Designation: B815 – 02 (Reapproved 2016)

Standard Specification for Cobalt-Chromium-Nickel-Molybdenum-Tungsten Alloy (UNS R31233) Rod[1]

This standard is issued under the fixed designation B815; 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 cobalt-chromium-nickel-molybdenum-tungsten alloy UNS R31233 in the form of rod for wear applications and general corrosion service.

1.2 The following products are covered under this specification:

1.2.1 Rods 3⁄16 to 3⁄4 in. (9.76 to 19.05 mm) exclusive in diameter, hot or cold finished, solution-annealed, and pickled or mechanically descaled; and

1.2.2 Rods 3⁄4 to 3½ in. (19.05 to 88.9 mm) inclusive 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 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 and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

E8 Test Methods for Tension Testing of Metallic Materials

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

E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *rod, n*—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 specification. Examples of such requirements include, but are not limited to, the following:

4.1.1 *Alloy.*

4.1.2 *Dimensions*—Nominal diameter and length. The shortest usable multiple length shall be specified (Table 1).

4.1.3 *Certification*—State whether certification or a report of test results is required (Section 15).

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 chemical composition requirements prescribed in Table 2.

5.2 If a product (check) analysis is made by the purchaser, the material shall conform to the requirements specified in Table 2 subject to the permissible tolerances given in Specification B880.

6. Mechanical Properties and Other Requirements

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

7. Dimensions, Mass, and Permissible Variations

7.1 *Diameter*—The permissible variations from the specified diameter shall be as prescribed in Table 4.

[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-815 in Section II of that code.

[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 Permissible Variations in Length of Rods

Random mill lengths	2 to 12 ft (610 to 3660 mm) long with not more than 25 weight % under 4 ft (1.22 m).
Multiple lengths	Furnished in multiples of a specified unit length, within the length limits indicated above. For each multiple, an allowance of ¼ in. (6.35 mm) shall be made for cutting, unless otherwise specified. At the manufacturer's option, individual specified unit lengths may be furnished.
Nominal lengths	Specified nominal lengths having a range of not less than 2 ft (610 mm) with no short lengths allowed.
Cut lengths	A specified length to which all rods shall be cut with a permissible variation of + ⅛ in. (3.17 mm) – 0.

TABLE 2 Chemical Requirements

Element	Composition Limits, %
Boron	0.015 max
Carbon	0.02–0.10
Chromium	23.5–27.5
Iron	1.0–5.0
Manganese	0.1–1.5
Molybdenum	4.0–6.0
Nitrogen	0.03–0.12
Nickel	7.0–11.0
Phosphorous	0.030 max
Sulfur	0.020 max
Silicon	0.05–1.00
Tungsten	1.0–3.0
Cobalt	Remainder[A]

[A] See 12.1.1.

TABLE 3 Mechanical Property Requirements

Tensile Strength, min, ksi (MPa)	130 (896)
Yield Strength, min, ksi (MPa)	55 (379)
Elongation in 2 in. (50.8 mm) or 4*D* [A], min, %	15

[A] *D* refers to the diameter of the tension specimen.

7.2 *Out-of-Roundness*—The permissible variation in roundness shall be as prescribed in Table 4.

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 5⁄16 to 11⁄16 in. (7.94 to 17.46 mm) inclusive, an allowance of 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 1. Where rods are ordered in multiple lengths, a ¼-in. (6.35-mm) length addition shall be permitted 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 the purposes of calculating the weight of the material covered by this specification, a density of 0.306 lb/in.^{5} (8.48 g/cm^5) shall be used.

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 defects.

9. Sampling

9.1 *Lots for Chemical 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*—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 Preparations

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 described in Test Methods E8.

11.3 In the event of disagreement, the referee specimen shall be the largest possible round specimen described in Test Methods E8.

12. Test Methods

12.1 The chemical composition and mechanical properties of the material as enumerated in this specification shall be determined, in case of disagreement, in accordance with the following ASTM standards:

12.1.1 *Chemical Analysis*—Test Methods E1473. For elements not covered by Test Methods E1473, the referee method shall be as agreed upon between the manufacturer and the purchaser. The composition of the remainder element shall be determined arithmetically by difference.

12.1.2 *Tension Test*—Test Methods E8.

12.1.3 *Method of Sampling*—Practice E55.

TABLE 4 Permissible Variations in Diameter and Out-of-Roundness of Finished Rods

Specified Diameter, in. (mm)	Permissible Variations, in. (mm)		
	Diameter		Out-of-Roundness, max
	+	–	
Hot-Finished, Annealed, and Descaled Rods			
3/16 to 7/16 (4.76–11.11), incl	0.012 (0.30)	0.012 (0.30)	0.018 (0.46)
Over 7/16 to 5/8 (11.11–15.87), incl	0.014 (0.36)	0.014 (0.36)	0.020 (0.51)
Over 5/8 to 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			
3/4 to 3 1/2 (19.05–88.9), incl	0.010 (0.25)	0	0.008 (0.20)

12.1.4 *Determining Significant Places*—Practice E29.

12.2 For purposes of determining compliance with the limits in this specification, an observed or calculated value shall be rounded in accordance with the rounding method of Practice E29:

Requirements	Rounded Unit for Observed or Calculated Value
Chemical composition hardness and tolerance (when expressed in decimals)	Nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	Nearest 1000 psi (7 MPa)
Elongation	Nearest 1 %

13. Inspection

13.1 Inspection of the material shall be made as agreed upon between the manufacturer and the purchaser as part of the purchase contract.

14. Rejection and Rehearing

14.1 Material evaluated by the purchaser that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

15. Certification

15.1 When specified in the purchase order or contract, 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. When specified in the purchase order or contract, a report of the test results shall be furnished.

16. Product Marking

16.1 Each piece of material ½ in. (12.7 mm) and over in diameter shall be marked with this specification number, manufacturer's identification, and size of the product.

16.2 Each bundle or shipping container shall be marked with this specification number; 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.

17. Keywords

17.1 rod; R31233

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.