



Standard Specification for Nickel-Chromium-Aluminum Alloys, Nickel-Chromium-Iron Alloys, Nickel-Chromium-Cobalt-Molybdenum Alloy, Nickel- Iron-Chromium-Tungsten Alloy, and Nickel-Chromium- Molybdenum-Copper Alloy Plate, Sheet, and Strip¹

This standard is issued under the fixed designation B168; 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 specification² covers rolled nickel-chromium-aluminum alloys (UNS N06699), nickel-chromium-iron alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696),³ nickel-chromium-cobalt-molybdenum alloy (UNS N06617), nickel-iron-chromium-tungsten alloy (UNS N06674), and nickel-chromium-molybdenum-copper alloy (UNS N06235) 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 The following precautionary caveat pertains only to the test methods portion, Section 14, of this specification: *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.*

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 Code applications, see related Specification SB-168 in Section II of that Code.

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

2. Referenced Documents

2.1 ASTM Standards:⁴

B166 Specification for Nickel-Chromium-Aluminum Alloy, Nickel-Chromium-Iron Alloys, Nickel-Chromium-Cobalt-Molybdenum Alloy, Nickel-Iron-Chromium-Tungsten Alloy, and Nickel-Chromium-Molybdenum-Copper Alloy Rod, Bar, and Wire

B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

B899 Terminology Relating to Non-ferrous Metals and Alloys

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

E8/E8M Test Methods for Tension Testing of Metallic Materials

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E38 Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys (Withdrawn 1989)⁵

E112 Test Methods for Determining Average Grain Size

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

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

⁴ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. 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.

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

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

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 Standard*:⁶

MIL-STD-129 Marking for Shipment and Storage

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this specification, refer to Terminology **B899**.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *cold rolled sheet, n*—material 0.018 in. to 0.250 in. (0.46 mm to 6.4 mm) thickness, incl, conforming to dimensional variations in Table A3.3 and A3.6 of Specification **B906**.

3.2.2 *cold rolled strip, n*—material 0.005 in. to 0.250 in. (0.13 mm to 6.4 mm) thickness, incl, conforming to dimensional variations in Table A3.3 and A3.6 of Specification **B906**.

3.2.3 *hot rolled plate, n*—material 0.1875 in. to 2.25 in. (4.8 mm to 57.2 mm), incl, conforming to dimensional variations in Tables A3.1, A3.2 and A3.5 of Specification **B906**.

3.2.4 *hot rolled sheet, n*—material 0.018 in. to 0.250 in. (0.46 mm to 6.4 mm) thickness, incl, conforming to dimensional variations in Tables A3.3 and A3.6 of Specification **B906**.

3.2.5 *lot, n*—for chemical analysis, shall consist of one heat.

3.2.5.1 *Discussion*—A lot for tension testing shall consist of all material from the same heat, nominal thickness, and condition.

3.2.5.2 *Discussion*—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.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification **B906** unless otherwise provided herein.

4.2 Hot rolled plate or sheet $\frac{3}{16}$ in. to $\frac{1}{4}$ in. (4.8 mm 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.

4.3 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 **B166**, provided the mechanical property requirements of this specification are met.

4.4 Cold rolled sheet and strip 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. 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*—Name or UNS number (see **Table 1**),

5.1.2 *ASTM designation*, including year of issue,

5.1.3 *Condition*—See **8.1** and **8.2** and **Appendix X1**,

5.1.4 *Finish*—**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 **9.7.2**); also how plate is to be cut (see **9.2.1** and **9.3.2**),

5.1.8 *Samples for Product (Check) Analysis*—Whether samples for product (check) analysis should be furnished (see **6.2**), and

5.1.9 *Purchaser Inspection*—If the purchaser wishes to witness 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 (Section **15**).

6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition prescribed in **Table 1**.

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**.

7. Heat Treatment

7.1 Material of N06674 shall be solution annealed after cold-working or hot-working by heating to 2150 °F (1175 °C) minimum, followed by quenching in water or rapidly cooling by other means.

8. Mechanical Properties and Other Requirements

8.1 *Mechanical Properties*—The material shall conform to the mechanical properties prescribed in **Table 2**.

8.2 *Deep Drawing and Spinning Quality Sheet and Strip*—The material shall conform to the grain size and hardness requirements as prescribed in **Table 3**.

8.2.1 The mechanical properties of **Table 2** do not apply to deep drawing and spinning quality sheet and strip.

8.3 *Grain Size*—Except as prescribed in **8.2**, the grain size for N06674 shall be 7 or coarser, as determined in accordance with Test Methods **E112**.

9. Dimensions and Permissible Variations

9.1 *Thickness and Weight*:

⁶ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.