



Designation: B572 – 24

# Standard Specification for Heat and Corrosion Resistant High Temperature Alloy Bar or Rod<sup>1</sup>

This standard is issued under the fixed designation B572; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification<sup>2</sup> covers alloys in the form of bar or rod that are typically used for (though not limited to) heat resisting and general-corrosive service.

1.2 Alloys that can currently be certified to this specification are UNS N06002, UNS N06230, UNS N12160, and UNS R30556.

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.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SB-572 in Section II of that Code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

**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 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 material ordered under this specification.

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

4.2.1 *Alloy*,

4.2.2 *Dimensions*—(Section 8),

4.2.3 *Purchaser Inspection*—(Section 13), and

4.2.4 *Samples for Product (Check) Analysis*—(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**.

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

**TABLE 1 Chemical Requirements<sup>A</sup>**

| Element              | Composition Limits, %  |                        |                        |                        |
|----------------------|------------------------|------------------------|------------------------|------------------------|
|                      | UNS N06002             | UNS N06230             | UNS N12160             | UNS R30556             |
| Nickel               | remainder <sup>B</sup> | remainder <sup>B</sup> | remainder <sup>B</sup> | 19.0–22.5              |
| Iron                 | 17.0–20.0              | 3.0                    | 3.5                    | remainder <sup>B</sup> |
| Chromium             | 20.5–23.0              | 20.0–24.0              | 26.0–30.0              | 21.0–23.0              |
| Cobalt               | 0.5–2.5                | 5.0                    | 27.0–33.0              | 16.0–21.0              |
| Molybdenum           | 8.0–10.0               | 1.0–3.00               | 1.0                    | 2.5–4.0                |
| Tungsten             | 0.2–1.0                | 13.0–15.0              | 1.0                    | 2.0–3.5                |
| Carbon               | 0.05–0.15              | 0.05–0.15              | 0.15                   | 0.05–0.15              |
| Silicon              | 1.00                   | 0.25–0.75              | 2.4–3.0                | 0.20–0.80              |
| Manganese            | 1.00                   | 0.30–1.00              | 1.5                    | 0.50–2.00              |
| Phosphorus           | 0.04                   | 0.030                  | 0.030                  | 0.04                   |
| Sulfur               | 0.03                   | 0.015                  | 0.015                  | 0.015                  |
| Niobium <sup>C</sup> | ...                    | ...                    | 1.0                    | 0.30                   |
| Tantalum             | ...                    | ...                    | ...                    | 0.30–1.25              |
| Aluminum             | ...                    | 0.50                   | ...                    | 0.10–0.50              |
| Zirconium            | ...                    | ...                    | ...                    | 0.001–0.10             |
| Lanthanum            | ...                    | 0.005–0.050            | ...                    | 0.005–0.10             |
| Nitrogen             | ...                    | ...                    | ...                    | 0.10–0.30              |
| Boron                | ...                    | 0.015                  | ...                    | 0.02                   |
| Titanium             | ...                    | ...                    | 0.20–0.80              | ...                    |

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

<sup>B</sup> The composition of the remainder element shall be determined arithmetically by difference.

<sup>C</sup> Columbium and Niobium are interchangeable names for the same element and both names are acceptable for use in B02.07 specifications.

**TABLE 2 Mechanical Property Requirements**

| UNS                 | Tensile Strength, min, ksi (MPa) | Yield Strength (0.2 % Offset), min, ksi (MPa) | Elongation in 2 in. (50.8mm) or 4D <sup>A</sup> min, % |
|---------------------|----------------------------------|-----------------------------------------------|--------------------------------------------------------|
| N06002              | 95 (660)                         | 35 (240)                                      | 35                                                     |
| N06230 <sup>B</sup> | 110 (760)                        | 45 (310)                                      | 40                                                     |
| N12160 <sup>C</sup> | 90 (620)                         | 35 (240)                                      | 40                                                     |
| R30556 <sup>D</sup> | 100 (690)                        | 45 (310)                                      | 40                                                     |

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

<sup>B</sup> Solution annealed at a temperature between 2200 °F to 2275 °F (1204 °C to 1246 °C) followed by a water quench or rapidly cooled by other means.

<sup>C</sup> Solution annealed at 1950 °F (1065 °C) minimum.

<sup>D</sup> Solution annealed at 2100 °F (1150 °C) minimum.

## 6. Chemical Composition

6.1 The material shall conform to the chemical composition prescribed in **Table 1**.

6.2 If a product (check) analysis is made by the purchaser, it shall be done in conformance with Specification **B880**.

## 7. Mechanical and Other Requirements

7.1 The mechanical properties of the material at room temperature shall conform to those shown in **Table 2**.

7.2 *Grain Size*—Annealed alloy (UNS N12160) shall conform to an average grain size of ASTM Number 5 or coarser.

## 8. Dimensions, Mass, 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  $\frac{11}{16}$  in. (7.94 mm to 17.46 mm) inclusive, 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, a  $\frac{1}{4}$  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 calculations of mass or weight, the following densities shall be used:

| Alloy  | Density             |                      |
|--------|---------------------|----------------------|
|        | lb/in. <sup>3</sup> | (g/cm <sup>3</sup> ) |
| N06002 | 0.297               | (8.23)               |
| N06230 | 0.324               | (8.97)               |
| N12160 | 0.292               | (8.08)               |
| R30556 | 0.297               | (8.23)               |

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.