



Designation: B333 – 25



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Standard Specification for Nickel-Molybdenum Alloy Plate, Sheet, and Strip¹

This standard is issued under the fixed designation B333; 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 plate, sheet, and strip of nickel-molybdenum alloys (UNS N10001, N10665, N10675, N10629, and N10624)³ as shown in **Table 1**, for use in general corrosive 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 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.*

1.5 *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.*

2. Referenced Documents

2.1 *ASTM Standards*:⁴

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

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

3. Terminology

3.1 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 plate, n*—material $\frac{3}{16}$ in. to $\frac{3}{8}$ in. (4.76 mm to 9.52 mm), inclusive, in thickness.

3.2.2 *hot-rolled plate, n*—material $\frac{3}{16}$ in. (4.76 mm) and over in thickness.

3.2.3 *plate, n*—material $\frac{3}{16}$ in. (4.76 mm) and over in thickness.

3.2.4 *sheet and strip, n*—material under $\frac{3}{16}$ in. (4.76 mm) in thickness.

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*—**Table 1**,

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.

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-333 in Section II of that Code.

³ Designation established in accordance with ASTM E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

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

TABLE 1 Chemical Requirements

Element	Composition Limits, % ^{A,B}				
	Alloy N10001	Alloy N10665	Alloy N10675	Alloy N10629	Alloy N10624
Nickel	Remainder ^C	Remainder ^C	65.0 min	Remainder ^C	Remainder ^C
Molybdenum	26.0–30.0	26.0–30.0	27.0–32.0	26.0–30.0	21.0–25.0
Iron	4.0–6.0	2.0	1.0–3.0	1.0–6.0	5.0–8.0
Chromium	1.0	1.0	1.0–3.0	0.5–1.5	6.0–10.0
Carbon	0.05	0.02	0.01	0.01	0.01
Silicon	1.0	0.10	0.10	0.05	0.10
Cobalt	2.5	1.00	3.0	2.5	1.0
Manganese	1.0	1.0	3.0	1.5	1.0
Phosphorus	0.04	0.04	0.030	0.04	0.025
Sulfur	0.03	0.03	0.010	0.01	0.01
Vanadium	0.2–0.4	...	0.20	...	...
Nickel plus Molybdenum	...	...	94.0–98.0	...	...
Aluminum	...	...	0.50	0.1–0.5	0.5
Niobium ^D	...	...	0.20	...	...
Copper	...	...	0.20	0.5	0.5
Tantalum	...	...	0.20	...	...
Titanium	...	...	0.20	...	...
Tungsten	...	...	3.0	...	...
Zirconium	...	...	0.10	...	...
Magnesium	...	...	...	...	...

^A All values are maximums unless specified as a minimum or a range is provided.

^B Where ellipses ([...]) appear in this table there is no requirement and the element need neither be analyzed for nor reported.

^C Element shall be determined arithmetically by difference.

^D Niobium (Nb) and Columbium (Cb) are considered equivalent.

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

5.1.3 *Optional Requirement*—Plate; how the plate is to be cut (Specification B906, Table A2.3)

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

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

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	lb/in. ³	Density (g/cm ³)
N10001	0.334	(9.24)
N10665	0.333	(9.22)
N10675	0.333	(9.22)
N10629	0.333	(9.22)
N10624	0.322	(8.9)

8.2 Thickness:

8.2.1 *Sheet and Strip*—The thickness shall be measured with the micrometer spindle $\frac{3}{8}$ 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 Length:

8.3.1 *Sheet and Strip*—Sheet and strip may be ordered to cut lengths, in which case a variation of $\frac{1}{8}$ in. (3.175 mm) over the specified length shall be permitted, with a 0 minus tolerance.

8.4 Straightness:

8.4.1 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 feet or 0.04 mm multiplied by the length in centimetres.

8.4.2 Straightness for coiled strip is subject to agreement between the manufacturer and the purchaser.

8.5 *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 degrees $\pm$ 0.15 degrees ($\frac{1}{16}$ in. in 24 in. or 2.6 mm/m).

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

8.7 Edges:

8.7.1 Plates shall have sheared, abrasive cut, or plasma-torch-cut edges as specified.

8.7.2 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. Certification

10.1 A manufacturer's certification shall be furnished to the purchaser stating that material has been manufactured, tested, and inspected in accordance with this specification, and that the test results on representative samples meet specification requirements. A report of the test results shall be furnished.

11. Keywords

11.1 plate; sheet; strip; UNS N10001; UNS N10629; UNS N10665; UNS N10675; UNS N10624

TABLE 2 Mechanical Property Requirements

Alloy	Thickness, in. (mm)	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
Sheet and Strip					
N10001	Under 3/16 (4.76)	115 000 (795)	50 000 (345)	45	100 HRB
N10665	Under 3/16 (4.76)	110 000 (760)	51 000 (350)	40	100 HRB
N10675	Under 3/16 (4.76)	110 000 (760)	51 000 (350)	40	100 HRB
N10629	Under 3/16 (4.76)	110 000 (760)	51 000 (350)	40	100 HRB
N10624	Under 3/16 (4.76)	104 000 (720)	46 000 (320)	40	100 HRB
Plate					
N10001	3/16 to 2 1/2 in. (4.76 to 63.5 mm), incl	100 000 (690)	45 000 (310)	40	100 HRB
N10665	3/16 to 2 1/2 in. (4.76 to 63.5 mm), incl	110 000 (760)	51 000 (350)	40	100 HRB
N10675	3/16 to 2 1/2 in. (4.76 to 63.5 mm), incl	110 000 (760)	51 000 (350)	40	100 HRB
N10629	3/16 to 2 1/2 in. (4.76 to 63.5 mm), incl	110 000 (760)	51 000 (350)	40	100 HRB
N10624	3/16 to 2 1/2 in. (4.76 to 63.5 mm), incl	104 000 (720)	46 000 (320)	40	100 HRB

^A D 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 for rejection or acceptance. For approximate hardness conversions, see Hardness Conversion Tables E140.

TABLE 3 Grain Size for Annealed Sheet

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

APPENDIX

(Nonmandatory Information)

X1. HEAT TREATMENT

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

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B333 – 03 (2018)) that may impact the use of this standard. (Approved April 15, 2025.)

- (1) Added Terminology **B899** in Section 2.
(2) Revised **Table 1**.

- (3) Made Certification mandatory.

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