



## Designation: ~~B409 – 06 (Reapproved 2011)~~ **B409 – 06 (Reapproved 2016)**

# Standard Specification for Nickel-Iron-Chromium Alloy Plate, Sheet, and Strip<sup>1</sup>

This standard is issued under the fixed designation B409; 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.

## 1. Scope

1.1 This specification<sup>2</sup> covers UNS N08120, UNS N08890, UNS N08800, UNS N08810, and UNS ~~N08811~~\*N08811<sup>3</sup> in the form of rolled plate, sheet, and strip. Alloy UNS N08800 is normally employed in service temperatures up to and including 1100°F (593°C). Alloys UNS N08120, UNS N08810, UNS N08811, and UNS N08890 are normally employed in service temperatures above 1100°F (593°C) where resistance to creep and rupture is required, and they are annealed to develop controlled grain size for optimum properties in this temperature range.

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:*<sup>4</sup>

**B408** Specification for Nickel-Iron-Chromium Alloy Rod and Bar

**B906** Specification for General Requirements for Flat-Rolled Nickel and Nickel Alloys Plate, Sheet, and Strip

**E140** Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

**F155** Method of Test for Temper of Strip and Sheet Metals for Electronic Devices (Spring-Back Method) (Withdrawn 1982)<sup>5</sup>

## 3. Terminology

3.1 *Definitions 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 the safe and satisfactory performance of material ordered under this specification. Examples of such requirements include but are not limited to the following:

5.1.1 Alloy (**Table 2**),

5.1.2 Condition (Temper)—**Table 3** and **Table 4**, **Appendix X1**, and Specification **B906**.

<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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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SB 409 in Section II of that Code.

\* New designations established in accordance with Practice E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

<sup>3</sup> New designations established in accordance with Practice E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

<sup>4</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.

<sup>5</sup> The last approved version of this historical standard is referenced on www.astm.org.

**TABLE 1 Product Description**

Product	Thickness, in. (mm)	Width, in. (mm)
Hot-rolled plate <sup>A</sup>	3/16 and over (B906, Table A3.1 and Table A3.2)	(B906, Table A3.4) <sup>B</sup>
Hot-rolled sheet <sup>A</sup>	0.018 to 0.250 (0.46 to 6.4), incl (B906, Table A3.3)	(B906, Table A3.6)
Cold-rolled sheet <sup>C</sup>	0.018 to 0.250 (0.46 to 6.4), incl (B906, Table A3.3)	(B906, Table A3.6)
Cold-rolled strip <sup>C</sup>	0.005 to 0.250 (0.13 to 6.4), incl (B906, Table A3.3)	(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. (254 mm) and under, may be furnished as hot-finished rectangles with sheared or cut edges in accordance with Specification B408, 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 Requirements**

Element	Composition Limits, %		
	Alloy N08120	Alloy N08890	Alloys N08800, N08810, and N08811
Nickel	35.0 min 39.0 max	40.0 min 45.0 max	30.0 min 35.0 max
Chromium	23.0 min 27.0 max	23.5 min 28.5 max	19.0 min 23.0 max
Iron	remainder <sup>A</sup>	remainder	39.5 min <sup>A</sup>
Manganese, max	1.5	1.5	1.5
Carbon	0.02 min 0.10 max	0.06 min 0.14 max	<sup>B</sup> ...
Copper, max	0.50	0.75	0.75
Silicon, max	1.0	1.0 min 2.0 max	1.0 ...
Sulfur, max	0.03	0.015	0.015
Aluminum <sup>C</sup>	0.40 max	0.05 min 0.60 max	0.15 min 0.60 max
Titanium <sup>C</sup>	0.20 max	0.15 min 0.60 max	0.15 min 0.60 max
Columbium	0.4 min 0.9 max	...	...
Molybdenum	2.50 max	1.0 min 2.0 max	...
Niobium	...	0.2 min 1.0 max	...
Tantalum	...	0.10 min 0.60 max	...
Phosphorus	0.040 max	...	...
Tungsten	2.50 max	...	...
Cobalt, max	3.0	...	...
Nitrogen	0.15 min 0.30 max	...	...
Boron	0.010 max	...	...

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

<sup>B</sup> Alloy UNS N08800: 0.10 max.

Alloy UNS N08810: 0.05–0.10.

Alloy UNS N08811: 0.06–0.10.

<sup>C</sup> Alloy UNS N08811: Al + Ti, 0.85–1.20.

5.1.3 *Finish*—Appendix X1 and Specification B906.

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

5.1.5 *Optional Requirements*:

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

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

5.1.5.3 *Plate*—Whether to be furnished specially flattened (see 9.7.2); also how plate is to be cut (Specification B906, Table A3.4 and Table A3.7).

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

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

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

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

5.1.8 *Samples for Product (Check) Analysis*—Whether samples for product (check) analysis should be furnished (see 7.2).

**TABLE 3 Mechanical Properties for Plate, Sheet, and Strip**  
(All thicknesses and sizes unless otherwise indicated)

Alloy	Condition	Tensile Strength, min, psi (MPa)	Yield Strength <sup>A</sup> (0.2 % offset), min, psi (MPa)	Elongation in 2 in. or 50 mm (or 4D), min, %
Hot-Rolled Plate				
UNS N08120	Annealed	90 000 (621)	40 000 (276)	30
UNS N08800	Annealed	75 000 (520)	30 000 (205)	30
UNS N08800	As-rolled <sup>B,C</sup>	80 000 (550)	35 000 (240)	25
UNS N08810	Annealed	65 000 (450)	25 000 (170)	30
UNS N08811	Annealed	65 000 (450)	25 000 (170)	30
UNS N08890	Annealed	75 000 (520)	30 000 (205)	35
Hot-Rolled Sheet				
UNS N08120	Annealed	90 000 (621)	40 000 (276)	30
UNS N08800	Annealed	75 000 (520)	30 000 (205)	30
UNS N08810 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08811 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08890	Annealed	75 000 (520)	30 000 (205)	35
Cold-Rolled Sheet				
UNS N08120	Annealed	90 000 (621)	40 000 (276)	30
UNS N08800	Annealed	75 000 (520)	30 000 (205)	30
UNS N08810 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08811 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08890	Annealed	75 000 (520)	30 000 (205)	35
Cold-Rolled Strip				
UNS N08120	Annealed	90 000 (621)	40 000 (276)	30
UNS N08800	Annealed	75 000 (520)	30 000 (205)	30 <sup>E</sup>
UNS N08810 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08811 <sup>D</sup>	Annealed	65 000 (450)	25 000 (170)	30
UNS N08890	Annealed	75 000 (520)	30 000 (205)	35

<sup>A</sup> Yield strength requirements do not apply to material under 0.020 in. (0.51 mm) in thickness.

<sup>B</sup> As-rolled plate may be given a stress-relieving heat treatment subsequent to final rolling.

<sup>C</sup> As-rolled plate specified "suitable for hot forming" shall be furnished from heats of known good hot-malleability characteristics (see X1.1.1.2). The purchaser must specify Alloy UNS N08800 or UNS N08810. There are no applicable tensile or hardness requirements for such material.

<sup>D</sup> Available only in thicknesses 0.115 in. (2.92 mm) and over.

<sup>E</sup> Not applicable for thickness under 0.010 in. (0.25 mm).

**TABLE 4 Grain Size and Hardness for Alloy UNS N08800 Cold-Rolled, Deep-Drawing, and Spinning Quality Sheet and Strip**

Thickness	Calculated Diameter of Average Grain Section, max, in. (mm)	Corresponding ASTM Micro- Grain Size No.	Rockwell B <sup>AB</sup> Hardness, max
Sheet (56 in. (1.42 m) Wide and Under)			
0.050 (1.3) and less	0.0030 (0.075)	4.5	86
Over 0.050 to 0.250 (1.3 to 6.4), incl	0.0043 (0.110)	3.5	86
Strip (12 in. (305 mm) Wide and Under) <sup>C</sup>			
0.005 <sup>D</sup> to 0.010 (0.13 to 0.25), incl	0.0009 (0.022)	8 <sup>E</sup>	88 <sup>E</sup>
Over 0.010 to 0.125 (0.25 to 3.2), incl	0.0030 (0.075)	4.5	86

<sup>A</sup> For Rockwell or equivalent hardness conversions see Hardness Conversion Tables E140.

<sup>B</sup> Caution should be observed in using the Rockwell test on thin material, as the results may be affected by specimen thickness. For thicknesses under 0.050 in. (1.3 mm), the use of the Rockwell superficial or the Vickers hardness test is suggested.

<sup>C</sup> Sheet requirements (above) apply to strip thicknesses over 0.125 in. (3.2 mm), and for all thicknesses of strip over 12 in. (305 mm) in width.

<sup>D</sup> For ductility evaluations for strip under 0.005 in. (0.13 mm) in thickness, the spring-back test such as described in Test Method F155, is often used and the manufacturer should be consulted.

<sup>E</sup> Accurate grain size and hardness determinations are difficult to make on strip under 0.005 in. (0.13 mm) in thickness and are not recommended.

5.1.9 *Purchaser Inspection*—If purchaser wishes to witness tests or inspection of material at place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed (Specification B906).

## 6. Materials and Manufacture

6.1 *Heat Treatment*—The final heat treatment of UNS N08120 shall be 2150°F (1177°C) minimum, UNS N08810, 2050°F (1121°C) minimum, UNS N08811 and UNS N08890, 2100°F (1149°C) minimum.

## 7. Chemical Composition

7.1 The material shall conform to the composition limits specified in Table 2.

7.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations in Specification B906.