Designation: B688 – 18

Standard Specification for Chromium-Nickel-Molybdenum-Iron (UNS N08367) Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation B688; 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 chromium-nickel-molybdenum-iron UNS N08367[2] plate, sheet, and strip for use in corrosive service and heat-resisting applications.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to become familiar with all hazards including those identified in the appropriate Safety Data Sheet (SDS) for this product/material as provided by the manufacturer, to establish appropriate safety, health, and environmental practices, and determine the applicability of regulatory limitations prior to use.*

1.4 *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:*[3]

B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

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

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E1473 Test Methods for Chemical Analysis of Nickel, Cobalt and High-Temperature Alloys

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *sheet, n*—material under 3⁄16 in. (5 mm) in thickness and 24 in. (610 mm) and over in width.

3.1.2 *strip, n*—material under 3⁄16 in. (5 mm) in thickness and under 24 in. (610 mm) in width.

3.1.3 *plate, n*—material 3⁄16 in. (5 mm) and over in thickness and over 10 in. (254 mm) in width.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information, as required:

4.1.1 Quantity (feet, meters, or number of pieces),

4.1.2 Alloy name or UNS number,

4.1.3 Finish (hot-rolled or cold-rolled),

4.1.4 Dimensions (thickness, width, and length if cut-length),

4.1.5 Purchaser's inspection, if required,

4.1.6 ASTM designation and year of issue, and

4.1.7 Samples for product analysis, if required.

5. Chemical Composition

5.1 The material shall conform to the composition limits specified in Table 1.

5.2 If a product (check) analysis is made by the purchaser, the material shall conform to the permissible variations for product (check) analysis in Specification B880.

[1] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt and Their Alloys.

Current edition approved Nov. 1, 2018. Published January 2019. Originally approved in 1981. Last previous edition approved in 2014 as B688 – 96 (2014). DOI: 10.1520/B0688-18.

[2] Designation established in accordance with ASTM E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

[3] 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**

TABLE 1 Chemical Requirements

Element	Composition Limits, %
	N08367
Carbon	0.030 max
Manganese	2.00 max
Silicon	1.00 max
Phosphorus	0.040 max
Sulfur	0.030 max
Chromium	20.00 to 22.00
Nickel	23.50 to 25.50
Molybdenum	6.00 to 7.00
Nitrogen	0.18 to 0.25
Iron[A]	remainder
Copper	0.75 max

[A] Iron shall be determined arithmetically by difference.

TABLE 2 Mechanical Properties for Plate, Sheet, and Strip

	N08367
Yield strength, 0.2 % offset, min, ksi (MPa)	45 (310)
Tensile strength, min, ksi (MPa)	
≤3⁄16 in. (4.8 mm) thick	100 (690)
>3⁄16	95 (655)
Elongation in 2 in. or 50 mm or 4*D*, min, %	30[A]
Hardness,[B] max	
≤3⁄16 in. (4.8 mm) thick	100 HRB
>3⁄16	240 HBN

[A] Not applicable for thickness under 0.015 in. (0.40 mm).
[B] Hardness values (Brinell, Rockwell, or equivalent) are informative only and are not to be construed as the basis for acceptance or rejection.

TABLE 3 Permissible Variations in Thickness for Hot-Rolled Sheets in Cut Lengths, Cold-Rolled Sheets in Cut Lengths and Coils

Specified Thickness,[A] in. (mm)	Permissible Variations, Plus and Minus	
	in.	mm
Over 0.145 (3.68) to less than 3⁄16 (4.76)	0.014	0.36
Over 0.130 (3.30) to 0.145 (3.68), incl	0.012	0.30
Over 0.114 (2.90) to 0.130 (3.30), incl	0.010	0.25
Over 0.098 (2.49) to 0.114 (2.90), incl	0.009	0.23
Over 0.083 (2.11) to 0.098 (2.49), incl	0.008	0.20
Over 0.072 (1.83) to 0.083 (2.11), incl	0.007	0.18
Over 0.058 (1.47) to 0.072 (1.83), incl	0.006	0.15
Over 0.040 (1.02) to 0.058 (1.47), incl	0.005	0.13
Over 0.026 (0.66) to 0.040 (1.02), incl	0.004	0.10
Over 0.016 (0.41) to 0.026 (0.66), incl	0.003	0.08
Over 0.007 (0.18) to 0.016 (0.41), incl	0.002	0.05
Over 0.005 (0.13) to 0.007 (0.18), incl	0.0015	0.04
0.005 (0.13)	0.001	0.03

[A] Thickness measurements are taken at least 3⁄8 in. (9.52 mm) from the edge of the sheet.

TABLE 4 Permissible Variations in Width and Length for Hot-Rolled and Cold-Rolled Resquared Sheets (Stretcher Leveled Standard of Flatness)

Specified Dimensions, in. (mm)	Tolerances		
	Plus		Minus
	in.	mm	
For thickness under 0.131 (3.33):			
Widths up to 48 (1219) excl	1⁄16	2	0
Widths 48 (1219) and over	1⁄8	3	0
Lengths up to 120 (3048) excl	1⁄16	2	0
Lengths 120 (3048) and over	1⁄8	3	0
For thicknesses 0.131 (3.33) and over:			
All widths and lengths	1⁄4	6	0

TABLE 5 Permissible Variations in Width for Hot-Rolled and Cold-Rolled Sheets not Resquared and Cold-Rolled Coils

Specified Thickness, in. (mm)	Tolerances for Specified Width, in. (mm)	
	24 (610) to 48 (1219), excl	48 (1219) and Over
Less than 3⁄16 (4.76)	1⁄16 (2) plus 0 minus	1⁄8 (3) plus 0 minus

TABLE 6 Permissible Variations in Camber for Hot-Rolled and Cold-Rolled Sheets Not Required and Cold-Rolled Coils[A]

Specified Width, in. (mm)	Tolerance per Unit Length of Any 8 ft (2438 mm), in. (mm)
24 (610) to 36 (914), incl	1⁄8 (3)
Over 36 (914)	1⁄16 (2)

[A] Camber is the greatest deviation of a side edge from a straight line and measurement is taken by placing an 8-ft (2438-mm) straightedge on the concave side and measuring the greatest distance between the sheet edge and the straightedge.

TABLE 7 Permissible Variations in Length for Hot-Rolled and Cold-Rolled Sheets Not Resquared

Length, ft (mm)	Tolerances, in. (mm)
Up to 10 (3048), incl	1⁄4 (6) plus 0 minus
Over 10 (3048) to 20 (6096), incl	1⁄2 (13) plus 0 minus

6. Mechanical Properties and Other Requirements

6.1 The material shall conform to the mechanical property requirements specified in Table 2.

7. Dimensions and Permissible Variations

7.1 *Sheet*—Material shall conform to the variations specified in Tables 3-9, inclusive. There will be no flatness requirements for non-stretcher leveled sheet.

7.2 *Strip*—Material shall conform to the variations specified in Tables 10-13, inclusive. Note that strip of all sizes may be ordered to cut lengths in which case a variation of 1⁄2 in. (13 mm) over the specified length shall be permitted. There shall be no flatness requirements for non-stretcher leveled strip.

7.3 *Plate*—Material shall conform to the variations specified in Tables 14-20, inclusive. Specially flattened plate, when so specified, shall have permissible variations in flatness as agreed upon between the manufacturer and purchaser.

8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and condition, smooth, commercially straight or flat, and free of injurious imperfections.

9. Sampling

9.1 *Lot for Chemical Analysis and Mechanical Testing:*

9.1.1 A lot for chemical analysis shall consist of one heat.

TABLE 8 Permissible Variations in Flatness for Hot-Rolled and Cold-Rolled Sheets Specified to Stretcher-Leveled Standard of Flatness

Specified Thickness, in. (mm)	Width, in. (mm)	Length, in. (mm)	Flatness Tolerance,[A] in. (mm)
Under 3/16 (4.76)	to 48 (1219), incl	to 96 (2438), incl	1/8 (3)
Under 3/16 (4.76)	to 48 (1219), incl	over 96 (2438)	1/4 (6)
Under 3/16 (4.76)	over 48 (1219)	to 96 (2438), incl	1/4 (6)
Under 3/16 (4.76)	over 48 (1219)	over 96 (2438)	1/4 (6)

TABLE 9 Permissible Variations in Diameter for Hot-Rolled and Cold-Rolled Sheets, Sheared Circles

Specified Thickness, in. (mm)	Tolerance Over Specified Diameter (No Tolerance Under), in. (mm)		
	Diameters Under 30 in. (762)	Diameters 30 (762) to 48 in. (1219)	Diameters Over 48 in. (1219)
0.0972 (2.46) and thicker	1/8 (3)	3/16 (5)	1/4 (6)
0.0971 (2.46) to 0.0568 (1.45), incl	3/32 (2)	5/32 (4)	7/32 (6)
0.0567 (1.45) and thinner	1/16 (2)	1/8 (3)	3/16 (5)

TABLE 10 Permissible Variations in Thickness for Cold-Rolled Strip in Coils and Cut Lengths

NOTE 1—Thickness measurements are taken at least 3/8 in. (9.52 mm) in from the edge of the strip, except that on widths less than 1 in. (25.4 mm), the tolerances are applicable for measurements at all locations. The tolerances in this table include crown tolerances.

Specified Thickness, in. (mm)	Thickness Tolerances, for the Thickness and Widths Given, Plus and Minus, in. (mm)		
	Width, in. (mm)		
	3/16 (4.76) to 6 (152), incl	Over 6 (152) to 12 (305), incl	Over 12 (305) to 24 (610), excl
	Thickness Tolerances[A]		
0.005 (0.13) to 0.010 (0.25), incl	10 %	10 %	10 %
Over 0.010 (0.25) to 0.011 (0.28), incl	0.0015 (0.04)	0.0015 (0.04)	0.0015 (0.04)
Over 0.011 (0.28) to 0.013 (0.33), incl	0.0015 (0.04)	0.0015 (0.04)	0.002 (0.05)
Over 0.013 (0.33) to 0.017 (0.43), incl	0.0015 (0.04)	0.002 (0.05)	0.002 (0.05)
Over 0.017 (0.43) to 0.020 (0.51), incl	0.0015 (0.04)	0.002 (0.05)	0.0025 (0.06)
Over 0.020 (0.51) to 0.029 (0.74), incl	0.002 (0.05)	0.0025 (0.06)	0.0025 (0.06)
Over 0.029 (0.74) to 0.035 (0.89), incl	0.002 (0.05)	0.003 (0.08)	0.003 (0.08)
Over 0.035 (0.89) to 0.050 (1.27), incl	0.0025 (0.06)	0.0035 (0.09)	0.0035 (0.09)
Over 0.050 (1.27) to 0.069 (1.75), incl	0.003 (0.08)	0.0035 (0.09)	0.0035 (0.09)
Over 0.069 (1.75) to 0.100 (2.54), incl	0.003 (0.08)	0.004 (0.10)	0.005 (0.13)
Over 0.100 (2.54) to 0.125 (2.98), incl	0.004 (0.10)	0.0045 (0.11)	0.005 (0.13)
Over 0.125 (2.98) to 0.161 (4.09), incl	0.0045 (0.11)	0.0045 (0.11)	0.005 (0.13)
Over 0.161 (4.09) to under 3/16 (4.76)	0.005 (0.13)	0.005 (0.13)	0.006 (0.15)

[A] Thickness tolerances given in in. (mm) unless otherwise indicated.

TABLE 11 Permissible Variations in Width for Cold-Rolled Strip in Coils and Cut Lengths for Edge Nos. 1 and 5

Specified Edge No.	Width, in. (mm)	Thickness, in. (mm)	Width Tolerance for Thickness and Width Given, in. (mm)	
			Plus	Minus
1 and 5	3/32 (7.14) and under	1/16 (1.59) and under	0.005 (0.13)	0.005 (0.13)
1 and 5	over 3/32 (7.14) to 3/4 (19.05), incl	3/32 (2.38) and under	0.005 (0.13)	0.005 (0.13)
1 and 5	over 3/4 (19.05) to 5 (127), incl	1/8 (3.18) and under	0.005 (0.13)	0.005 (0.13)
5	over 5 (127.00) to 9 (228.60), incl	1/8 (3.18) to 0.008 (0.20), incl	0.010 (0.25)	0.010 (0.25)
5	over 9 (228.60) to 20 (508.00), incl	0.105 (2.67) to 0.015 (0.38)	0.010 (0.25)	0.010 (0.25)
5	over 20 (508.00)	0.080 (2.03) to 0.023 (0.58)	0.015 (0.38)	0.015 (0.38)

9.1.2 Lots for mechanical testing shall consist of the material from one heat, in the same condition, and of the same nominal thickness.

9.2 *Test Material Selection:*

9.2.1 *Chemical Analysis:*

9.2.1.1 An analysis of each lot shall be made by the manufacturer from a representative sample obtained during the pouring of the heat or subsequent processing.

9.2.1.2 If samples for product (check) analysis are specified, a representative sample shall be taken from each lot (see 9.1.1) of finished material.

9.2.2 *Sampling for Mechanical Properties*—Samples of the material to provide test specimens for mechanical testing shall be taken from such locations in each lot (see 9.1.2) as to be representative of that lot.

10. Number of Tests

10.1 *Chemical Analysis*—One test per lot.

10.2 *Mechanical Tests*—One test per lot.

10.3 *Retests*—If the specimen used in the mechanical test of any lot fails to meet the specified requirements, two additional