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Standard Specification for Precipitation-Hardening Nickel Alloys Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation B872; 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 rolled precipitation hardenable nickel-iron-chromium-columbium (Nb)-titanium-aluminum alloy (N09908) plate, sheet, and strip in the annealed condition (temper). This alloy is used as sheathing for super conductor cables, as tooling for fabrication of such cables, and for other applications requiring a material with low coefficient-of-expansion properties.

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 and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E8 Test Methods for Tension Testing of Metallic Materials

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

E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

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 The terms given in Table 1 shall apply.

4. Ordering Information

4.1 Orders for material under this specification should include the following information:

4.1.1 *Alloy*—Name or UNS number (see Table 2).

4.1.2 ASTM designation and year of issue.

4.1.3 *Condition*—See 6.1 and Appendix X1.

4.1.4 *Finish*—See Appendix X1.

4.1.5 *Dimensions*—Thickness, width, and length.

4.1.6 Quantity.

4.1.7 *Optional Requirements:*

4.1.7.1 *Sheet and Strip*—Whether to be furnished in coil, in cut straight lengths, or in random straight lengths.

4.1.7.2 *Strip*—Whether to be furnished with commercial slit edge, square edge, or round edge.

4.1.7.3 *Plate*—Whether to be furnished specially flattened (see 7.7); also how plate is to be cut (see 7.2.1 and 7.3.2).

4.1.8 *Fabrication Details*—Not mandatory but helpful to the manufacturer:

4.1.8.1 *Welding or Brazing*—Process to be employed.

4.1.8.2 *Plate*—Whether material is to be hot-formed.

4.1.9 *Certification*—State if certification or a report of test results is required (see Section 15).

4.1.10 *Samples for Product (Check) Analysis*—Whether samples should be furnished (see 5.2).

4.1.11 *Purchaser Inspection*—If the purchaser wishes to witness the tests or inspection of material at the place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed (see Section 13).

5. Chemical Composition

5.1 The material shall conform to the requirements as to chemical composition prescribed in Table 2.

5.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations prescribed in Table 2.

[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.

TABLE 1 Product Description

Product	Thickness, in. (mm)	Width
Hot-rolled plate[A]	3⁄16 to 2¼ (4.8 to 57.2) (Table 4)	Table 6[B] and Table 7
Cold-rolled sheet[C]	0.010 to 0.250 (0.25 to 6.4), incl (Table 5)	Table 8
Cold-rolled strip[C]	0.005 to 0.250 (0.13 to 6.4), incl (Table 5)	Table 8

[A] Material 3⁄16 to ¼ in. (4.8 to 6.4 mm), incl, in thickness may be furnished as sheet or plate provided the material meets the specification requirements for the condition ordered.
[B] Hot-rolled plate, in widths 10 in. (250 mm) and under, may be furnished as hot-finished rectangles with sheared or cut edges provided the mechanical property requirements of this specification are met.
[C] Material under 48 in. (1219 mm) in width may be furnished as sheet or strip provided the material meets the specification requirements for the condition ordered.

6. Mechanical and Other Requirements

6.1 *Tensile Properties*—The material after precipitation hardening shall conform to the tensile properties prescribed in Table 3.

6.2 *Coefficient of Thermal Expansion:*

6.2.1 The mean coefficient of thermal expansion from 77°F (25°C) to 1292°F (700°C) shall not exceed 7.8×10^{-6} in./in./°F (14.0×10^{-6} cm/cm/°C).

6.2.2 The inflection temperature shall not exceed 572°F (300°C).

7. Dimensions and Permissible Variations

7.1 *Thickness and Weight:*

7.1.1 *Plate*—The permissible variation under the specified thickness and permissible excess in overweight shall not exceed the amounts prescribed in Table 4.

7.1.1.1 For use with Table 4, plate shall be assumed to weigh 0.292 lb/in.^{3} (8.08 g/cm^3).

7.1.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Table 5. The thickness of strip and sheet shall be measured with the micrometer spindle 3⁄8 in. (9.5 mm) or more from either edge for material 1 in. (25.4 mm) or over in width and at any place on the strip under 1 in. in width.

7.2 *Width or Diameter:*

7.2.1 *Plate*—The permissible variations in width of rectangular plates and diameter of circular plates shall be as prescribed in Table 6 and Table 7.

7.2.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Table 8.

7.3 *Length:*

7.3.1 Sheet and strip of all sizes may be ordered to cut lengths, in which case a variation of 1⁄8 in. (3.2 mm) over the specified length shall be permitted.

7.3.2 Permissible variations in length of rectangular plate shall be as prescribed in Table 9.

7.4 *Straightness:*

7.4.1 The edgewise curvature (depth of chord) of flat sheet, strip, and plate shall not exceed 0.05 in. multiplied by the length of the product in feet (0.04 mm multiplied by the length of the product in centimetres).

7.4.2 Straightness for coiled strip material is subject to agreement between the manufacturer and the purchaser.

7.5 *Edges:*

7.5.1 When finished edges of strip are specified in the contract or purchase order, the following descriptions shall apply:

7.5.1.1 Square-edge strip shall be supplied with finished edges, with sharp, square corners, and without bevel or rounding.

7.5.1.2 Round-edge strip shall be supplied with finished edges, semicircular in form, and the diameter of the circle forming the edge being equal to the strip thickness.

7.5.1.3 When no description of any required form of strip edge is given, it shall be understood that edges such as those resulting from slitting or shearing will be acceptable.

7.5.1.4 Sheet shall have sheared or slit edges.

7.5.1.5 Plate shall have sheared or cut (machined, abrasive-cut, powder-cut, or inert-arc-cut) edges, as specified.

7.6 *Squareness (Sheet)*—For sheets of all thicknesses, the angle between adjacent sides shall be 90 ± 0.15° (1⁄16 in. in 24 in.) (1.6 mm in 610 mm).

7.7 *Flatness*—Standard flatness tolerances for plate shall conform to the requirements prescribed in Table 10. "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 temper, smooth, commercially straight or flat, and free of injurious imperfections.

9. Sampling

9.1 *Lot*—Definition:

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

9.1.2 A lot for tension testing shall consist of all material from the same heat, nominal thickness, and condition.

9.1.2.1 Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material in the same thickness and condition, except for plates weighing over 500 lb, in which case only one specimen shall be taken.

9.2 *Test Material Selection:*

9.2.1 *Chemical Analysis*—Representative samples shall be taken during pouring or subsequent processing.

9.2.1.1 Product (Check) Analysis shall be wholly the responsibility of the purchaser.

9.2.2 *Tension and Coefficient of Thermal Expansion Testing*—Samples of the material to provide test specimens for tension and coefficient of thermal expansion testing shall be taken from such locations in each lot as to be representative of that lot.

10. Number of Tests

10.1 *Chemical Analysis*—One test per lot.

10.2 *Tension*—One test per lot.

10.3 *Coefficient of Thermal Expansion*—One test per lot.

TABLE 2 Chemical Requirements

Element	Composition Limits, % N09908	Composition Limits, % N09925	Composition Limits, % N07725	Product (Check) Analysis Variations, Under min or Over max, of the Specified Limit of Element
Nickel	47.0 min	42.0 min	55.0 min	0.35
	51.0 max	46.0 max	59.0 max	0.35
Chromium	3.75 min	19.5 min	19.0 min	0.10
	4.5 max	22.5 max	22.5 max	0.10
Iron	remainder[A]	22.0 min	remainder[A]	...
Manganese, max	1.0	1.0	0.35	0.03
Carbon, max	0.03	0.03	0.03	0.01
Copper	...	1.5 min	...	0.03
	0.5 max	3.0 max	...	
Silicon, max	0.5	0.5	0.20	0.03
Sulfur, max	0.005	0.03	0.010	0.003
Aluminum	0.75 min	0.1 min	...	0.10
	1.25 max	0.5 max	0.35 max	0.10
Titanium	1.20 min	1.9 min	1.00 min	0.05
	1.80 max	2.40 max	1.70 max	0.05
Columbium (Nb)	2.7 min	...	2.75 min	0.10
	3.3 max	0.5 max	4.00 max	0.15
Phosphorus	0.015 max	0.03	0.015	0.005
Boron	0.012 max	...	...	0.005
Cobalt	0.5 max	...	...	0.03
Molybdenum	...	2.5 min	7.00 min	0.15
	...	3.5 max	9.50 max	0.15

[A] Iron shall be determined arithmetically by difference.

TABLE 3 Tensile Properties for Plate, Sheet, and Strip[A]

Nominal Thickness, in. (mm)	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % offset), min, ksi (MPa)	Elongation in 2 in. or 50 mm (or 4D), min %
N09908[B]			
Up to 1.0 (25.4), incl	170 (1172)	120 (827)	12
Over 1.0 to 2.25 (25.4 to 57.2), incl	170 (1172)	120 (827)	10
N09925[C]			
Up to 1.0 (25.4), incl	140 (965)	105 (724)	18
Over 1.0 to 2.25 (25.4 to 57.2), incl	140 (965)	105 (724)	18
N07725[D]			
Up to 1.0 (25.4), incl	150 (1034)	120 (827)	20
Over 1.0 to 2.25 (25.4 to 57.2), incl	150 (1034)	120 (827)	20

[A] Material shall be supplied in the annealed condition (temper). The manufacturer shall demonstrate that annealed material is capable of meeting the properties prescribed in Table 3 after precipitation heat treatment.
[B] Precipitation heat treatment for N09908 shall consist of heating to 1292°F (700°C), holding at temperature for 50 h, and then air cooling.
[C] Precipitation heat treatment for N09925 consists of 1365°F (740°C), hold at temperature for 6 to 9 h, furnace cool to 1150°F (621°C), hold until total precipitation heat treatment time has reached 18 h, air cool or faster.
[D] Precipitation heat treatment for N07725 consists of 1350°F (732°C) for 8 h followed by furnace cooling to 1500 to 1200°F (621 to 649°C), holding 8 h, and air cooling.

11. Specimen Preparation

11.1 Tension test specimens shall be taken from material in the annealed condition (temper). The specimen shall be transverse to the direction of rolling when width will permit. The test specimen shall be precipitation heat treated (see Table 3) prior to testing.

11.2 Tension test specimens shall be any of the standard or subsize specimens shown in Test Methods E8.

11.3 In the event of disagreement, referee specimens shall be as follows:

11.3.1 Full thickness of the material machined to the form and dimensions shown for the sheet-type specimen in Test Methods E8 for material under ½ in. (12.7 mm) in thickness.

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

11.4 Coefficient of thermal expansion test specimens may be taken from material in the annealed condition following the final hot rolling, or in the annealed condition following any subsequent cold rolling. The coefficient of thermal expansion test specimens shall be given the age hardening heat treatment prescribed in Table 3 prior to testing.

12. Test Methods

12.1 The chemical composition, mechanical, and other properties of the material as enumerated in this specification shall be determined, in case of disagreement, in accordance with the following methods:

Test	ASTM Designation
Chemical analysis	E1473
Tension	E8
Rounding procedure	E29
Coefficient of Thermal Expansion	E228

12.2 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall

TABLE 4 Permissible Variations in Thickness and Overweight of Rectangular Plates

NOTE 1—All plates shall be ordered to thickness and not to weight per square foot (centimetre). No plates shall vary more than 0.01 in. (0.25 mm) under the thickness ordered, and the overweight of each lot[A] in each shipment shall not exceed the amount in the table. Spot grinding is permitted to remove surface imperfections, such spots not to exceed 0.01 in. (0.25 mm) under the specified thickness.

Specified Thickness, in. (mm)	Permissible Excess in Average Weight[B,C] per Square Foot of Plates for Widths Given in Inches (Millimetres) Expressed in Percentage of Nominal Weights									
	Under 48 (1220)	48 to 60 (1220 to 1520), excl	60 to 72 (1520 to 1830), excl	72 to 84 (1830 to 2130), excl	84 to 96 (2130 to 2440), excl	96 to 108 (2440 to 2740), excl	108 to 120 (2740 to 3050), excl	120 to 132 (3050 to 3350), excl	132 to 144 (3350 to 3660), excl	144 to 160 (3660 to 4070), incl
3/16 to 5/16 (4.8 to 7.9), excl	9.0	10.5	12.0	13.5	15.0	16.5	18.0	...	...	...
5/16 to 3/8 (7.9 to 9.5), excl	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0	...	...
3/8 to 7/16 (9.5 to 11.1), excl	7.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0	19.5
7/16 to 1/2 (11.1 to 12.7), excl	6.0	7.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0
1/2 to 5/8 (12.7 to 15.9), excl	5.0	6.0	7.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5
5/8 to 3/4 (15.9 to 19.1), excl	4.5	5.5	6.0	7.0	7.5	9.0	10.5	12.0	13.5	15.0
3/4 to 1 (19.1 to 25.4), excl	4.0	4.5	5.5	6.0	7.0	7.5	9.0	10.5	12.0	13.5
1 to 2 1/4 (25.4 to 57.2), incl	5.0	5.0	5.5	6.5	7.0	8.0	8.5	10.0	11.5	13.0

[A] The term "lot" applied to this table means all of the plates of each group width and each group thickness.
[B] The permissible overweight for lots of circular and sketch plates shall be 25 % greater than the amounts given in this table.
[C] The weight of individual plates shall not exceed the nominal weight by more than 1 1/4 times the amount given in this table and Table Footnote B.

TABLE 5 Permissible Variations in Thickness of Sheet and Strip

NOTE 1—Permissible variations, plus and minus, in thickness, in. (mm), for widths given in in. (mm).

Specified Thickness, in. (mm)	Sheet			
	Hot-Rolled		Cold-Rolled	
	48 (1220) and Under[A]	Over 48 to 60 (1220 to 1520), incl[A]	48 (1220) and Under[A]	Over 48 to 60 (1220 to 1520), incl[A]
0.018 to 0.025 (0.46 to 0.64), incl	0.003 (0.08)	0.004 (0.10)	0.002 (0.05)	0.003 (0.08)
Over 0.025 to 0.034 (0.64 to 0.86), incl	0.004 (0.10)	0.005 (0.13)	0.003 (0.08)	0.004 (0.10)
Over 0.034 to 0.043 (0.86 to 1.1), incl	0.005 (0.13)	0.006 (0.15)	0.004 (0.10)	0.005 (0.13)
Over 0.043 to 0.056 (1.1 to 1.4), incl	0.005 (0.13)	0.006 (0.15)	0.004 (0.10)	0.005 (0.13)
Over 0.056 to 0.070 (1.4 to 1.8), incl	0.006 (0.15)	0.007 (0.18)	0.005 (0.13)	0.006 (0.15)
Over 0.070 to 0.078 (1.8 to 2.0), incl	0.007 (0.18)	0.008 (0.20)	0.006 (0.15)	0.007 (0.18)
Over 0.078 to 0.093 (2.0 to 2.4), incl	0.008 (0.20)	0.009 (0.23)	0.007 (0.18)	0.008 (0.20)
Over 0.093 to 0.109 (2.4 to 2.8), incl	0.009 (0.23)	0.010 (0.25)	0.007 (0.18)	0.009 (0.23)
Over 0.109 to 0.125 (2.8 to 3.2), incl	0.010 (0.25)	0.012 (0.31)	0.008 (0.20)	0.010 (0.25)
Over 0.125 to 0.140 (3.2 to 3.6), incl	0.012 (0.31)	0.014 (0.36)	0.008 (0.20)	0.010 (0.25)
Over 0.140 to 0.171 (3.6 to 4.3), incl	0.014 (0.36)	0.016 (0.41)	0.009 (0.23)	0.012 (0.31)
Over 0.171 to 0.187 (4.3 to 4.8), incl	0.015 (0.38)	0.017 (0.43)	0.010 (0.25)	0.013 (0.33)
Over 0.187 to 0.218 (4.8 to 5.5), incl	0.017 (0.43)	0.019 (0.48)	0.011 (0.28)	0.015 (0.38)
Over 0.218 to 0.234 (5.5 to 5.9), incl	0.018 (0.46)	0.020 (0.51)	0.012 (0.31)	0.016 (0.41)
Over 0.234 to 0.250 (5.9 to 6.4), incl	0.020 (0.51)	0.022 (0.56)	0.013 (0.33)	0.018 (0.46)

Cold-Rolled Strip	
Specified Thickness, in. (mm)	Widths 12 in. (305 mm) and Under, ±[A]
Up to 0.050 (1.3), incl	0.0015 (0.04)
Over 0.050 to 0.093 (1.3 to 2.4), incl	0.0025 (0.06)
Over 0.093 to 0.125 (2.4 to 3.2), incl[B]	0.004 (0.11)

[A] Measured 3/8 in. (9.5 mm) or more from either edge except for strip under 1 in. (25.4 mm) in width, which is measured at any place.
[B] Standard sheet tolerances apply for thicknesses over 0.125 in. (3.2 mm) and for all thicknesses of strip over 12 in. (305 mm) wide.

be rounded as indicated in accordance with the rounding method of Practice E29.

Test	Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances (when expressed in decimals)	nearest unit in the last right-hand place of figures of the specified limit If two choices are possible, as when the digits are dropped are exactly a 5, or a 5 followed only by zeros, choose the one ending in an even digit, with zero defined as an even digit.
Tensile strength and yield strength	nearest 1000 psi (6.9 MPa)
Elongation	nearest 1 %
Rupture life	nearest 1 h

13. Inspection

13.1 Inspection of the material shall be agreed upon between the manufacturer and the purchaser as part of the purchase contract.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

TABLE 6 Permissible Variations in Width[A] of Sheared, Plasma-Torch-Cut, and Abrasive-Cut Rectangular Plate[B,C]

Specified Thickness	Permissible Variations in Widths for Widths Given, in. (mm)									
	Up to 30 (760), incl		Over 30 to 72 (760 to 1830), incl		Over 72 to 108 (1830 to 2740), incl		Over 108 to 144 (2740 to 3660), incl		Over 144 to 160 (3660 to 4070), incl	
	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
Inches										
Sheared:[D]										
3/16 to 5/16, excl	3/16	1/8	1/4	1/8	3/8	1/8	1/2	1/8	...	...
5/16 to 1/2, excl	1/4	1/8	3/8	1/8	3/8	1/8	1/2	1/8	5/8	1/8
1/2 to 3/4, excl	3/8	1/8	3/8	1/8	1/2	1/8	5/8	1/8	3/4	1/8
3/4 to 1, excl	1/2	1/8	1/2	1/8	5/8	1/8	3/4	1/8	7/8	1/8
1 to 1 1/4, incl	5/8	1/8	5/8	1/8	3/4	1/8	7/8	1/8	1	1/8
Abrasive-cut:[E, F]										
3/16 to 1 1/4, incl	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
over 1 1/4 to 2 1/4 , incl	3/16	1/8	3/16	1/8	3/16	1/8	3/16	1/8	3/16	1/8
Plasma-torch-cut:[G]										
3/16 to 1 1/2, excl	3/4	0	3/4	0	3/4	0	3/4	0	3/4	0
1 1/2 to 2 1/4, incl	1	1/4	1	1/4	1	1/4	1	1/4	1	1/4
Millimetres										
Sheared:[D]										
4.8 to 7.9, excl	4.8	3.2	6.4	3.2	9.5	3.2	12.7	3.2	...	...
7.9 to 12.7, excl	6.4	3.2	9.5	3.2	9.5	3.2	12.7	3.2	15.9	3.2
12.7 to 19.0, excl	9.5	3.2	9.5	3.2	12.7	3.2	15.9	3.2	19.0	3.2
19.0 to 25.4, excl	12.7	3.2	12.7	3.2	15.9	3.2	19.0	3.2	22.2	3.2
25.4 to 31.8, incl	15.9	3.2	15.9	3.2	19.0	3.2	22.2	3.2	25.4	3.2
Abrasive-cut:[E, F]										
4.8 to 31.8, incl	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
over 31.8 to 57.2, incl	4.8	3.2	4.8	3.2	4.8	3.2	4.8	3.2	4.8	3.2
Plasma-torch-cut:[G]										
4.8 to 38.1, excl	19.0	0	19.0	0	19.0	0	19.0	0	19.0	0
38.1 to 57.2, incl	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4

[A] Permissible variations in width for powder or inert-arc-cut plate shall be as agreed upon between the manufacturer and the purchaser.
[B] Permissible variations in machined, powder, or inert-arc-cut circular plate shall be as agreed upon between the manufacturer and the purchaser.
[C] Permissible variations in plasma-torch-cut sketch plates shall be as agreed upon between the manufacturer and the purchaser.
[D] The minimum sheared width is 10 in. (254 mm) for material 3/4 in. (19.0 mm) and under in thickness and 20 in. (508 mm) for material over 3/4 in. in thickness.
[E] The minimum abrasive-cut width is 2 in. (51 mm) and increases to 4 in. (102 mm) for thicker plates.
[F] These tolerances are applicable to lengths of 240 in. (6100 mm) max. For lengths over 240 in., an additional 1/16 in. (1.6 mm) is permitted, both plus and minus.
[G] The tolerance spread shown for plasma-torch cutting may be obtained all on the minus side, or divided between the plus and minus side if so specified by the purchaser.

TABLE 7 Permissible Variations in Diameter for Circular Plates

Sheared Plate	
Specified Diameter, in. (mm)	Permissible Variations Over Specified Diameter for Thickness Given, in. (mm)[A]
	To 3/8 (9.5), incl
20 to 32 (508 to 813), excl	1/4 (6.4)
32 to 84 (813 to 2130), excl	5/16 (7.9)
84 to 108 (2130 to 2740), excl	3/8 (9.5)
108 to 140 (2740 to 3560), incl	7/16 (11.1)

Plasma-Torch-Cut Plate[B]					
Specified Diameter, in. (mm)	Permissible Variations in Specified Diameter for Thickness Given, in. (mm)[C]				
	Thickness, max, in. (mm)	3/16 to 1 1/2 (4.8 to 38.1), excl		1 1/2 to 2 1/4 (38.1 to 57.2), incl	
		Plus	Minus	Plus	Minus
19 to 20 (483 to 508), excl	2 1/4 (57.2)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
20 to 22 (508 to 559), excl	2 1/4 (57.2)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
22 to 24 (559 to 610), excl	2 1/4 (57.2)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
24 to 28 (610 to 711), excl	2 1/4 (57.2)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
28 to 32 (711 to 812), excl	2 (50.8)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
32 to 34 (812 to 864), excl	1 3/4 (44.5)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
34 to 38 (864 to 965), excl	1 1/2 (38.1)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
38 to 40 (965 to 1020), excl	1 1/4 (31.8)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)
40 to 140 (1020 to 3560), incl	2 1/4 (57.2)	3/4 (19.0)	0	1 (25.4)	1/4 (6.4)

[A] No permissible variations under.
[B] Permissible variations in plasma-torch-cut sketch plates shall be as agreed upon between the manufacturer and the purchaser.
[C] The tolerance spread shown may also be obtained all on the minus side or divided between the plus and minus sides if so specified by the purchaser.

15. Certification

15.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser stating that the material has been manufactured, tested, and inspected in accordance with this specification, and that the test

TABLE 8 Permissible Variations in Width of Sheet and Strip

Specified Thickness, in. (mm)	Specified Width, in. (mm)	Permissible Variations in Specified Width, in. (mm)	
		Plus	Minus
	Sheet		
Up to 0.250 (6.4)	all	0.125 (3.2)	0
	Strip[A]		
Under 0.075 (1.9)	Up to 12 (305), incl	0.007 (0.18)	0.007 (0.18)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0
0.075 to 0.100 (1.9 to 2.5), incl	Up to 12 (305), incl	0.009 (0.23)	0.009 (0.23)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0
Over 0.100 to 0.125 (2.5 to 3.2), incl	Up to 12 (305), incl	0.012 (0.30)	0.012 (0.30)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0
Over 0.125 to 0.160 (3.2 to 4.1), incl	Up to 12 (305), incl	0.016 (0.41)	0.016 (0.41)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0
Over 0.160 to 0.187 (4.1 to 4.7), incl	Up to 12 (305), incl	0.020 (0.51)	0.020 (0.51)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0
Over 0.187 to 0.250 (4.7 to 6.4), incl	Up to 12 (305), incl	0.062 (1.6)	0.062 (1.6)
	Over 12 to 48 (305 to 1219), incl	0.062 (1.6)	0.062 (1.6)

[A] Rolled or round square-edge strip in thicknesses of 0.071 to 0.125 in. (1.8 to 3.2 mm), incl, in widths 3 in. (76.2 mm) and under, shall have permissible width variations of ±0.005 in. (±0.130 mm). Permissible variations for other sizes shall be as agreed upon between the manufacturer and the purchaser.

TABLE 9 Permissible Variations in Length[A] of Sheared, Plasma-Torch-Cut,[B] and Abrasive-Cut Rectangular Plate[C]

Specified Thickness	Permissible Variation in Length or Lengths Given, in. (mm)															
	Up to 60 (1520), incl		Over 60 to 96 (1520 to 2440), incl		Over 96 to 120 (2440 to 3050), incl		Over 120 to 240 (3050 to 6096), incl		Over 240 to 360 (6096 to 9144), incl		Over 360 to 450 (9144 to 11 430), incl		Over 450 to 540 (11 430 to 13 716), incl		Over 540 (13 716)	
	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
							Inches									
Sheared:[D]																
3/16 to 5/16, excl	3/16	1/8	1/4	1/8	3/8	1/8	1/2	1/8	5/8	1/8	3/4	1/8	7/8	1/8	...	...
5/16 to 1/2, excl	3/8	1/8	1/2	1/8	1/2	1/8	1/2	1/8	5/8	1/8	3/4	1/8	7/8	1/8	1	1/8
1/2 to 3/4, excl	1/2	1/8	1/2	1/8	5/8	1/8	5/8	1/8	3/4	1/8	7/8	1/8	1 1/8	1/8	1 3/8	1/8
3/4 to 1, excl	5/8	1/8	5/8	1/8	5/8	1/8	3/4	1/8	7/8	1/8	1 1/8	1/8	1 3/8	1/8	1 5/8	1/8
1 to 1 1/4, incl	3/4	1/8	3/4	1/8	3/4	1/8	7/8	1/8	1 1/8	1/8	1 3/8	1/8	1 5/8	1/8	...	...
Abrasive-cut:[E]																
3/16 to 1 1/4, incl	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	...	...	...	...
over 1 1/4 to 2 1/4 , incl	3/16	1/8	3/16	1/8	3/16	1/8	3/16	1/8	3/16	1/8	3/16	1/8	...	...	...	...
Plasma-torch-cut:[E]																
3/16 to 1 1/2, excl	3/4	0	3/4	0	3/4	0	3/4	0	3/4	0	3/4	0	3/4	0	3/4	0
1 1/2 to 2 1/4, incl	1	1/4	1	1/4	1	1/4	1	1/4	1	1/4	1	1/4	1	1/4	1	1/4
							Millimetres									
Sheared:[D]																
4.8 to 7.9, excl	4.8	3.2	6.4	3.2	9.5	3.2	12.7	3.2	15.9	3.2	19.0	3.2	22.2	3.2	...	...
7.9 to 12.7, excl	9.5	3.2	12.7	3.2	12.7	3.2	12.7	3.2	15.9	3.2	19.0	3.2	22.2	3.2	25.4	3.2
12.7 to 19.0, excl	12.7	3.2	12.7	3.2	15.9	3.2	15.9	3.2	19.0	3.2	22.2	3.2	28.6	3.2	34.9	3.2
19.0 to 25.4, excl	15.9	3.2	15.9	3.2	15.9	3.2	19.0	3.2	22.2	3.2	28.6	3.2	34.9	3.2	41.2	3.2
25.4 to 31.8, incl	19.0	3.2	19.0	3.2	19.0	3.2	22.2	3.2	28.6	3.2	34.9	3.2	41.2	3.2	...	...
Abrasive-cut:[E]																
4.8 to 31.8, incl	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	...	...	...	...
over 31.8 to 57.2, incl	4.8	3.2	4.8	3.2	4.8	3.2	4.8	3.2	4.8	3.2	4.8	3.2	...	...	...	...
Plasma-torch-cut:[F]																
4.8 to 38.1, excl	19.0	0	19.0	0	19.0	0	19.0	0	19.0	0	19.0	0	19.0	0	19.0	0
38.1 to 57.2, incl	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4

[A] Permissible variations in length for power- or inert-arc-cut plate shall be as agreed upon between the manufacturer and the purchaser.
[B] The tolerance spread shown for plasma-torch cutting may be obtained all on the minus side or divided between the plus and minus sides if so specified by the purchaser.
[C] Permissible variations in machined, powder-, or inert-arc-cut circular plate shall be as agreed upon between the manufacturer and the purchaser.
[D] The minimum sheared length is 10 in. (254 mm).
[E] Abrasive cut applicable to a maximum length of 144 to 400 in. (3658 to 10 160 mm) depending on the thickness and width ordered.
[F] The tolerance spread shown for plasma-torch-cut sketch plate shall be as agreed upon between the manufacturer and the purchaser.

results on representative samples meet specification requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

16. Product Marking

16.1 Each plate, sheet, or strip shall be marked on one face with the specification number, alloy, condition (temper), heat number, manufacturer's identification, and size. The markings shall not have a deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

TABLE 10 Permissible Variations from Flatness of Rectangular, Circular, and Sketch Plates

NOTE 1—Permissible variations apply to plates up to 12 ft (3.66 m) in length, or to any 12 ft of longer plates.

NOTE 2—If the longer dimension is under 36 in. (914 mm) the permissible variation is not greater than ¼ in. (6.4 mm).

NOTE 3—The shorter dimension specified is considered the width, and the permissible variation in flatness across the width does not exceed the tabular amount for that dimension.

NOTE 4—The maximum deviation from a flat surface does not customarily exceed the tabular tolerance for the longer dimension specified.

Specified Thickness	Permissible Variations from a Flat Surface for Thickness and Widths Given, in. (mm)								
	To 48 (1220), excl	48 to 60 (1220 to 1520), excl	60 to 72 (1520 to 1830), excl	72 to 84 (1830 to 2130), excl	84 to 96 (2130 to 2440), excl	96 to 108 (2440 to 2740), excl	108 to 120 (2740 to 3050), excl	120 to 144 (3050 to 3660), excl	144 (3660) and over
				Inches					
3/16 to ¼, excl	¾	1 11/16	1¼	1⅜	1⅝	1⅝	...	...	...
¼ to ⅜, excl	11/16	¾	15/16	1⅛	1⅜	1 7/16	1 9/16	1⅞	...
⅜ to ½, excl	½	9/16	11/16	¾	15/16	1⅛	1¼	1 7/16	1¾
½ to ¾, excl	½	9/16	⅝	⅝	13/16	1⅛	1⅛	1⅛	1⅜
¾ to 1, excl	½	9/16	⅝	⅝	¾	13/16	15/16	1	1⅛
1 to 2, excl	½	9/16	9/16	9/16	11/16	11/16	11/16	¾	1
2 to 2¼ , incl	¼	5/16	⅜	7/16	½	9/16	⅝	¾	⅞
				Millimetres					
4.8 to 6.4, excl	19.1	27.0	31.7	34.9	41.3	41.3	...	...	...
6.4 to 9.5, excl	17.5	19.1	23.8	28.6	35.0	36.5	39.7	47.6	...
9.5 to 12.7, excl	12.7	14.3	17.5	19.1	23.8	28.6	31.7	35.0	44.4
12.7 to 19.1, excl	12.7	14.3	15.9	15.9	20.6	28.6	28.6	28.6	34.9
19.1 to 25.4, excl	12.7	14.3	15.9	15.9	19.1	20.6	23.8	25.4	28.6
25.4 to 50.8, excl	12.7	14.3	14.3	14.3	17.5	17.5	17.5	19.1	25.4
50.8 to 57.2, incl	6.4	7.9	9.5	11.1	12.7	14.3	15.9	19.1	22.2

16.2 When applicable, each bundle or shipping container shall be marked with the name of the material, condition (temper), this specification number, alloy, size, consignor and consignee address, contract or order number, and such other information as may be defined in the contract or order.

17. Keywords

17.1 plate; sheet; strip; UNS N07725; UNS N09908; UNS N09925

APPENDIX

(Nonmandatory Information)

X1. CONDITIONS AND FINISHES NORMALLY SUPPLIED

X1.1 This appendix lists the conditions and finishes in which plate, sheet, and strip are normally supplied.

X1.1.1 *Plate*—Hot-rolled, annealed, and descaled.

X1.1.2 *Sheet*—Cold-rolled, annealed, descaled, or bright annealed.

X1.1.3 *Strip*—Cold-rolled, annealed, descaled, or bright annealed.