



Designation: B425 – 19

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

This standard is issued under the fixed designation B425; 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 nickel-iron-chromium-molybdenum-copper alloys (UNS N06845, UNS N08221, UNS N08825, and UNS N08827)<sup>3</sup> in the form of hot-finished and cold-drawn rounds, squares, hexagons, and rectangles.

1.2 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.

1.3 The following precautionary caveat pertains only to the test methods portion, Section 12, of this specification: *This standard does not purport to address all of the safety problems, 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.*

1.4 *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>4</sup>

**B424 Specification for Ni-Fe-Cr-Mo-Cu Alloy (UNS**

<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-425 in Section II of that code.

<sup>3</sup> New designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

<sup>4</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.

**N08825, UNS N08221, and UNS N06845) Plate, Sheet, and Strip**

**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 [Metric] E0008\_E0008M**

**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 *Definitions of Terms Specific to This Standard:*

3.1.1 *bar, n*—material of rectangular (flats), hexagonal, or square solid section up to and including 10 in. (254 mm) in width and 1/8 in. (3.2 mm) and over in thickness in straight lengths.

3.1.1.1 *Discussion*—Hot-worked rectangular bar in widths 10 in. (254 mm) and under may be furnished as hot-rolled plate with sheared or cut edges in accordance with Specification B424, provided the mechanical property requirements of this specification are met.

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

4.1.1 ASTM designation and date of issue,

4.1.2 UNS number,

4.1.3 *Section*—Rod (round) or bar (square, hexagonal, or rectangular),

4.1.4 *Dimensions*, including length,

4.1.5 Condition (see **Appendix X1**),

4.1.6 Finish (see **Appendix X1**),

4.1.7 *Quantity*—Feet (or metres) or number of pieces,

4.1.8 *Certification*—State if certification is required (Section 15),

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

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

| Element           | UNS N06845 | UNS N08221 | UNS N08825 | UNS N08827  |
|-------------------|------------|------------|------------|-------------|
| Nickel            | 44.0–50.0  | 39.0–46.0  | 38.0–46.0  | 39.0–43.0   |
| Chromium          | 20.0–25.0  | 20.0–22.0  | 19.5–23.5  | 21.0–23.0   |
| Iron <sup>B</sup> | balance    | balance    | 22.0 min   | balance     |
| Manganese         | 0.5        | 1.0        | 1.0        | 0.5–0.9     |
| Carbon            | 0.05       | 0.025      | 0.05       | 0.015       |
| Copper            | 2.0–2.4    | 1.5–3.0    | 1.5–3.0    | 1.6–2.3     |
| Silicon           | 0.5        | 0.5        | 0.5        | 0.2–0.5     |
| Sulfur            | 0.010      | 0.03       | 0.03       | 0.005       |
| Aluminum          | ...        | 0.2        | 0.2        | 0.06–0.25   |
| Titanium          | ...        | 0.6–1.0    | 0.6–1.2    | ...         |
| Molybdenum        | 5.0–7.0    | 5.0–6.5    | 2.5–3.5    | 4.5–6.5     |
| Tungsten          | 2.0–5.0    | ...        | ...        | ...         |
| Cobalt            | ...        | ...        | ...        | 0.5         |
| Nitrogen          | ...        | ...        | ...        | 0.03        |
| Columbium         | ...        | ...        | ...        | 0.15        |
| Boron             | ...        | ...        | ...        | 0.002–0.004 |
| Magnesium         | ...        | ...        | ...        | 0.006–0.015 |

<sup>A</sup> Maximum unless range or minimum is given. Where ellipses (...) appear in this table, there is no requirement and analysis for the element need not be determined or reported.

<sup>B</sup> Element shall be determined arithmetically by difference.

**TABLE 2 Mechanical Properties (Rod and Bar)**

| Alloy      | Condition                              | Tensile Strength<br>min, ksi (MPa) | Yield Strength<br>0.2 % offset, min,<br>ksi (MPa) | Elongation in 2<br>in. or 50 mm or<br>4 <sup>D</sup> , min, % |
|------------|--|------------------------------------|---|---|
| UNS N06845 | All sizes annealed                     | 100 (690)                          | 40 (276)  | 30  |
| UNS N08221 | All sizes annealed                     | 79 (544)                           | 34 (235)  | 30  |
| UNS N08825 | Annealed:<br>Hot-finished, cold-drawn  | 85 (586)                           | 35 (241)  | 30 <sup>A</sup>   |
| UNS N08827 | Forging Quality:<br>All sizes annealed | <sup>B</sup><br>85 (586)           | <sup>B</sup><br>35 (241)                          | <sup>B</sup><br>30 <sup>A</sup>                               |

<sup>A</sup> Not applicable to diameters or cross sections under 3/32 in. (2.4 mm).

<sup>B</sup> Forging quality is furnished to chemical requirements and surface inspection only. No tensile properties are required.

4.1.9 *Samples for Product (Check) Analysis*—State whether samples for product (check) analysis should be furnished (see 5.2), and

4.1.10 *Purchaser Inspection*—If purchaser wishes to witness tests or inspection of material at place of manufacture, the purchase order must so state, indicating which test or inspections are to be witnessed (Section 13).

## 5. Chemical Composition

5.1 The material shall conform to the composition limits specified in Table 1.

5.2 If a product (check) analysis is performed by the purchaser, it shall be done in accordance with Specification B880 and the material shall conform to the product (check) analysis variations defined in Table 1 of Specification B880.

## 6. Mechanical Properties and Other Requirements

6.1 *Mechanical Properties*—The material shall conform to the mechanical properties specified in Table 2.

## 7. Dimensions and Permissible Variations

7.1 *Diameter, Thickness, or Width*—The permissible variations from the specified dimensions as measured on the diameter or between parallel surfaces of cold-worked rod and bar shall be as prescribed in Table 3, and of hot-worked rod and bar as prescribed in Table 4.

**TABLE 3 Permissible Variations in Diameter or Distance Between Parallel Surfaces of Cold-Worked Rod and Bar**

| Specified Dimension,<br>in.<br>(mm) <sup>A</sup> | Permissible Variations From<br>Specified Dimension, in. (mm) |              |
|--|--|--------------|
|  | Plus   | Minus        |
| Rounds:  | 0  |              |
| 1/16 (1.6) to 3/16 (4.8), excl                   |  | 0.002 (0.05) |
| 3/16 (4.8) to 1/2 (12.7), excl                   | 0  | 0.003 (0.08) |
| 1/2 (12.7) to 15/16 (23.8), incl                 | 0.001 (0.03)   | 0.002 (0.05) |
| Over 15/16 (23.8) to 115/16 (49.2), incl         | 0.0015 (0.04)  | 0.003 (0.08) |
| Over 115/16 (49.2) to 21/2 (63.5), incl          | 0.002 (0.05)   | 0.004 (0.10) |
| Hexagons, squares, rectangles:                   |  |              |
| 1/2 (12.7) and less                              | 0  | 0.004 (0.10) |
| Over 1/2 (12.7) to 7/8 (22.2), incl              | 0  | 0.005 (0.13) |
| Over 7/8 (22.2) to 11/4 (31.8), incl             | 0  | 0.007 (0.18) |
| Over 1 1/4 (31.8) to 2 (50.8), incl              | 0  | 0.009 (0.23) |

<sup>A</sup> Dimensions apply to diameter of rounds, to distance between parallel surfaces of hexagons and squares, and separately to width and thickness of rectangles.

7.2 *Out-of-Round*—Hot-worked rods and cold-worked rods (except “forging quality”) all sizes, in straight lengths, shall not be out-of-round by more than one half the total permissible variations in diameter shown in Table 3 and Table 4, except for hot-worked rods 1/2 in. (12.7 mm) in diameter and under, which may be out-of-round by the total permissible variations in diameter shown in Table 4.

7.3 *Corners*—Cold-worked bars will have practically exact angles and sharp corners.