



Designation: B573 – 24



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# Standard Specification for Nickel-Molybdenum-Chromium-Iron Alloys Bar or Rod<sup>1</sup>

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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification<sup>2</sup> 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:<sup>3</sup>

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

<sup>1</sup> 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 April 1, 2024. Published April 2024. Originally approved in 1972. Last previous edition approved in 2016 as B573 – 06 (2016). DOI: 10.1520/B0573-24.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see Specification SB-573 in Section II of that Code.

<sup>3</sup> 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<sup>A</sup>**

| 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 <sup>B</sup> | 0.50           | ...        |
| Copper                | 0.35           | 0.50       |
| Boron                 | 0.010          | 0.006      |
| Nickel                | remainder      | remainder  |
| Aluminum              | ...            | 0.50       |

<sup>A</sup> Values in the table are maximums unless a range or minimum is indicated.

<sup>B</sup> 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 <sup>3</sup> | g/cm <sup>3</sup> |
|--------|--------------------|-------------------|
| 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,<br>min,<br>ksi (MPa) | Yield Strength<br>(0.2 % Offset), min,<br>ksi (MPa) | Elongation in 2 in.<br>(50.8 mm) or 4D <sup>A</sup><br>min, % |
|--------|----------------------------------------|-----------------------------------------------------|---------------------------------------------------------------|
| N10003 | 100 (690)                              | 40 (280)                                            | 35                                                            |
| N10242 | 105 (725)                              | 45 (310)                                            | 40                                                            |

<sup>A</sup> 4D—D refers to the diameter of the tension specimen.

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

| Specified Diameter, in. (mm)             | Permissible Variations, in. (mm) |              |                       |
|------------------------------------------|----------------------------------|--------------|-----------------------|
|                                          | Diameter                         |              | Out of Roundness, max |
|                                          | Plus                             | Minus        |                       |
| Hot-Finished, Annealed, and Descaled Rod |                                  |              |                       |
| 5/16 to 7/16 (7.94 to 11.11), incl       | 0.012 (0.30)                     | 0.012 (0.30) | 0.018 (0.46)          |
| Over 7/16 to 5/8 (11.11 to 15.87), incl  | 0.014 (0.36)                     | 0.014 (0.36) | 0.020 (0.51)          |
| Over 5/8 to 1.0 (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 35/8 (50.8 to 92.08), excl   | 0.047 (1.19)                     | 0.031 (0.79) | 0.058 (1.47)          |
| Hot-Finished, Annealed, and Ground Bar   |                                  |              |                       |
| 5/16 to 35/8 (7.94 to 92.08), incl       | 0.010 (0.25)                     | 0            | 0.008 (0.20)          |
| Over 35/8 to 8.0 (92.08 to 203.2), excl  | 0.050 (1.27)                     | 0            | —                     |
| Hot-Finished, Annealed, and Turned Bar   |                                  |              |                       |
| 35/8 to 8.0 (92.08 to 203.2)             | 0.125 (3.18)                     | 0            | —                     |
| Cold-Finished, Annealed Bar              |                                  |              |                       |
| 1/8 to 3/4 (3.18 to 19.05)               | 0.010 (0.25)                     | 0            | 0.008 (0.20)          |
| Cold-Finished, Annealed, and Ground Bar  |                                  |              |                       |
| 1/8 to 3/4 (3.18 to 19.05)               | 0.002 (0.05)                     | 0.002 (0.05) | 0.002 (0.05)          |

**TABLE 4 Permissible Variations in Length**

|                     |                                                                                                                                                                                                                                                                                            |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Random mill lengths | 2 ft to 12 ft (610 mm 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 1/4 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 + 1/8 in. (3.17 mm) – 0.                                                                                                                                                                                 |

**TABLE 5 Test Methods**

| Test Methods      | ASTM Designation |
|-------------------|------------------|
| Tension           | E8/E8M           |
| Chemical Analysis | E1473            |

**TABLE 6 Rounding of Observed Values**

| Requirements                        | Rounded Unit for Observed or Calculated Value                               |
|-------------------------------------|-----------------------------------------------------------------------------|
| Chemical composition and tolerance  | nearest unit in the last right-hand place of figures of the specified limit |
| Tensile strength and yield strength | nearest 1 ksi or 5 MPa                                                      |
| Elongation                          | nearest 1 %                                                                 |

### 13. Inspection

13.1 Inspection of the material shall be made as agreed upon between the manufacturer and the purchaser. The details shall be outlined in the purchase contract.

13.2 If any testing is to be witnessed, the details shall be outlined in the purchase contract.

### 14. Rejection and Rehearing

14.1 Material tested 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 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.

### 16. Product Marking

16.1 Each piece of material 1/2 in. (12.7 mm) and over in diameter shall be marked with this specification number, name of the material or the UNS number, and size of the product.

16.2 The following information shall be marked either on the material or included on the package, or on a label or tag attached thereto: gross and net weight; consignor and consignee address; contract or order number; and such other information as may be defined in the contract or order. The UNS number, material's name, specification number and size may be included as well.

### 17. Keywords

17.1 bar; rod; UNS N10003; UNS N10242

## 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 (B573 – 06 (2016)) that may impact the use of this standard. (Approved April 1, 2024.)

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>(1) Revised title to remove UNS numbers.</li> <li>(2) Added bar to title and definitions.</li> <li>(3) Increased diameter range offered by the specification.</li> <li>(4) Added permissible variations for cold finished material (Table 3).</li> <li>(5) Specification structure brought into alignment with Practice B1015.</li> <li>(a) Moved permissible variations table from Section 4 (ordering information) to Section 8 (Dimensions and Permissible Variations).</li> <li>(b) Added Materials and Manufacture Section 5; moved manufacturing and finishing information from the Scope to this section.</li> </ul> | <ul style="list-style-type: none"> <li>(c) Chemistry Table restructured (Section 6).</li> <li>(d) Deleted former Section 11 (specimen preparation) due to info being covered in ASTM E8/E8M.</li> <li>(e) Made certification and test reports mandatory (Section 15).</li> <li>(6) Fixed conversion error of tensile property table (Section 6).</li> <li>(7) Improved the presentation of maximum curvature equation (8.7).</li> <li>(8) Added additional direction for requesting chemical analysis samples (10.2.2).</li> </ul> |
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