



Designation: B 335 – 03

Standard Specification for Nickel-Molybdenum Alloy Rod¹

This standard is issued under the fixed designation B 335; 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 Department of Defense.

1. Scope

1.1 This specification² covers rod of nickel-molybdenum alloys (UNS N10001, N10665, N10675, N10629, and N10624)* as shown in Table 1, for use in general corrosive service.

1.2 The following products are covered under this specification:

1.2.1 Rods 5/16 to 3/4 in. (7.94 to 19.05 mm) excl in diameter, hot or cold finished, solution annealed and pickled or mechanically descaled.

1.2.2 Rods 3/4 to 3 1/2 in. (19.05 to 88.9 mm) incl in diameter, hot or cold finished, solution annealed, ground or turned.

1.3 The values stated in inch-pound units are to be regarded as the 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 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:

B 880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys³

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵

E 55 Practice for Sampling Wrought Nonferrous Metals and

TABLE 1 Chemical Requirements

Element	Composition Limits, %				
	Alloy N10001	Alloy N10665	Alloy N10675	Alloy N10629	Alloy N10624
Nickel	remainder ^A	remainder ^A	65.0 min	remainder ^A	Bal
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 max	1.0–3.0	1.0–6.0	5.0–8.0
Chromium	1.0 max	1.0 max	1.0–3.0	0.5–1.5	6.0–10.0
Carbon, max	0.05	0.02	0.01	0.01	0.01
Silicon, max	1.0	0.10	0.10	0.05	0.10
Cobalt, max	2.5	1.00	3.0	2.5	1.0
Manganese, max	1.0	1.0	3.0	1.5	1.0
Phosphorus, max	0.04	0.04	0.030	0.04	0.025
Sulfur, max	0.03	0.03	0.010	0.01	0.01
Vanadium	0.2–0.4	...	0.20 max	...	...
Nickel plus Molybdenum	...	...	94.0–98.0	...	...
Aluminum	...	...	0.50 max	0.1–0.5	0.5
Columbium (Nb), max	...	...	0.20	...	...
Copper, max	...	...	0.20	0.5	0.5
Tantalum, max	...	...	0.20	...	...
Titanium, max	...	...	0.20	...	...
Tungsten, max	...	...	3.0	...	...
Zirconium, max	...	...	0.10	...	...
Magnesium, max	...	...	...	...	...

^ASee 12.1

Alloys for Determination of Chemical Composition⁶
E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys⁶

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *rod*—a product of round solid section furnished in straight lengths.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this

⁶ Annual Book of ASTM Standards, Vol 03.05.

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.

Current edition approved June 10, 2003. Published July 2003. Originally approved in 1958. Last previous edition approved in 1998 as B 335 - 98.

² For ASME Boiler and Pressure Vessel Code applications see related Specification SB-335 in Section II of that Code.

* New designation established in accordance with ASTM E 527 and SAE J1086, Recommended Practice for Numbering Metals and Alloys (UNS).

³ Annual Book of ASTM Standards, Vol 02.04.

⁴ Annual Book of ASTM Standards, Vol 03.01.

⁵ Annual Book of ASTM Standards, Vol 14.02.

specification. Examples of such requirements include, but are not limited to the following:

4.1.1 *Alloy*—Table 1.

4.1.2 *Dimensions*—Nominal diameter and length. The shortest usable multiple length shall be specified (Table 2).

4.1.3 *Certification*—State if certification or a report of test results is required (Section 16).

4.1.4 *Purchaser Inspection*—State which tests or inspections are to be witnessed (Section 13).

4.1.5 *Samples for Product (Check) Analysis*—State whether samples should be furnished (9.2.2).

5. Chemical Composition

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

5.2 If a product (check) analysis is made by the purchaser, the material shall conform to the requirements specified in Table 1 subject to the permissible tolerances in B 880.

6. Mechanical Properties and Other Requirements

6.1 The mechanical properties of the material at room temperature shall conform to those shown in Table 3.

7. Dimensions and Permissible Variations

7.1 *Diameter*—The permissible variations from the specified diameter shall be as prescribed in Table 2.

7.2 *Out of Roundness*—The permissible variation in roundness shall be as prescribed in Table 2.

7.3 *Machining Allowances*—When the surfaces of finished material are to be machined, the following allowances are suggested for normal machining operations.

7.3.1 *As-finished (Annealed and Descaled)*—For diameters of $\frac{5}{16}$ to $\frac{11}{16}$ in. (7.94 to 17.46 mm) incl., an allowance of $\frac{1}{16}$ in. (1.59 mm) on the diameter should be made for finish machining.

7.4 *Length*:

7.4.1 Unless multiple, nominal, or cut lengths are specified, random mill lengths shall be furnished.

7.4.2 The permissible variations in length of multiple, nominal, or cut length rod shall be as prescribed in Table 4. Where rods are ordered in multiple lengths, a $\frac{1}{4}$ -in. (6.35-mm) length addition shall be allowed for each uncut multiple length.

7.5 *Ends*:

7.5.1 Rods ordered to random or nominal lengths shall be furnished with either cropped or sawed ends.

7.5.2 Rods ordered to cut lengths shall be furnished with square saw-cut or machined ends.

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

Alloy	Density	
	lb/in ³	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

7.7 *Straightness*—The maximum curvature (depth of chord) shall not exceed 0.050 in. multiplied by the length of the chord in feet (0.04 mm multiplied by the length in centimetres).

8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and condition, smooth, and free of injurious imperfections.

9. Sampling

9.1 *Lots for Chemical Analysis and Mechanical Testing*:

9.1.1 A lot for chemical analysis shall consist of one heat.

9.1.2 A lot of bar for mechanical testing shall be defined as the material from one heat in the same condition and specified diameter.

9.2 *Sampling for Chemical Analysis*:

9.2.1 A representative sample shall be obtained from each heat during pouring or subsequent processing.

9.2.2 Product (check) analysis shall be wholly the responsibility of the purchaser.

9.3 *Sampling for Mechanical Testing*:

9.3.1 A representative sample shall be taken from each lot of finished material.

10. Number of Tests and Retests

10.1 *Chemical Analysis*—One test per heat.

10.2 *Tension Tests*—One test per lot.

10.3 *Retests*—If the specimen used in the mechanical test of any lot fails to meet the specified requirements, two additional specimens shall be taken from different sample pieces and tested. The results of the tests on both of these specimens shall meet the specified requirements.

11. Specimen Preparation

11.1 Tension test specimens shall be taken from material after final heat-treatment and tested in the direction of fabrication.

11.2 Tension test specimens shall be any of the standard or subsized specimens shown in Test Methods E 8.

11.3 In the event of disagreement, the referee specimen shall be the largest possible round specimen shown in Test Methods E 8.

TABLE 2 Permissible Variations in Diameter and Out-of-Roundness of Finished Rods

Specified Diameter, in. (mm)	Permissible Variations, in. (mm)		
	Diameter		Out of Roundness, max
	Plus	Minus	
Hot-Finished, Annealed, and Descaled Rods			
$\frac{5}{16}$ to $\frac{7}{16}$ (7.94–11.11), incl	0.012 (0.30)	0.012 (0.30)	0.018 (0.46)
Over $\frac{7}{16}$ to $\frac{5}{8}$ (11.11–15.87), incl	0.014 (0.36)	0.014 (0.36)	0.020 (0.51)
Over $\frac{5}{8}$ to $\frac{3}{4}$ (15.87–19.05), excl	0.016 (0.41)	0.016 (0.41)	0.024 (0.61)
Hot-Finished, Annealed, and Ground or Turned Rods			
$\frac{3}{4}$ to $\frac{3}{2}$ (19.05–88.9), incl	0.010 (0.25)	0	0.008 (0.20)