



Designation: B670 – 07 (Reapproved 2013)

# Standard Specification for Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service<sup>1</sup>

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 ( $\epsilon$ ) 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 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) 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:*<sup>2</sup>

- [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-Rolled 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](#)

<sup>1</sup> 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 E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

<sup>2</sup> 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.

## 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](#)).
- 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](#)).

**TABLE 1 Product Description**

Product	Thickness, in. (mm)	Width
Hot-rolled plate <sup>A</sup>	3/16 to 2 1/4 (4.8 to 57.2) (B906, Table A3.1)	B906, Tables A3.2 and A3.5 <sup>B</sup>
Cold-rolled sheet <sup>C</sup>	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 <sup>C</sup>	...	B906, Table A3.6

<sup>A</sup> 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.

<sup>B</sup> 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.

<sup>C</sup> 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 <sup>A</sup>	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 <sup>B</sup>	remainder
Copper	0.30 max
Nickel	50.0 to 55.0
Boron	0.006 max

<sup>A</sup> If determined.

<sup>B</sup> Iron shall be determined arithmetically by difference.

**TABLE 3 Tensile Properties for Plate, Sheet, and Strip<sup>A</sup>**

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

<sup>A</sup> 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<sup>A</sup>**

Nominal Thickness, in. (mm)	Stress, <sup>B</sup> 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

<sup>A</sup> 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.

<sup>B</sup> 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.

## 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:

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.<sup>3</sup> (8.19 g/cm<sup>3</sup>).

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