designation A 1018/A 1018M; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification covers hot-rolled, heavy-thickness coils beyond the size limits of Specification A 1011/A 1011M.

1.2 The product is available in five designations: Commercial Steel, Drawing Steel, Structural Steel, High-Strength Low-Alloy Steel, and High-Strength Low-Alloy Steel with Improved Formability.

1.3 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 [Over 200 to 300]	0.230 to 1.000, incl [Over 6.0 to 25]
Sheet	Over 12 to 48, incl [Over 300 to 1200]	0.230 to 1.000, incl [Over 6.0 to 25]
Sheet	Over 48 [Over 1200]	0.180 to 1.000, incl [Over 4.5 to 25]

1.4 Sheet and strip in coils of sizes noted in 1.3 are covered by this specification only with the following provisions:

1.4.1 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.

1.4.2 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 A 6/A 6M (plates provided from coils) or A 20/A 20M (plates produced from coils). Plate converted from coils is no longer governed by this sheet steel specification and since this material is now a plate, the requirements of the appropriate plate specification shall apply, except in cases where there is a conflict between the requirements of the plate specification and this specification. In these cases, the more restrictive limits of either specification shall apply.

1.4.3 The dimensional tolerances of Specification A 635/A 635M are applicable to material produced to this specification.

1.4.4 Not all strength levels are available in all thicknesses. The user should consult the producer for appropriate size limitations.

1.5 The values stated in either inch-pound units or SI units [metric] are to be regarded separately as standard. Within the text the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A 20/A 20M Specification for General Requirements for Steel Plates for Pressure Vessels

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 572/A 572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A 635/A 635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A 1011/A 1011M Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

G 101 Guide for Estimating the Atmospheric Corrosion

<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.

Current edition approved Sept. 15, 2005. Published September 2005. Originally approved in 2001. Last previous edition approved in 2005 as A 1018/A 1018M – 05.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard.

## 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 635/A 635M**, unless otherwise provided herein.

### 4. Classification

4.1 Heavy thickness coils are available in the following designations:

4.1.1 *Commercial Steel (CS)*

4.1.2 *Drawing Steel (DS)*

4.1.3 *Structural Steel*—(SS grades 30[205], 33[230], 36[250] Types 1 and 2, and 40[275]).

4.1.4 *High-Strength Low-Alloy Steel*—(HSLAS grades 45[310], 50[340], 55[380], 60[410], 65[450], 70[480]) in Classes 1 and 2.

4.1.4.1 This material is intended for miscellaneous applications where greater strength and savings in weight are important. The material is available in two classes. They are similar in strength level, except that Class 2 offers improved weldability and more formability than Class 1. Atmospheric corrosion resistance of these steels is equivalent to plain carbon steels. With copper specified, the atmospheric corrosion is somewhat enhanced.

4.1.5 *High-Strength Low-Alloy Steel with Improved Formability*—(HSLAS-F grades 50[340], 60[410], 70[480], 80[550]).

4.1.5.1 This material has improved formability when compared with HSLAS. The steel is killed and made to a fine ferritic grain practice and includes microalloying elements such as columbium, titanium, vanadium, zirconium, etc. The steel shall be treated to achieve inclusion control. The material is intended for miscellaneous applications where higher

strength, savings in weight, improved formability, and weldability are important. Atmospheric corrosion resistance of these steels is equivalent to plain carbon steels. With copper specified, the atmospheric corrosion resistance is somewhat enhanced.

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

4.1.6 When required for HSLAS and HSLAS-F steels, limitations on the use of one or more of the microalloy elements shall be specified on the order.

4.2 The limits for copper, chromium, nickel, and molybdenum are available in two levels, Limits A and Limits B (see **Table 1**).

### 5. Ordering Information

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

5.1.1 ASTM specification number and year of issue.

5.1.2 Name of material and designation (hot-rolled steel sheet or hot-rolled strip) (include grade and, as appropriate, type and class for CS, DS, SS, HSLAS, and HSLAS-F) (see section 4.1).

5.1.2.1 For HSLAS, when a class is not specified class 1 will be furnished) (see section 4.1),

5.1.3 Copper bearing, (if required),

5.1.4 For SS, HSLAS, and HSLAS-F and selected CS steels, specify the limits for chemical requirements listed in **Table 1** (elements Cu, Cr, Ni, and Mo). When Limits A or Limits B are not specified, Limits A shall be furnished.

5.1.5 *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,

**TABLE 1 Chemical Requirements: Cu, Ni, Cr and Mo for Commercial Steels, Structural Steels, High-Strength Low-Alloy Steels, and High-Strength Low-Alloy Steels with Improved Formability**

Designation	% Heat Analysis, Element Maximum Unless Otherwise Shown				
	Limits	Cu <sup>A,B</sup>	Ni <sup>B</sup>	Cr <sup>B,C</sup>	Mo <sup>B,C</sup>
CS: Grades 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1524	A	0.20	0.20	0.15	0.06
	B	0.40	0.40	0.30	0.12
SS: All grades	A	0.20	0.20	0.15	0.06
	B	0.40	0.40	0.30	0.12
HSLAS: All grades and classes except for Grade 70 [480]	A	0.20	0.20	0.15	0.06
	B	0.40	0.40	0.30	0.12
Grade 70 [480] Class 1 and Class 2	A	0.20	0.20	0.15	0.16
	B	0.40	0.40	0.30	0.16
HSLAS-F: Grades 50 [340] and 60 [410]	A	0.20	0.20	0.15	0.06
	B	0.40	0.40	0.30	0.12
Grade 70 [480] and 80 [550]	A	0.20	0.20	0.15	0.16
	B	0.40	0.40	0.30	0.16

<sup>A</sup> When copper bearing steel is specified, the minimum limit for copper is 0.20 %. When copper bearing steel is not specified, the maximum limit for copper is as shown in the table.

<sup>B</sup> For Limits B steels, the sum of copper, nickel, chromium and molybdenum shall not exceed 1.00 % on heat analysis. When one or more of these elements are specified by the purchaser, the sum does not apply; in which case, only the individual limits on the remaining elements shall apply.

<sup>C</sup> For Limits B steels, the sum of chromium and molybdenum shall not exceed 0.32 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements shall apply.

5.1.6 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),

5.1.7 Dimensions (decimal thickness and width of material),

5.1.7.1 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 tolerances shown in Specification **A 635/A 635M**,

NOTE 2—Not all producers are capable of meeting all the limitations of the thickness tolerance tables in Specification **A 635/A 635M**. The purchaser should contact the producer regarding possible limitations prior to placing an order.

5.1.8 Coils size and weight requirements (must include inside diameter (ID), outside diameter (OD), and maximum weight,

5.1.9 Quantity (weight),

5.1.10 Application (part identification and description). Orders for conversion to plate shall include reference to the applicable ASTM plate specification.

5.1.11 Special requirements, if required, and

5.1.11.1 If required, a limit on “carbon equivalent” may be specified (see Supplementary Requirement S1).

5.1.12 A report is required of heat analysis and mechanical properties as determined by the tension test.

NOTE 3—A typical ordering description is as follows: (inch pound units) ASTM A 1018/A 1018M: Grade 50, High-Strength, Low-Alloy Steel, Class 2, Limits B, hot rolled sheet coils, 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; (SI units) ASTM A 1018/A 1018M: Grade 340, High-Strength Low-Alloy Steel, Class 2, Limits B, hot-rolled sheet coils, 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. For conversion to plate: (inch-pound units) ASTM A 1018/A 1018M: Grade 50, High-Strength Low-Alloy Steel, Class 1, Limits A, hot-rolled sheet coils, as rolled, mill edge, 0.500 in. by 50 in. by coil, ID 24 in., OD 72 in., maximum; coil weight 40 000 lb., maximum; 200 000 lb. for conversion to plate, Specification **A 572/A 572M** Grade 50; (SI units) ASTM A 1018/A 1018M: Grade 340, Structural Steel, hot-rolled sheet coils, as rolled,

mill edge; 10 mm by 1000 mm by coil; ID 600 mm, OD 1800 mm, maximum; coil weight 18 000 kg maximum; 100 000 kg for conversion to plate, Specification **A 572/A 572M** Grade 340.

## 6. Chemical Composition

6.1 The heat analysis of commercial steel and drawing steel shall conform to the requirements of **Table 2**.

6.1.1 The heat analysis of structural steel, high-strength low-alloy steel, and high-strength low-alloy steel with improved formability shall conform to the requirements of **Tables 1-3**. **Table 1** describes the heat analysis requirements for two sets of limits for the elements copper, chromium, nickel, and molybdenum. The required limits of these elements shall be specified on the order.

NOTE 4—**Table 1** does not apply to drawing steels and some commercial steels (see **Table 2**).

6.1.2 Chemical analysis shall be conducted in accordance with Test Method **A 751**.

6.1.3 Each of the elements listed in **Tables 2 and 3** shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium, or molybdenum is less than 0.02 %, report the analysis as <0.02 % or the actual value. When the amount of columbium, titanium, or vanadium is less than 0.008 %, report the analysis as <0.008 % or the actual determined value.

6.1.4 For Structural Steel (SS) the addition of microalloying elements, including columbium, vanadium, or titanium, as well as nitrogen, as strength enhancers is prohibited.

6.1.5 Sheet steel grades defined by this specification are suitable for welding if appropriate welding conditions are selected. For certain welding processes, more restrictive composition limits may be desirable and should be requested at the time of inquiry and ordering.

## 7. Mechanical Properties

7.1 Test specimen preparation and mechanical testing shall be in accordance with Test Methods **A 370**.

**TABLE 2 Chemical Requirements<sup>A</sup>  
Commercial and Drawing Steels**

Designation	% Heat Analysis, Element Maximum Unless Otherwise Shown											
	C	Mn	P	S	Cu	Ni	Cr	Mo	V	Cb	Ti <sup>B</sup>	N
Commercial Steel (CS)												
1006	0.08	0.45	0.030	0.035	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...
1008	0.10	0.50	0.030	0.035	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...
1009	0.15	0.60	0.030	0.035	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...
1010	0.08 to 0.13	0.30 to 0.60	0.030	0.035	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...
1012	0.10 to 0.15	0.30 to 0.60	0.030	0.035	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...
1015	0.13 to 0.18	0.30 to 0.60	0.030	0.035					0.008	0.008	0.025	...
1016	0.13 to 0.18	0.60 to 0.90	0.030	0.035					0.008	0.008	0.025	...
1017	0.15 to 0.20	0.30 to 0.60	0.030	0.035					0.008	0.008	0.025	...
1018	0.15 to 0.20	0.60 to 0.90	0.030	0.035					0.008	0.008	0.025	...
1019	0.15 to 0.20	0.70 to 1.00	0.030	0.035					0.008	0.008	0.025	...
1020	0.18 to 0.23	0.30 to 0.60	0.030	0.035					0.008	0.008	0.025	...
1021	0.18 to 0.23	0.60 to 0.90	0.030	0.035					0.008	0.008	0.025	...
1022	0.18 to 0.23	0.70 to 1.00	0.030	0.035					0.008	0.008	0.025	...
1023	0.20 to 0.25	0.30 to 0.60	0.030	0.035					0.008	0.008	0.025	...
1524	0.19 to 0.25	1.35 to 1.65	0.030	0.035					0.008	0.008	0.025	...
Drawing Steel (DS)	0.10	0.50	0.030	0.020	0.20 <sup>C</sup>	0.20	0.15	0.06	0.008	0.008	0.025	...

<sup>A</sup> Where an ellipsis ( . . . ) appears in the table, there is no requirement, but the analysis shall be reported.

<sup>B</sup> Titanium is permitted to 0.025 %, at the producer's option, provided the ratio of % titanium to % nitrogen does not exceed 3.4.

<sup>C</sup> When copper steel is specified, the copper limit is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.

**TABLE 3 Chemical Requirements<sup>A</sup>**  
**Structural Steels, High-Strength Low-Alloy Steels, and High-Strength Low-Alloy Steels with Improved Formability**

% Heat Analysis, Element Maximum Unless Otherwise Shown										
Designation	C	Mn	P	S	Al	Si	V	Cb	Ti	N
<b>SS<sup>B</sup></b>										
Grade 30 [205]	0.25	1.50	0.035	0.04	...	...	0.008	0.008	0.025	0.014
Grade 33 [230]	0.25	1.50	0.035	0.04	...	...	0.008	0.008	0.025	0.014
Grade 36 [250] Type 1	0.25	1.50	0.035	0.04	...	...	0.008	0.008	0.025	0.014
Grade 36 [250] Type 2	0.25	1.50 <sup>C</sup>	0.035	0.04	...	...	0.008	0.008	0.025	0.014
Grade 40 [275]	0.25	1.50	0.035	0.04	...	...	0.008	0.008	0.025	0.014
<b>HSLAS<sup>D</sup></b>										
Grade 45 [310] Class 1	0.22	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 45 [310] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 50 [340] Class 1	0.23	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 50 [340] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 55 [380] Class 1	0.25	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 55 [380] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 60 [410] Class 1	0.26	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 60 [410] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 65 [450] Class 1	0.26	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 65 [450] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 70 [480] Class 1	0.26	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 70 [480] Class 2	0.15	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
<b>HSLAS-F<sup>D</sup></b>										
Grade 50 [340]	0.15	1.65	0.025	0.035	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 60 [410]	0.15	1.65	0.025	0.035	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 70 [480]	0.15	1.65	0.025	0.035	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>
Grade 80 [550]	0.15	1.65	0.025	0.035	...	...	0.005 min	0.005 min	0.005 min	<sup>E</sup>

<sup>A</sup> An ellipsis (...) indicates that no limits have been set for that element. See Table 1 for requirements for Cu, Ni, Cr, and Mo.

<sup>B</sup> Titanium is permitted for SS designations, at the producer's option, to 0.025 % maximum, provided the ratio of % titanium to % nitrogen does not exceed 3.4.

<sup>C</sup> For product greater than 0.75 in. in thickness, the manganese requirement is 0.80 to 1.20 %.

<sup>D</sup> HSLAS and HSLAS-F steels contain the strengthening elements columbium, vanadium, and titanium added singly or in combination. The minimum requirements only apply to the microalloy elements selected for strengthening of the steel.

<sup>E</sup> The purchaser has the option of restricting the nitrogen content. It should be noted that, depending on the microalloying scheme (for example, use of vanadium) of the producer, nitrogen may be a deliberate addition. Consideration should be made for the use of nitrogen binding elements (for example, vanadium, titanium).

**7.2 Tensile Properties**—The material, structural steel, high-strength low-alloy steel, and high-strength low-alloy steel with improved formability, as represented by the test specimens shall conform to the mechanical property requirements as stated in Table 4. These requirements do not apply to the uncropped ends of unprocessed coils.

**7.3 Tension Test Specimen Location and Orientation**—Tension test specimens shall be taken sufficiently far from the as hot-rolled coil ends 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], Tension 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, tension test specimens shall be taken such that longitudinal axis of the specimen is parallel to the direction of rolling (longitudinal test).

**7.4 Tension Tests**—Two tension tests shall be conducted from each heat or each of 50 tons [45 Mg]. When the amount of finished material from a heat is less than 50 tons [45 Mg], only one tension test shall be conducted. When material rolled from one heat differs 0.050 in. [1.3 mm] or more in thickness, one tension test shall be conducted from both the thickest and the thinnest material rolled regardless of the weight represented.

**7.5** 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 E 29.

**7.6** Structural steel, high-strength low-alloy steel, and high-strength low-alloy steel with improved formability covered by this specification 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. The producer shall be consulted concerning the recommended minimum inside radius and bending direction. Where possible, a larger radius or “easy way” bending (with the bend axis perpendicular to rolling direction), or both, are recommended for improved performance.

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

## 8. Workmanship, Finish, and Appearance

**8.1 Edges**—The normal edge condition in heavy-thickness coils is mill edge. If cut edge is required, it must be specified.