



Designation: **B815–02 (Reapproved 2016) B815 – 24**

Standard Specification for Cobalt-Chromium-Nickel-Molybdenum-Tungsten Alloy (UNS R31233) Bar or Rod¹

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~~ Scope*

1.1 This specification² covers cobalt-chromium-nickel-molybdenum-tungsten alloy ~~UNS R31233~~ in the form of ~~rod~~ bar or rod. While the alloy is typically used for wear applications and general corrosion ~~service~~, it is not limited to this usage.

1.2 ~~The following products are covered under this specification:~~ UNS R31233 is the only alloy currently allowed to be certified to this specification.

1.2.1 Rods $\frac{3}{16}$ to $\frac{3}{4}$ 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 $\frac{3}{4}$ to $3\frac{1}{2}$ 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 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:³

[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](#)

[E8E8/E8M Test Methods for Tension Testing of Metallic Materials \[Metric\] E0008_E0008M](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

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.

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

3. Terminology

3.1 Common B02.07 terminology is found in Terminology B899.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bar, n*—an elongated, forged, or rolled metal product with uniform strength, length and diameter.

3.2.2 *rod, n*—a hot-finished 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.

4.2 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*.

4.2.1 *Dimensions*—Nominal Section 8 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).

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

4.2.3 *Samples for Product (Check) Analysis*—State whether samples should be furnished (Section 9.2.210).

5. Materials and Manufacture

5.1 The finish options for products certified to this specification are:

5.1.1 Hot-Finished, Annealed, and Descaled Rod.

5.1.2 Hot-Finished, Annealed, and Ground Bar.

5.1.3 Hot-Finished, Annealed, and Turned Bar.

5.1.4 Cold-Finished and Annealed Bar.

5.1.5 Cold-Finished, Annealed, and Ground Bar.

5.2 The diameters permitted for certification for each finish appear in the left column of Table 3.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements prescribed in Table 21.

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

7. Mechanical Properties and Other Requirements

7.1 The mechanical properties of the material at room temperature shall conform to those given in Table 32.

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

TABLE 1 Chemical Requirements^A

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

^A See Values ~~12.1.1~~ in the table are maximums unless a range or minimum is indicated.

^B The composition of the remainder element shall be determined arithmetically by difference.

TABLE 32 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 4D ^A , min, %	15

^A D refers to the diameter of the tension specimen.

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8. Dimensions, Mass, and Permissible Variations

8.1 *Diameter*—The permissible variations from the specified diameter shall be as prescribed in [Table 43](#).

8.2 *Out-of-Roundness*—The permissible variation in roundness shall be as prescribed in [Table 43](#).

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

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

8.4 *Length*:

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

8.4.2 The permissible variations in length of multiple, nominal, or cut length rod shall be as prescribed in [Table 14](#). Where rods are ordered in multiple lengths, a ~~$\frac{1}{4}$ -in. (6.35-mm)~~ $\frac{1}{4}$ -in. (6.35 mm) length addition shall be permitted for each uncut multiple length.

8.5 *Ends*:

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

Specified Diameter, in. (mm)	Permissible Variations, in. (mm)		Out-of-Roundness, max
	Diameter		
	+	-	
Hot-Finished, Annealed, and Descaled Rods			
$\frac{3}{16}$ to $\frac{7}{16}$ (4.76–11.11), 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			
$\frac{5}{16}$ to $\frac{3}{8}$ (19.05–88.9), incl	0.010 (0.25)	0	0.008 (0.20)

TABLE 3 Permissible Variations in Diameter and Out-of-Roundness of Finished Products

Specified Diameter, in. (mm)	Permissible Variations, in. (mm)		Out-of-Roundness, max
	Diameter		
	+	-	
Hot-Finished, Annealed, and Descaled Rod			
$\frac{3}{16}$ to $\frac{7}{16}$ (4.76 to 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 to 15.87), incl	0.014 (0.36)	0.014 (0.36)	0.020 (0.51)
Over $\frac{5}{8}$ to 1 (15.87 to 25.4), incl	0.016 (0.41)	0.016 (0.41)	0.024 (0.61)
Over 1.0 to 2.0 (25.4 to 50.8), incl	0.031 (0.79)	0.016 (0.41)	0.035 (0.89)
Over 2.0 to $\frac{3}{8}$ (50.8 to 92.08), excl	0.047 (1.19)	0.031 (0.79)	0.058 (1.47)
Hot-Finished, Annealed, and Ground Bar			
$\frac{5}{16}$ to $\frac{3}{8}$ (50.8 to 92.08), incl	0.010 (0.25)	0	0.008 (0.20)
Over $\frac{3}{8}$ to 6.0 (92.08 to 152.4), incl	0.050 (1.27)	0	---
Hot-Finished, Annealed, and Turned Bar			
$\frac{3}{8}$ to 6.0 (92.08 to 152.4)	0.125 (3.18)	0	---
Cold-Finished, Annealed Bar			
$\frac{1}{8}$ to $\frac{3}{4}$ (3.18 to 19.05)	0.010 (0.25)	0	0.008 (0.20)
Cold-Finished, Annealed, and Ground Bar			
$\frac{1}{8}$ to $\frac{3}{4}$ (3.18 to 19.05)	0.002 (0.05)	0.002 (0.05)	0.002 (0.05)

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

8.5.2 Rods or bars ordered to cut lengths shall be furnished with square saw cut or machined ends.

8.6 *Weight*—For the purposes of calculating the weight of the material covered by this specification, a density of 0.3060.306 lb/in.³ (8.48 g/cm³ (8.48 g/cm³)) shall be used.

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8.7 *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); the number calculated by the equation below. The calculated number is the maximum allowed curvature in inches (inch-pound units) or millimeters (SI units).

$$\text{Curvature}[\text{customary unit}] = 0.05 \times \text{length}(\text{in feet})$$

$$\text{Curvature}[\text{SI unit}] = 0.04 \times \text{length}(\text{in cm})$$

9. Workmanship, Finish, and Appearance

9.1 The material shall be uniform in quality and condition, smooth, and free of injurious defects.

9.2 The finish should be smooth and free of injurious defects.

10. Sampling

10.1 *Lots for Chemical and Mechanical Testing:*

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

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

10.2 *Sampling for Chemical Analysis:*