~~Designation:B670–02~~ Designation: B 670 – 07

Standard Specification for Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service[1]

This standard is issued under the fixed designation B 670; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers rolled precipitation hardenable nickel alloy (N07718)* plate, sheet, and strip in the annealed condition (temper).

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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) 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]

B 637 Specification for Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service

~~B880Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys~~

906 Specification for General Requirements for Flat-Rolled Nickel and Nickel Alloys Plate, Sheet, and Strip

~~E8Test Methods for Tension Testing of Metallic Materials~~

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

E 139~~Test Methods for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials~~[4]

~~E354Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys~~[3]

~~E1473Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys~~ [3] Test Methods for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

3. Terminology

3.1 *Description of Terms Specific to This Standard*—The terms given in Table 1 shall apply.

4. ~~Ordering Information~~

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

~~4.1.1~~*General Requirements*

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification B 906 unless otherwise provided herein.

5. Ordering Information

5.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered to this specification. Examples of such requirements include, but are not limited to, the following:

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[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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* New designation established in accordance with ASTM E 527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

[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* ~~, Vol 02.04.~~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 5)~~	~~Tables 7 [B] and 8~~
Hot-rolled plate[A]	3/16 to 2¼ (4.8 to 57.2) (B 906, Table A3.1)	B 906, Tables A3.2 and A3.5[B]
~~Cold-rolled sheet[C]~~	~~0.010 to 0.250 (0.25 to 6.4), incl (Table 6)~~	~~Table 9~~
Cold-rolled sheet[C]	0.010 to 0.250 (0.25 to 6.4), incl (, Table A3.3)	B 906 , Table A3.6
	~~0.005 to 0.250 (0.13 to 6.4), incl (Table 6)~~	
	0.005 to 0.250 (0.13 to 6.4), incl (, Table A3.3)	
~~Cold-rolled strip[C]~~		~~Table 9~~
Cold-rolled strip[C]	...	B 906, Table A3.6

[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 in accordance with Specification B 637, UNS N07718, 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.

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

~~4~~5.1.2 ASTM designation, including year of issue.

~~4.1.3~~5.1.3 *Condition*~~—See 6.1~~ —See 7.1 and Appendix X1.

~~4.1.4~~

5.1.4 *Finish*~~—~~—Specification B 906 or Appendix X1.

~~4.1.5~~

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

~~4.1.6~~

5.1.6 *Quantity*:

~~4.1.7~~

5.1.7 *Optional Requirements*:

~~4.1.7.1~~

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

~~4.1.7.2~~5.1.7.2 *Strip*—Whether to be furnished with commercial slit edge, square edge, or round edge.

~~4.1.7.3~~

5.1.7.3 *Plate*—Whether to be furnished specially flattened (see ~~7.7.1);~~8.7); also how plate is to be cut (see ~~7.2.1~~8.2.1 and ~~7.3.2~~8.3.2).

~~4.1.8~~

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

~~4.1.8.1~~

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

~~4.1.8.2~~

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

~~4.1.9~~

5.1.9 *Certification*—State if certification or a report of test results is required (see ~~Section~~ Specification B 906~~15~~).

~~4.1.10~~

5.1.10 *Samples for Product (Check) Analysis*—Whether samples should be furnished (see ~~5.2~~6.2).

~~4.1.11~~

5.1.11 *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~~ Specification B 906~~13~~).

~~5.~~6. Chemical Composition

~~5.1 The~~6.1 The material shall conform to the requirements as to chemical composition prescribed in Table 2.

~~5.2~~6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations prescribed in Specification ~~B880~~B 906.

~~6. Mechanical and Other Requirements~~

~~6.1~~

TABLE 7 2 Permissible Variations in Width[A] of Sheared, Plasma-Torch-Cut, and Abrasive-Cut Rectangular Plate[B,C]

Specified Thickness									
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 1 (3660 to 4070), incl	
Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
Element	Compos	Plus	Minus	Plus	Mtion	Plus	Minus	Plus	Minus
				Inches					
				Inches,%					
Sheared:[D]									
Carbon	0.08 max								
3⁄16 to 5⁄16 , excl	...	...							
Manganese	0.35 max								
5⁄16 to 1⁄2 , excl									
Silicon	0.35 max								
1⁄2 to , excl									
Phosphorus	0.015 max								
3⁄4 to 1, excl									
Sulfur	0.015 max								
1 to 1¼ , incl	1								
Chromium	17.0 to 21.0								
Abrasive-cut:[E,F]									
Cobalt[A]	1.0 max								
3⁄16 to 1¼ , incl									
Molybdenum	2.80 to 3.30								
over 1¼ to 2¼ , incl									
Columbium (Nb) + tantalum	4.75 to 5.50								
Plasma-torch-cut:[G]									
Titanium	0.65 to 1.15								
3⁄16 to 1½ , excl	00 00	3⁄4	0						
Aluminum	0.20 to 00	3⁄4	.80						
1½ to 2¼ , incl	1	1⁄4	1	1⁄4	1	1⁄4	1	1⁄4	1
Ironel	1	1⁄4	1	1⁄4	1	1⁄4	1	1⁄4	1
				Millimetres					
Sheared:[D]									
Sheared:[B]	remainder								
4.8 to 7.9,excl	4.8	3.2	6.4	3.2	9.5	3.2	12.7	3.2	...
Copper	0.8	3.2	6.4	3.2	9.5	3.2	12.7	3.2	...
7.9 to 12.7, excl	6.4	3.2	9.53.2	9. 53.2	12.7	3.2	15.9	3.2	
Nickel	6.4	3.2	9.50.2	9.0 to 53.2	12.7	3.2	15.9	3.20	
12.7 to 19.0, excl	9.5	3.2	9.5	3.2	12.7	3.2	15.9	3.2	19.0
Boron	9.5	3.2	9.5	3.2	12.7	3.2	15.9	3.2	19.0
19.0 to 25.4, excl	12.7	3.2	12.7	3.2	15.9	3.2	19.03.2	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
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
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
Plas ma-torch-cut:[G]									
Plas6 ma-torch-cut:[G]									
4.8 to 38.1, excl	19.0	0	19.0	0	19.0	0	19.0	0	19.0
38.1 to 57.2, incl	25.4	6.4	25.4	6.4	25.4	6.4	25.4	6.4	25.4

[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.

7. Mechanical and Other Requirements

7.1 *Tensile Properties*—The material after precipitation hardening shall conform to the tensile properties prescribed in Table 3.
6.2

7.2 *Stress-Rupture Properties*—The material after precipitation hardening shall conform to the stress-rupture properties prescribed in Table 4.

TABLE 2 3 Chemical Composition[A]

ENominal Thickneмess, int. (mm)	CompoTensile Strength mien,%
C	0.08 max
arbon	
C	Yield Strength
ksi (MPa)	(0.2 % offset),
	max
Manganese	0.3 5 max
Main, ksi	Elongation in 2
(MPa)	in. or 50 mm
	(or 4*D*),
	min, %
Silicon	0.35 max
N07718	0.35 max
Phosphorus	0.015 max
Sulfur	0.015 max
Sulfur	
Chrom ium	17.0 to21.0
Up to 1.0 (25.4), incl	180 (1241.0
Cobalt[A]	1.0 max
Cobalt[A])	150 max
Molybdenum	2.80 to 3.30
Molybdenum (1034)	12
Columbium (Nb) + tantalum	4.75 to 5.50
	4.75 to 5.50
Titanium	0.65 to 1.15
Aluminum	0.20 to 0.80
Aluminum	
IronB	remainder
Over 1.0 to 2.25	remainder
(25.4 to 57.2), incl	
Copper	0.30 max
Copper180 (1241)	150 (10 max
Nickel	50.0 to 55.0
Nickel34)	10.0 to 55.0
Boron	0.006 max

[A] If de Matermial shall be supplied in the annealed condition (temper). B I The manufacturer shall demonstrate that anneall bede material is capable of meeting the properties prescribed in Table 3 after precipitation heat treatmenti. For UNS N07718, precipitation heat treatment shall by d consist of heating to 1325 ± 25°F (718 ± 14°C), hold at temperature for 8 h, furnace cool to 1150 ± 25°F (621 ± 14°C), hold until total precipitation heat treatment time has reached 18 h, and then air cool.

7.Dimensions and Permissible Variations

7.1

8. Dimensions and Permissible Variations

8.1 *Thickness and Weight*:

7.1.1

8.1.1 *Plate*—The permissible variation under the specified thickness and permissible excess in overweight shall not exceed the amounts prescribed in Table 5Specification B 906. , Table A3.1.

78.1.1.1 For use with Table 5Specification B 906, Table A3.1, , plate shall be assumed to weigh 0.296 lb/in.^{3}(8.19 g/cm^3).

7.1.2

8.1.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Table 6Specification B 906. , Table A3.3. The thickness of strip and sheet shall be measured with the micrometer spindle ⅜ 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.

7.28.2 *Width or Diameter*:

7.2.1

8.2.1 *Plate*—The permissible variations in width of rectangular plates and diameter of circular plates shall be as prescribed in Table 7Specification B 906, Table A3.4 and Table 8. Table A3.5.

7.2.28.2.2 *Sheet and Strip*— The permissible variations in width for sheet and strip shall be as prescribed in Table 9.

7.3—*The permissible variations in width for sheet and strip shall be as prescribed in Specification B 906, Table A3.6.*

8.3 *Length*:

78.3.1 Sheet and strip of all sizes may be ordered to cut lengths, in which case a variation of ⅛ in. (3.2 mm) over the specified length shall be permitted.

7.3.2Permissible variations in length of rectangular plate shall be as prescribed in Table 10.