



Designation: A1039/A1039M – 20

Standard Specification for Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, and Ultra-High Strength, Produced by Twin-Roll Casting Process¹

This standard is issued under the fixed designation A1039/A1039M; 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 commercial, structural, high-strength low-alloy, and ultra-high strength steel sheet in coils and cut lengths produced by the twin-roll casting process.

1.2 The steel sheet is available in the designations listed in Section 4.

1.3 The material is available in the following sizes:

Thickness:	0.027 to 0.078 in. [0.7 to 2.0 mm]
Width:	up to 79 in. [2000 mm]

1.4 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.

NOTE 1—A description of the Twin-roll Casting Process is included in Appendix X1.

1.5 *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

[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](#)

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.

[A606/A606M Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance](#)

[A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys](#)

[G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels](#)

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this specification refer to Terminology [A941](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *twin-roll casting process, n*—production of steel sheet directly from liquid metal.

3.2.1.1 *Discussion*—The properties of the steel sheet are the result of the control of the casting conditions, and in some cases, through a combination of the casting process and hot rolling of the sheet.

4. Classification

4.1 Twin-roll cast steel sheet is available in the following designations:

4.1.1 Commercial steel (CS Types A, B, and D),

4.1.2 Drawing steel (DS Types A, B, and D),

4.1.3 Structural steel (SS Grades 30 [205], 33 [230], 36 [250] Types 1 and 2, 40 [275], 45 [305], 50 [340], 55 [380], 60 [410], 70 [480], and 80 [550]), and

4.1.4 High-strength low-alloy steel (HSLAS, classes 1 and 2 in grades 45 [310], 50 [340], 55 [380], 60 [410], 65 [450], 70 [480], and 80 [550]).

4.1.5 Ultra-high strength steel (UHSS in grades W 100 [690], W 150 [10304], Mart 190 [1300], Mart 220 [1500], Mart250 [1700]).

5. Ordering Information

5.1 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to describe the required material. Examples of such information include, but are not limited to, the following:

5.1.1 ASTM specification number and year of issue,

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

5.1.2 Name of material and designation (direct cast or hot rolled sheet) (include grade and class, and limits for Cu, Ni, Cr, and Mo as appropriate, for CS, DS, SS, and HSLAS, and UHSS) (see 4.1),

5.1.2.1 When a type is not specified for CS, Type B will be furnished,

5.1.2.2 When a type is not specified for DS, Type B will be furnished,

5.1.2.3 When a class for HSLAS is not specified, Class 1 will be furnished.

5.1.2.4 When limits for Cu, Ni, Cr, and Mo are not specified, limit H (see Table 1) will be furnished.

5.1.3 Finish (see 9.1),

5.1.4 Type of edge (see 9.3),

5.1.5 Oiled or not oiled, as required (see 9.2),

5.1.6 Dimensions (thickness, width, and whether cut lengths or coils),

5.1.7 Coil size (inside diameter, outside diameter, and maximum weight),

5.1.8 Copper bearing steel, (if required),

5.1.9 Quantity,

5.1.10 Application (part identification and description),

5.1.11 A report of heat analysis will be supplied, if requested, for CS or DS. For materials with required mechanical properties, SS, HSLAS, or UHSS a report is required of heat analysis and mechanical properties as determined by the tension test, and

5.1.12 Special requirements (if any).

5.1.12.1 When the purchaser requires thickness tolerances for 3/8 in. [10 mm] minimum edge distance (see Supplementary

TABLE 1 Chemical Requirements^{A,B} for Twin-roll Cast Hot Rolled Steel Sheet Designations SS, HSLAS, and UHSS

Designation	% Heat Analysis, Element Maximum Unless Otherwise Shown									
	C	Mn	P	S	Al ^C	Si ^C	V	Nb ^D	Ti	N
SS: ^E										
Grade 30 [205]	0.25	0.90	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 33 [230]	0.25	0.90	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 36 [250] Type 1	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 36 [250] Type 2	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 40 [275]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 45 [305]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 50 [345]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 55 [380]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 60 [410]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 70 [480]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
Grade 80 [550]	0.25	1.35	0.035	0.04	...	...	0.008	0.008	0.008	...
HSLAS: ^C										
Grade 45 [310] Class 1 ^E	0.22	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 45 [310] Class 2	0.15	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 50 [340] Class 1 ^E	0.23	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 50 [340] Class 2	0.15	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 55 [380] Class 1 ^E	0.25	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
Grade 55 [380] Class 2	0.15	1.35	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	...
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	...
Grade 65 [450] Class 1	0.26	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 65 [450] Class 2	0.15	1.50	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 70 [480] Class 1	0.26	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 70 [480] Class 2	0.15	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 80 [550] Class 1	0.26	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 80 [550] Class 2	0.15	1.65	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 100 [690] Class 1	0.26	1.75	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 100 [690] Class 2	0.15	1.75	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
UHSS:										
Grade 100 [690] Class 1	0.26	1.75	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
Grade 100 [690] Class 2	0.15	1.75	0.04	0.04	...	...	0.005 min	0.005 min	0.005 min	^F
W-100 ^G [690]	0.30	1.50	0.05	0.003	...	...	0.005 min	0.005 min	0.005 min	^F
W-150 ^G [10340]	0.30	1.50	0.05	0.003	...	...	0.005 min	0.005 min	0.005 min	^F
Mart 190 [1300]	0.25	2.00	0.05	0.003	...	...	0.005 min	0.005 min	0.005 min	^F
Mart 220 [1500]	0.28	2.00	0.05	0.003	...	...	0.005 min	0.005 min	0.005 min	^F
Mart 250 [1700]	0.30	3.00	0.05	0.003	...	...	0.005 min	0.005 min	0.005 min	^F

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

^B The limits for copper, nickel, chromium and molybdenum are shown in Table 3.

^C HSLAS steels contain the strengthening elements columbium (niobium), vanadium, titanium, and molybdenum added singly or in combination. The minimum requirements only apply to the microalloy elements selected for strengthening of the steel.

^D Columbium (Cb) and niobium (Nb) are considered interchangeable names for element 41 in the periodic table and are acceptable for use.

^E For each reduction of 0.01 % below the specified carbon maximum, an increase of 0.06 % manganese above the specified maximum will be permitted up to a maximum of 1.50 %.

^F 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 is permitted as a deliberate addition. Consideration should be made for the use of nitrogen binding elements.

^G Grade W shall have an atmospheric corrosion resistance index of 6.0 or higher calculated from heat analysis in accordance with Guide G101, using the Larabee and Coburn method of evaluation.

TABLE 2 Chemical Requirements^A for Twin-roll Cast Hot Rolled Steel Sheet Designations CS and DS

	Composition, % Heat Analysis, Element Maximum Unless Otherwise Shown													
	C	Mn	P	S	Al ^B	Si	Cu ^C	Ni	Cr	Mo	V	Nb ^D	Ti	N
CS Type A ^E	0.10	0.70	0.030	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008	...
CS Type B	0.02–0.15	0.70	0.030	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008	...
CS Type D	0.15	0.80	0.030	0.035	...	...	0.50	0.30	0.30	0.15	0.008	0.008	0.008	...
DS Type A ^E	0.10	0.60	0.030	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008	...
DS Type B	0.02–0.15	0.60	0.030	0.035	...	...	0.20	0.20	0.15	0.06	0.008	0.008	0.008	...
DS Type D	0.15	0.60	0.030	0.035	...	...	0.50	0.30	0.30	0.15	0.008	0.008	0.008	...

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

^B When aluminum deoxidized steel is required, it may be ordered to a minimum of 0.01 % total aluminum.

^C When copper steel is specified, the copper limit is a minimum of 0.20 %.

^D Columbium (Cb) and niobium (Nb) are considered interchangeable names for element 41 in the periodic table and are acceptable for use.

^E Specify Type B to avoid carbon levels below 0.02 %.

Requirement in Specification **A568/A568M**), this requirement shall be specified in the purchase order or contract.

5.1.12.2 Martensitic grades are typically sold according to tensile strength.

NOTE 2—A typical ordering description is as follows: ASTM A1039/A1039M steel sheet, CS Type A, pickled and oiled, cut edge, 0.075 by 36 by 96 in, 100 000 lb, for part No. 6310, for shelf bracket, or

ASTM A1039/A1039M, hot rolled steel sheet, SS Grade 40, pickled and oiled, cut edge, 1.5 by 117 mm by coil, ID 600 mm, OD 1500 mm, max weight 10 000 kg, 100 000 kg, for part number A4885 for lower housing.

6. General Requirements for Delivery

6.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification **A568/A568M** for steel sheet.

7. Chemical Composition

7.1 The heat analysis of the steel shall conform to the chemical requirements of the appropriate designation shown in **Table 2** for CS, **Table 1** for SS and HSLAS, and **Table 3** for Cu, Ni, Cr, and Mo.

7.2 Each of the elements listed in **Tables 1 and 2** shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium, or molybdenum is less than 0.02 %, the analysis shall be reported as “<0.02 %” or the actual determined value. When the amount of vanadium, columbium, or titanium is less than 0.008 %, the analysis shall be reported as “<0.008 %” or the actual determined value.

7.3 Sheet steel grades defined by this specification are suitable for welding if appropriate welding conditions are selected. Certain welding processes may require more restrictive composition limits than those included in **Table 1** or **Table 2**, and in these cases, the restrictive limits shall be reviewed with the producer at the time of inquiry and ordering.

NOTE 3—The twin-roll cast product may be deoxidized using either silicon or aluminum.

8. Mechanical Properties

8.1 CS:

8.1.1 Typical, non-mandatory mechanical properties for CS are found in **Table 4**.

8.1.2 The material shall be capable of being bent at room temperature in any direction through 180° flat on itself without

TABLE 3 Chemical Requirements: Cu, Ni, Cr, and Mo for Structural Steels, High-strength Low-alloy Steels, and Ultra-high Strength Steels

Designation	Limits	% Heat Analysis, maximum Unless Otherwise Specified			
		Cu ^{A,B}	Ni ^B	Cr ^{B,C}	Mo ^{B,C}
SS:					
All grades	L	0.35	0.20	0.15	0.06
	H	0.50	0.30	0.30	0.16
HSLAS:					
All grades and classes and UHSS Grade 100	L	0.35	0.20	0.15	0.06
	H	0.50	0.30	0.30	0.16
UHSS					
Grade W (100 and 150)	L	0.35	0.20	0.15	0.08
	H	0.50	0.30	0.30	0.16
Grade Mart (190 [1300], 220 [1500] and 250 [1700])	L	0.35	0.20	0.15	0.08
	H	0.50	0.30	0.30	0.16

^A When copper is specified, a minimum of 0.20 % is required. When copper steel is not specified, the copper limit is a maximum requirement.

^B For limit H 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.

^C For limit H 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.

cracking on the outside of the bent portion (see section on bend test of Test Methods and Definitions **A370**).

8.2 SS, HSLAS, and UHSS:

8.2.1 The available grades and corresponding mechanical property requirements for SS, HSLAS, and UHSS steels are shown in **Table 5**.

8.2.2 Tension Tests:

8.2.2.1 *Requirements*—Material as represented by the test specimen shall conform to the mechanical property requirements specified in **Table 5**.

8.2.2.2 *Number of Tests*—Two tension tests shall be made from each heat or from each 50 tons [45 000 kg]. When the amount of finished material from a heat is less than 50 tons [45 000 kg], one tension test shall be made. When material