



Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip¹

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

1. Scope

1.1 This specification² covers rolled nickel-copper alloy (UNS N04400)³ plate, sheet, and strip.

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:⁴

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F155 Method of Test for Temper of Strip and Sheet Metals for Electronic Devices (Spring-Back Method) (Withdrawn 1982)⁵

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 ASME Boiler and Pressure Vessel Code applications, see related Specification SB-127 in Section II of that code.

³ New designation established in accordance with ASTM E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

⁴ 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.

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

2.2 Federal Standards:⁶

Fed. Std. No. 102 Preservation, Packaging, and Packing Levels

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

Fed. Std. No. 182 Continuous Identification Marking of Nickel and Nickel-Base Alloys

2.3 Military Standards:⁶

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-271 Nondestructive Testing Requirements for Metals

3. Terminology

3.1 *Descriptions 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 under 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**, **7.2**, and **Appendix X1**.

5.1.4 *Finish*—See **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 (**7.2**); also how plate is to be cut (**8.2.1** and **8.3.2**).

⁶ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

*A Summary of Changes section appears at the end of this standard



TABLE 1 Product Description

Product	Thickness, in. (mm)
Hot-rolled plate ^A	3/16 and over
Hot-rolled sheet ^A	0.018 to 0.250 (0.46 to 6.4), incl
Cold-rolled sheet ^B	0.018 to 0.250 (0.46 to 6.4), incl
Cold-rolled strip ^B	0.005 to 0.250 (0.13 to 6.4), incl

^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 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, %	
	Alloy N04400	
Nickel, min ^A	63.0	
Copper	28.0 to 34.0	
Iron, max	2.5	
Manganese, max	2.0	
Carbon, max	0.3	
Silicon, max	0.5	
Sulfur, max	0.024	

^A Element shall be determined arithmetically by difference.

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, section on Material Test Report and Certification).

5.1.10 *Samples for Product (Check) Analysis*—Whether samples for product (check) analysis should be furnished (see Specification B906, section on Sampling).

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, section on Inspection).

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 *Mechanical Properties*—The material shall conform to the requirements for mechanical properties prescribed in Table 3.

7.2 *Deep-Drawing and Spinning Quality Sheet and Strip*—The material shall conform to the requirements for grain size and hardness properties prescribed in Table 4.

7.2.1 The mechanical properties of Table 3 do not apply to deep-drawing and spinning quality sheet and strip.

8. Dimensions and Permissible Variations

8.1 Weight:

8.1.1 For calculations of mass or weight a density of 0.319 lb/in.³ (8.83 g/cm³) shall be used.

8.2 Thickness:

TABLE 3 Mechanical Properties for Plate, Sheet, and Strip (All Thicknesses and Sizes Unless Otherwise Indicated)

Condition (Temper)	Tensile Strength, min, psi (MPa)	Yield Strength ^A (0.2 % offset), min, psi (MPa)	Elongation in 2 in. or 50 mm, or 4D, min, %	Rockwell Hardness (B Scale) ^{B,C}
Hot-Rolled Plate				
Annealed	70 000 (485)	28 000 (195)	35	...
As-rolled ^{D,E}	75 000 (515)	40 000 (275)	25	...
Hot-Rolled Sheet				
Annealed	70 000 (485)	28 000 (195)	35	...
Cold-Rolled Sheet				
Annealed	70 000 to 85 000 (485 to 585)	28 000 (195)	35	...
Quarter-hard	...	...	...	73 to 83
Half-hard	...	...	...	82 to 90
Hard	100 000 (690)	90 000 (620)	2	...
Cold-Rolled Strip				
Annealed	70 000 to 85 000 (485 to 585) ^F	28 000 (195)	35 ^F	...
Skin hard	...	...	...	68 to 73
Quarter-hard	...	...	...	73 to 83
Half-hard	...	...	...	82 to 90
Three-quarter-hard	...	...	...	89 to 94
Hard	100 000 (690) ^F	90 000 (620)	2 ^F	...
Spring temper	...	...	...	98 min

^A Yield strength requirements do not apply to material under 0.020 in. (0.51 mm) in thickness.

^B For Rockwell or equivalent hardness conversions see Hardness Conversion Tables E140.

^C 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.

^D As-rolled plate may be given a stress-relieving heat treatment subsequent to final rolling.

^E As-rolled plate specified "suitable for hot forming" shall be furnished from heats of known good hot-malleability characteristics (see X1.2.2). There are no applicable tensile or hardness requirements for such material.

^F Not applicable for thickness under 0.010 in. (0.25 mm).

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

Thickness, in. (mm)	Calculated Diameter of Average Grain Section, max		Corresponding ASTM Micro- Grain Size No.	Rockwell B ^{A,B} Hardness, max
	mm	in.		
Sheet (56 in. (1420 mm) Wide and Under)				
0.050 (1.3) and under	0.075	0.0030	4.5	76
Over 0.050 to 0.250 (1.3 to 6.4), incl	0.110	0.0043	3.5	76
Strip (12 in. (305 mm) Wide and Under) ^C				
0.005 ^D to 0.015 (0.13 to 0.38), incl	0.022	0.0009	8 ^E	76 ^E
Over 0.015 to 0.024 (0.38 to 0.61), incl	0.060	0.0024	5.5	76
Over 0.024 to 0.125 (0.61 to 3.2), incl	0.075	0.0030	4.5	76

^A For Rockwell or equivalent hardness conversions see Hardness Conversion Tables E140.

^B 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.

^C Sheet requirements in Table 4 apply to strip thicknesses over 0.125 in. (3.2 mm), and for all thicknesses of strip over 12 in. (305 mm) in width.

^D 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.

^E 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.

8.2.1 *Plate*—For plate up to 2 in. (50.8 mm) inclusive, in thickness, the permissible variation, under the specified thickness and permissible excess in overweight shall not exceed the amounts prescribed in Specification B906, see Permissible Variations in Thickness and Overweight of Rectangular Plates Table.

8.2.2 *Plate*—For plate over 2 in. (50.8 mm) in thickness, the permissible variations over the specified thickness shall not exceed the amounts prescribed in Specification B906, see Permissible Variations in Thickness for Rectangular Plates Over 2 in. (51 mm) in Thickness Table.

8.2.3 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be prescribed in Specification B906, see Permissible Variations in Thickness of Sheet and Strip Table. The thickness of strip and sheet shall be measured with the micrometer spindle $\frac{3}{8}$ 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.

8.3 Width or Diameter:

8.3.1 *Plate*—The permissible variations in width of rectangular plates and diameter of circular plates shall be as prescribed in Specification B906, see Permissible Variations in Width of Sheared, Plasma Torch-Cut, and Abrasive-Cut Rectangular Plate Table and Permissible Variations in Diameter for Circular Plates Table.

8.3.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Specification B906, see Permissible Variations in Width of Sheet and Strip Table.

8.4 Length:

8.4.1 Sheet and strip of all sizes may be ordered to cut lengths in which case, a variation of $\frac{1}{8}$ in. (3.2 mm) over the specified length shall be permitted.

8.4.2 Permissible variations in length of rectangular plate shall be as prescribed in Specification B906, see Permissible Variations in Length of Sheared, Plasma Torch-Cut, and Abrasive-Cut Rectangular Plate Table.

8.5 Straightness:

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

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

8.6 Edges:

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

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

8.6.1.2 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.

8.6.1.3 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.

8.6.1.4 Sheet shall have sheared or slit edges.

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

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

8.8 Flatness:

8.8.1 There shall be no flatness requirements for “deep drawing quality,” “spinning quality,” or “as-rolled,” sheet and strip (see X1.4).

8.8.2 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. Workmanship, Finish, and Appearance

9.1 The material shall be uniform in quality and temper, smooth, commercially straight or flat, and free of injurious imperfections.

9.2 *Sheet, Strip, and Plate*—Sheet, strip, and plate supplied in the conditions and finishes as listed in the appendix may be ground or machined to remove surface imperfections, provided such removal does not reduce the material below the minimum specified dimensions. Surface eliminated depressions shall be