



Designation: B573 – 24

Standard Specification for Nickel-Molybdenum-Chromium-Iron Alloys Bar or Rod¹

This standard is issued under the fixed designation B573; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification² covers nickel-molybdenum-chromium-iron alloys in the form of bar or rod. The alloys are typically for general corrosive service but not limited to this usage.

1.2 Alloys that can currently be certified to this specification are UNS N10003 and UNS N10242.

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:*³

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

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 Specification SB-573 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.

B899 Terminology Relating to Non-ferrous Metals and Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

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

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

3. Terminology

3.1 Common B02.07 terminology is found in Specification 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 the safe and satisfactory performance of material ordered under this specification.

4.2 Examples of such requirements include but are not limited to the following:

4.2.1 *Dimensions*—See Section 8.

4.2.2 *Purchaser Inspection*—See Section 13.

4.2.3 *Samples for Product (Check) Analysis*—See Section 10.

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, and

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 prescribed in Table 1.

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

TABLE 1 Chemical Requirements^A

| Element | Composition, % | |
|-----------------------|----------------|------------|
| | UNS N10003 | UNS N10242 |
| Chromium | 6.0–8.0 | 7.0–9.0 |
| Iron | 5.0 | 2.0 |
| Carbon | 0.04–0.08 | 0.03 |
| Silicon | 1.00 | 0.80 |
| Cobalt | 0.20 | 1.00 |
| Manganese | 1.00 | 0.80 |
| Tungsten | 0.50 | ... |
| Vanadium | 0.50 | ... |
| Molybdenum | 15.0–18.0 | 24.0–26.0 |
| Phosphorus | 0.015 | 0.030 |
| Sulfur | 0.020 | 0.015 |
| Aluminum ^B | 0.50 | ... |
| Copper | 0.35 | 0.50 |
| Boron | 0.010 | 0.006 |
| Nickel | remainder | remainder |
| Aluminum | ... | 0.50 |

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

^B Includes titanium.

6.2 If a product (check) analysis is made by the purchaser, it shall be done 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 shown in **Table 2**.

8. Dimensions and Permissible Variations

8.1 *Diameter*—The permissible variations from the specified diameter shall be as prescribed in **Table 3**.

8.2 *Out-of-Roundness*—The permissible variation in roundness shall be as prescribed in **Table 3**.

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 $\frac{1}{4}$ in. (7.94 mm to 17.46 mm) incl, an allowance of $\frac{1}{16}$ in. (1.59 mm) should be added on the diameter 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 4**. Where rods are ordered in multiple lengths, $\frac{1}{4}$ in. (6.35 mm) length addition shall be allowed for each uncut multiple length.

8.5 Ends:

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 calculation of mass or weight, the following densities shall be used:

| Alloy | lb/in ³ | g/cm ³ |
|--------|--------------------|-------------------|
| N10003 | 0.317 | 8.78 |
| N10242 | 0.327 | 9.05 |

8.7 *Straightness*—The maximum curvature (depth of chord) shall not exceed the number calculated by the equation below. The calculated number is the maximum allowed curvature in inches (inch-pound units) or millimeters (SI units).

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

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

9. Workmanship, Finish, and Appearance

9.1 The material shall be uniform in quality and condition.

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

10. Sampling

10.1 *Lots for Chemical Analysis and Mechanical Testing:*

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

10.1.2 A lot 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:*

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

10.2.2 Product (check) analysis shall be wholly the responsibility of the purchaser. If the furnished sample is to be in addition to the overall bulk product that was ordered, then this shall be stipulated in the contract or purchase order.

10.3 *Sampling for Mechanical Testing*—A representative sample shall be taken from each lot of finished material.

11. Number of Tests and Retests

11.1 *Chemical Analysis*—One test per heat.

11.2 *Tension Tests*—One test per lot.

11.3 *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.

12. Test Methods

12.1 The ASTM test methods used to determine material property values shall be those shown in **Table 5**.

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

TABLE 2 Mechanical Property Requirements

| UNS | Tensile Strength, min, ksi (MPa) | Yield Strength (0.2 % Offset), min, ksi (MPa) | Elongation in 2 in. (50.8 mm) or 4D ^A min, % |
|--------|----------------------------------|---|---|
| N10003 | 100 (690) | 40 (280) | 35 |
| N10242 | 105 (725) | 45 (310) | 40 |

^A 4D—D refers to the diameter of the tension specimen.