



Designation: B670 – 07 (Reapproved 2018)



www.dlsspipeline.com

info@dlsspipe.com

Standard Specification for Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service¹

This standard is issued under the fixed designation B670; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers rolled precipitation hardenable nickel alloy (N07718)² plate, sheet, and strip in the annealed condition (temper).

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

B637 Specification for Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High Temperature Service

B906 Specification for General Requirements for Flat-

Roller Nickel and Nickel Alloys Plate, Sheet, and Strip
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E139 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. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification **B906** 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:

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

5.1.2 *ASTM designation*, including year of issue.

5.1.3 *Condition*—See **7.1** and **Appendix X1**.

5.1.4 *Finish*—Specification **B906** or **Appendix X1**.

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

5.1.6 *Quantity*:

5.1.7 *Optional Requirements*:

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

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

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

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

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

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

5.1.9 *Certification*—State if certification or a report of test results is required (see Specification **B906**).

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

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.

Current edition approved Nov. 1, 2018. Published November 2018. Originally approved in 1972. Last previous edition approved in 2013 as B670 – 07 (2013). DOI: 10.1520/B0670-07R18.

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.



TABLE 1 Product Description

Product	Thickness, in. (mm)	Width
Hot-rolled plate ^A	3/16 to 2 1/4 (4.8 to 57.2) (B906, Table A3.1)	B906, Tables A3.2 and A3.5 ^B
Cold-rolled sheet ^C	0.010 to 0.250 (0.25 to 6.4), incl (B906, Table A3.3) 0.005 to 0.250 (0.13 to 6.4), incl (B906, Table A3.3)	B906, Table A3.6
Cold-rolled strip ^C	...	B906, Table A3.6

^A Material 3/16 to 1/4 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 B637, 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.

TABLE 2 Chemical Composition

Element	Composition, %
Carbon	0.08 max
Manganese	0.35 max
Silicon	0.35 max
Phosphorus	0.015 max
Sulfur	0.015 max
Chromium	17.0 to 21.0
Cobalt ^A	1.0 max
Molybdenum	2.80 to 3.30
Columbium (Nb) + tantalum	4.75 to 5.50
Titanium	0.65 to 1.15
Aluminum	0.20 to 0.80
Iron ^B	remainder
Copper	0.30 max
Nickel	50.0 to 55.0
Boron	0.006 max

^A If determined.

^B Iron shall be determined arithmetically by difference.

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 Specification B906).

6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition prescribed in Table 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 B906.

7. Mechanical and Other Requirements

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

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

8. Dimensions and Permissible Variations

8.1 Thickness and Weight:

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, %
N07718			
Up to 1.0 (25.4), incl	180 (1241)	150 (1034)	12
Over 1.0 to 2.25 (25.4 to 57.2), incl	180 (1241)	150 (1034)	10

^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. For UNS N07718, precipitation heat treatment shall 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.

TABLE 4 Stress-Rupture Test at 1200°F (649°C) for Plate, Sheet, and Strip^A

Nominal Thickness, in. (mm)	Stress, ^B ksi (MPa)	Life, min, h	Elongation in 2 in. or 50 mm (or 4D), min, %
N07718			
Up to 0.015 (0.38), incl	95 (655)	23	...
Over 0.015 to 0.025 (0.38 to 0.64), incl	95 (655)	23	4
Over 0.025 to 1.5 (0.64 to 38.1), incl	100 (690)	23	4

^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 4 after precipitation heat treatment. Precipitation heat treatment is as specified in footnote A of Table 3.

^B Testing may be conducted at a stress higher than that specified but stress shall not be changed while test is in process. Time to rupture and elongation requirements shall be as specified in Table 4.

Testing may also be conducted using incremental loading. In such case, the stress specified in Table 4 shall be maintained to rupture or for 48 h, whichever occurs first. After the 48 h and at intervals of 8 to 16 h, preferably 8 to 10 h, thereafter, the stress shall be increased in increments of 5000 psi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in Table 4.

8.1.1 *Plate*—The permissible variation under the specified thickness and permissible excess in overweight shall not exceed the amounts prescribed in Specification B906, Table A3.1.

8.1.1.1 For use with Specification B906, Table A3.1, , plate shall be assumed to weigh 0.296 lb/in.³ (8.19 g/cm³).

8.1.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Specification B906, Table A3.3. 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.

8.2 Width or Diameter:

8.2.1 *Plate*—The permissible variations in width of rectangular plates and diameter of circular plates shall be as prescribed in Specification B906, Table A3.4 and Table A3.5.

8.2.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Specification B906, Table A3.6.

8.3 Length:

8.3.1 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.



8.3.2 Permissible variations in length of rectangular plate shall be as prescribed in Specification B906, Table A3.7.

8.4 Straightness:

8.4.1 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).

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

8.5 Edges:

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

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

8.5.1.2 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.

8.5.1.3 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.

8.5.1.4 Sheet shall have sheared or slit edges.

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

8.6 *Squareness (Sheet)*—For sheets of all thicknesses, the angle between adjacent sides shall be $90 \pm 0.15^\circ$ ($1/16$ in. in 24 in.) (1.6 mm in 610 mm).

8.7 *Flatness*—Standard flatness tolerances for plate shall conform to the requirements prescribed in Table 5. “Specially

flattened” plate when so specified, shall have permissible variations in flatness as agreed upon between the manufacturer and the purchaser.

9. Sampling

9.1 Lot—Definition:

9.1.1 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.

10. Number of Tests

10.1 *Stress Rupture*—One test per lot.

11. Specimen Preparation

11.1 Stress-rupture specimens shall be the same as tension specimens except modified as necessary for stress-rupture testing in accordance with Test Methods E139.

12. Test Methods

12.1 The stress rupture 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

Stress rupture E139

12.2 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table and this specification, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Recommended Practice E29 referenced in Specification B906.

TABLE 5 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. If the longer dimension is under 36 in. (914 mm) the permissible variation is not greater than $1/4$ in. (6.4 mm).

NOTE 2—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 3—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 $1/4$, excl	$3/4$	$1 1/16$	$1 1/4$	$1 3/8$	$1 5/8$	$1 5/8$	...	...	...
$1/4$ to $3/8$, excl	$1 1/16$	$3/4$	$1 5/16$	$1 1/8$	$1 3/8$	$1 7/16$	$1 9/16$	$1 7/8$	...
$3/8$ to $1/2$, excl	$1/2$	$9/16$	$1 1/16$	$3/4$	$1 5/16$	$1 1/8$	$1 1/4$	$1 7/16$	$1 3/4$
$1/2$ to $3/4$, excl	$1/2$	$9/16$	$5/8$	$5/8$	$1 3/16$	$1 1/8$	$1 1/8$	$1 1/8$	$1 3/8$
$3/4$ to 1, excl	$1/2$	$9/16$	$5/8$	$5/8$	$3/4$	$1 3/16$	$1 5/16$	1	$1 1/8$
1 to 2, excl	$1/2$	$9/16$	$9/16$	$9/16$	$1 1/16$	$1 1/16$	$1 1/16$	$3/4$	1
2 to $2 1/4$, incl	$1/4$	$5/16$	$3/8$	$7/16$	$1/2$	$9/16$	$5/8$	$3/4$	$7/8$
Millimetres									
4.8 to 6.4, excl	19.0	27.0	31.8	34.9	41.3	41.3	...	...	...
6.4 to 9.5, excl	17.5	19.0	23.8	28.6	34.9	36.5	39.7	47.6	...
9.5 to 12.7, excl	12.7	14.3	17.5	19.0	23.8	28.6	31.8	36.5	44.4
12.7 to 19.0, excl	12.7	14.3	15.9	15.9	20.6	28.6	28.6	28.6	34.9
19.0 to 25.4, excl	12.7	14.3	15.9	15.9	19.0	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	19.0	25.4
50.8 to 57.2, incl	6.4	7.9	9.5	11.1	12.7	14.3	15.9	19.0	22.2



Test

Rounded Unit for Observed
or Calculated Value

Rupture life

nearest 1 h

13. Product Marking

13.1 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.

13.2 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.

14. Keywords

14.1 N07718; plate; sheet; strip

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.

X1.2 *Plate*—Hot-rolled, annealed, and descaled.

X1.3 *Sheet*—Cold-rolled, annealed, descaled, or bright annealed.

X1.4 *Strip*—Cold-rolled, annealed, descaled, or bright annealed.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>