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Standard Specification for Nickel-Chromium-Molybdenum-Cobalt-Tungsten-Iron-Silicon Alloy (UNS N06333) Plate, Sheet, and Strip¹

This standard is issued under the fixed designation B718; 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 wrought alloy UNS N06333 plate, sheet, and strip intended for heat resisting applications and general corrosive service.

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 Material Safety Data Sheet (MSDS)(SDS) for this product/material as provided by the manufacturer; to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

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

E8 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 *plate, n*—material $\frac{3}{16}$ in. (4.76 mm) and over in thickness and over 10 in. (254) mm in width.

3.1.2 *sheet, n*—material under $\frac{3}{16}$ in. (4.76 mm) in thickness and 24 in. (610 mm) and over in width.

3.1.3 *strip, n*—material under $\frac{3}{16}$ in. (4.76 mm) in thickness and under 24 in. (610 mm) in width.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for the safe and satisfactory performance of material ordered under this specification. Examples of such requirements include but are not limited to the following:

4.1.1 Alloy name or UNS number.

4.1.2 Quantity.

4.1.3 ASTM Designation and year of issue.

4.1.4 Form (plate, sheet, or strip).

4.1.5 Dimensions—Thickness, Width, and Length.

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.

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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.

4.1.6 Finish (Section 9).

4.1.7 *Certification*—State if certification is required (Section 16).

4.1.8 *Samples for Product (Check) Analysis*—State whether samples shall be furnished.

4.1.9 *Purchaser Inspection*—If a purchaser wishes to witness tests or inspections of material at the place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed.

5. Materials and Manufacture

5.1 All material shall be furnished in the annealed condition.

6. Chemical Requirements

6.1 The material shall conform to the requirements as to chemical composition specified in **Table 1**.

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations in Specification **B880**.

7. Mechanical and Other Requirements

7.1 The mechanical properties of the material at room temperature shall conform to those shown in **Table 2**.

8. Permissible Variations in Dimensions

8.1 *Sheet*, shall conform to the variations in dimensions specified in **Tables 3-5**, inclusive.

8.2 *Cold-Rolled Strip*, shall conform to the permissible variations in dimensions as specified in **Tables 6-10** inclusive.

8.3 *Plate*, shall conform to the permissible variations in dimensions specified in **Tables 11-16**, inclusive.

8.4 *Sheet, Strip, and Plate*—Material with No. 1 finish may be ground to remove surface defects, provided such grinding does not reduce the thickness, width, or length at any point beyond the permissible variations in dimensions.

9. Workmanship, Finish, and Appearance

9.1 The material shall be uniform in quality and temper, smooth, commercially straight, and free from injurious imperfections.

9.2 Available finishes are:

9.2.1 *Sheet*—No. 1 finish; hot rolled, annealed, and descaled, and No. 2 D finish; cold rolled, dull finish.

9.2.2 *Strip*—No. 1 finish; cold rolled, annealed, and descaled.

9.2.3 *Plate*—Hot rolled, annealed, and descaled.

10. Sampling

10.1 *Lot Definitions*:

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

10.1.2 A lot for mechanical properties shall consist of material from one heat of the same condition and nominal thickness.

10.2 *Test-Material Selection*:

10.2.1 *Chemical Analysis*—Representative samples from each lot shall be taken during pouring or subsequent processing.

10.2.1.1 Product (check) analysis shall be wholly the responsibility of the purchaser.

10.2.2 *Mechanical Properties*—Samples of the material to provide test specimens for mechanical properties shall be taken from such locations in each lot as to be representative of that lot.

TABLE 1 Chemical Requirements

Element	Composition Limits, %
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Carbon	0.10 max
Manganese	2.0 max
Phosphorus	0.03
Sulfur	0.03
Silicon	1.5 max
Chromium	24.0–27.0
Nickel	44.0–48.0
Molybdenum	2.5–4.0
Cobalt	2.5–4.0
Tungsten	2.5–4.0
Iron ^A	Remainder

^A Element may be determined arithmetically by difference.

TABLE 2 Mechanical Properties

Condition	Tensile Strength, Min psi (MPa)	Yield Strength, 0.2 % Offset, Min psi (MPa)	Elongation in 2 in. or 50 mm, or 4D, Min %	Hardness ^A
Annealed	80 000 (551)	35 000 (241)	30	75 to 95 HRB

^A Hardness values are informative only and not to be construed as the basis for acceptance.

TABLE 3 Thickness Tolerances for Hot-Rolled and Cold-Rolled Sheets

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

TABLE 4 Width, Length, and Camber Tolerances for Hot-Rolled and Cold-Rolled Sheets Not Resquared Nor Stretcher Levelled

Specified Thickness, in. (mm)	Tolerance for Specified Width, in. (mm)	
	24 to 48-(610 (610 to 1220), excl	48 in. (1220) and over
Less than $\frac{3}{16}$ in. (4.76)	$\frac{1}{16}$ (1.6) over, 0 under	$\frac{1}{8}$ in. (3.2) over, 0 under
Length Tolerances		
Specified Length, ft (cm)	Tolerance, in. (mm)	
	Over	Under
Up to 10 (305), incl	$\frac{1}{4}$ (6.4)	0 (0)
Over 10 to 20 (305 to 610), incl	$\frac{1}{2}$ (12.7)	0 (0)
Camber Tolerances ^A		
Specified Width, in. (mm)	Tolerance per Unit Length of any 8 ft (244 cm), in. (mm)	
24 to 36 in. (610 to 914), incl	$\frac{1}{8}$ (3.2)	
Over 36 in. (914)	$\frac{3}{32}$ (2.4)	

^A Camber is the greatest deviation of a side edge from a straight line, and measurement is taken by placing an 8-ft (2440-mm) straightedge *on the concave side* and measuring the greatest distance between the sheet edge and the straightedge.

11. Number of Tests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Mechanical Properties*—One test per lot.

12. Specimen Preparation

12.1 Tension test specimens shall be taken from material in the final condition (temper). Tests shall be performed transverse to the direction of rolling, where width will permit.

12.1.1 All material shall be tested in full cross-section size when possible.

12.2 Tension-test specimens shall be as follows:

12.2.1 Full thickness of the material, machine to the form and dimensions shown for the sheet-type specimen in Test Methods E8 for material up through $\frac{1}{2}$ in. (12.7 mm) in thickness.

TABLE 5 Flatness Tolerances for Hot-Rolled and Cold-Rolled Sheets

Sheets not Specified to Stretcher Leveled Standard of Flatness		
Specified Thickness, in. (mm)	Width, in. (mm)	Flatness Tolerance (max Deviation from a Horizontal Flat Surface), in. (mm)
0.062 (1.57) and over	To 60 in. (1524), incl	½ (12.7)
	Over 60 to 72 (1524 to 1829), incl	¾ (19.1)
	Over 72 (1829)	1 (25.4)
Under 0.062 (1.57)	To 36 (914), incl	½ (12.7)
	Over 36 to 60 (914 to 1524), incl	¾ (19.1)
	Over 60 (1524)	1 (25.4)

TABLE 6 Thickness Tolerances for Cold-Rolled Strip in Coils and Cut Lengths

NOTE 1—Thickness measurements are taken at least ⅜ inch (9.5 mm) in from edge of the strip, except that on widths less than 1 in. (25.4 mm) the tolerances are applicable for measurements at all locations.

NOTE 2—Above tolerances include crown.

Specified thickness, in. (mm)	Thickness Tolerances, in. (mm), for the Thicknesses and Widths Given, Over and Under		
	Width, in. (mm)		
	⅜ (4.8) to 6 (152), incl	Over 6 (152) to 12 (305), incl	Over 12 (305) to 24 (610), excl
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 (3.18), incl	0.004 (0.10)	0.0045 (0.11)	0.005 (0.13)
Over 0.125 (3.18) to 0.161 (4.09), incl	0.0045 (0.11)	0.0045 (0.11)	0.005 (0.13)
Over 0.161 (4.09) to ⅜ (4.76), excl	0.005 (0.13)	0.005 (0.13)	0.006 (0.15)

TABLE 7 Width Tolerances Cold-Rolled Strip in Coils and Cut Lengths Edge Nos. 1 and 5

Specified Edge No.	Width in., (mm)	Thickness, in. (mm)	Width Tolerance, in. (mm) for Thickness and Width Given Over and Under
1 and 5	⅜ (7.1) and under	⅜ (1.6) and under	0.005 (0.13)
1 and 5	Over ⅜ (7.1) to ¼ (19.1), incl	⅜ (2.4) and under	0.005 (0.13)
1 and 5	Over ¼ (19.1) to 5 (127), incl	⅝ (3.2) and under	0.005 (0.13)
5	Over 5 (127) to 9 (229), incl	⅝ (3.2) to .008 (.20), incl	0.010 (0.25)
5	Over 9 (229) to 20 (508), incl	0.105 (2.67) to 0.015 (0.38), incl	0.010 (0.25)
5	Over 20 (508) to 24 (610), excl	0.080 (2.03) to 0.023 (0.58), incl	0.015 (0.38)

TABLE 8 Width Tolerances Cold-Rolled Strip in Coils and Cut Lengths Edge No. 3

Specific Thickness, in. (mm)	Width Tolerances, in. (mm) Over and Under, for Thickness and Width Given					
	Under ½ (12.7) to ⅜ (4.8)	½ (12.7) to 6 (152)	Over 6 (152) to-9 9 (229)	Over 9 (229) to-12 12 (305)	Over 12 (305) to-20 20 (508)	Over 20 (508) to-24 24 (610)
0.068 (1.73) and under	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)	0.010 (0.25)	0.016 (0.41)	0.020 (0.51)
Over 0.068 (1.73) to 0.099 (2.51), incl	0.008 (0.20)	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)	0.016 (0.41)	0.020 (0.51)
Over 0.099 (2.51) to 0.160 (4.06), incl	0.010 (0.25)	0.010 (0.25)	0.016 (0.41)	0.016 (0.41)	0.020 (0.51)	0.020 (0.51)
Over 0.160 (4.06) to under ⅜ in. (4.76), excl	...	0.016 (0.41)	0.020 (0.51)	0.020 (0.51)	0.031 (0.79)	0.031 (0.79)

12.2.2 The largest possible round specimen shown in Test Methods E8 for material over ½ in. (12.7 mm).

13. Test Methods

13.1 *Chemical Composition*—Test Methods E1473.

13.2 *Tension Test*—Test Methods E8.

13.3 *Rockwell Hardness*—Test Methods E18.