Designation: B932 – 04(Reapproved 2010)

Standard Specification for Low-Carbon Nickel-Chromium-Molybdenum-Gadolinium Alloy Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation B932; 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.

1. Scope

1.1 This specification[2] covers plate, sheet, and strip of low-carbon nickel-chromium-molybdenum-gadolinium alloy (UNS N06464) as shown in Table 1, for use for neutron adsorption, structural, and corrosive application in nuclear waste disposal service.

1.2 The following products are covered under this specification:

1.2.1 *Sheet and Strip*—Hot or cold rolled, solution annealed, and descaled unless solution anneal is performed in an atmosphere yielding a bright finish.

1.2.2 *Plate*—Hot or cold rolled, solution annealed, and descaled.

1.3 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.

1.4 *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, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

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, and Scleroscope Hardness

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *cold-rolled plate, n*—material 3⁄16 to 3⁄8 in. (4.76 to 9.52 mm), inclusive, in thickness.

3.1.2 *hot-tolled plate, n*—material 3⁄16 in. (4.76 mm) and over in thickness.

3.1.3 *plate, n*—material 3⁄16 in. (4.76 mm) and over in thickness.

3.1.4 *sheet and strip, n*—material under 3⁄16 in. (4.76 mm) in thickness.

4. Ordering Information

4.1 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:

4.1.1 *Alloy*—See Table 1,

4.1.2 *Dimensions*—Thickness (in decimals of an inch), width, and length (inch or fractions of an inch),

4.1.3 *Optional Requirements*—Plate; state how plate is to be cut (Specification B906, Table A2.3),

4.1.4 *Certification*—State if certification or a report of test results is required (Specification B906, Section 21),

4.1.5 *Purchase Inspection*—State which tests or inspections are to be witnessed (Specification B906, Section 18), and

4.1.6 *Samples for Product (Check) Analysis*—State whether samples should be furnished (Specification B906, 7.2.2).

5. Material

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

[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-575 in Section II of that Code. New designations 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 Chemical Requirements

Element	Composition Limits, % Alloy N06464
Molybdenum	13.1 to 16.0
Chromium	14.5 to 17.1
Iron	1.0 max
Cobalt, max	2.0
Carbon, max	0.010
Silicon, max	0.08
Manganese, max	0.5
Phosphorus, max	0.005
Sulfur, max	0.005
Nickel	Remainder[A]
Oxygen	0.005
Nitrogen, max	0.010
Gadolinium	1.9 to 2.1

[A] Shall be determined arithmetically by difference.

6. Chemical Composition

6.1 The material shall conform to the composition limits specified in Table 1.

6.2 If a product (check) analysis is made by the purchaser, the material shall conform to the requirements specified in Table 1 and Specification B906.

7. Mechanical Properties and Other Requirements

7.1 *Tensile Properties*—The material shall conform to the room temperature tensile properties prescribed in Table 2.

7.2 *Hardness*—The hardness values given in Table 2 are informative only.

7.3 *Grain Size for Sheet and Strip*—Sheet and strip shall conform to the grain sizes as illustrated in Plate 1 of Test Methods E112. The requirements shall be as indicated in Table 3.

8. Dimensions, Mass, and Permissible Variations

8.1 *Weight*—For calculations of mass or weight, the following densities shall be used:

Alloy	Density lb/in.^{3}	g/cm^3
N06464	0.316	8.76

8.2 *Thickness:*

8.2.1 *Plate*—The permissible variations in thickness of plate shall be as prescribed in Specification B906, Table A2.1.

8.2.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Specification B906, Table A2.2.

TABLE 2 Mechanical Property Requirements

Alloy	Tensile Strength, min, psi (MPa)	Yield Strength (0.2 % Offset), min, psi (MPa)	Elongation in 2 in. (50.8 mm) or 4D[A] min, %	Rockwell Hardness,[B] max
N06464	100 000 (690)	45 000 (310)	20	100 HRB

[A] Refers to the diameter of the tension specimen.
[B] Hardness values are shown for information purposes only and are not to be used as a basis of acceptance or rejection. For approximate hardness conversion, see Tables E140.

TABLE 3 Grain Size for Annealed Sheet

Thickness, in. (mm)	ASTM Micrograin Size Number	Average Grain Diameter, in. (mm)
0.125 (3.175) and under	3.0 or finer	0.0050 (0.127)
Over 0.125 (3.175)	1.5 or finer	0.0084 (0.214)

8.2.3 The thickness shall be measured with the micrometer spindle ⅜ in. (9.525 mm) or more from any edge for material 1 in. (25.4 mm) or over in width and at any place on material under 1 in. (25.4 mm) in width.

8.3 *Width:*

8.3.1 *Plate*—The permissible variations in width of rectangular plates shall be as prescribed in Specification B906, Table A2.3.

8.3.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Specification B906, Table A2.4.

8.4 *Length:*

8.4.1 *Plate*—Permissible variations in the length of rectangular plate shall be as prescribed in Specification B906, Table A2.3.

8.4.2 *Sheet and Strip*—Sheet and strip may be ordered to cut lengths, in which case a variation of ½ in. (3.175 mm) over the specified length shall be permitted, with a 0 minus tolerance.

8.5 *Straightness:*

8.5.1 The edgewise curvature (depth of chord) of flat sheet, strip, and plate shall not exceed 0.05 in. (1.27 mm) multiplied by the length in centimeters.

8.6 *Squareness (Sheet)*—For sheets of all thicknesses and widths of 6 in. (152.4 mm) or more, the angle between adjacent sides shall be 90 ± 0.15° (1/16 in. in 24 in. of 2.6 mm/m).

8.7 *Flatness*—Plate, sheet, and strip shall be commercially flat.

8.8 *Edges:*

8.8.1 Plates shall have sheared or cut (machined, abrasive cut, powdered cut, or inert arc cut) edges, as specified.

8.8.2 Sheet and strip shall have sheared or slit edges.

9. Product Marking

9.1 Each plate, sheet, or strip shall be marked on one face with the specification number, alloy, heat number, manufacturer's identification and size. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

9.2 Each bundle or shipping container shall be marked with the name of the material; this specification number, alloy; the size; gross, tare, and net weight; consignor and consignee address; contract or order number, and such other information as may be defined in the contract or order.

10. Keywords

10.1 N06464; plate; sheet; strip

APPENDIX

(Nonmandatory Information)

X1. HEAT TREATMENT

X1.1 Proper heat treatment during or subsequent to fabrication is necessary to optimum performance, and the manufacturer should be consulted for details.