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## Standard Specification for ~~Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221) Rod and Bar~~ Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825, UNS N08221, and UNS N06845) 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 alloy (UNS N08825, UNS N08221, and UNS ~~N08221~~)\*N06845)<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 Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>4</sup>

B424 Specification for Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825, UNS ~~N08221~~, N08821, 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

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

<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> 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.

<sup>4</sup> New designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

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

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),
- 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.

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 ½ 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.

7.4 *Machining Allowances for Hot-Worked Materials* —When the surfaces of hot-worked products are to be machined, the allowances prescribed in Table 5 are recommended for normal machining operations.

7.5 *Length*—The permissible variations in length of cold-worked and hot-worked rod and bar shall be as prescribed in Table 6.

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

Element	UNS N08825	UNS N08221	UNS N06845
Nickel	38.0–46.0	39.0–46.0	
Nickel	38.0–46.0	39.0–46.0	44.0–50.0
Chromium	19.5–23.5	20.0–22.0	
Chromium	19.5–23.5	20.0–22.0	20.0–25.0
Iron <sup>A</sup>	22.0 min	balance	
Iron <sup>B</sup>	22.0 min	balance	balance
Manganese	1.0	1.0	0.5
Manganese	1.0 max	1.0 max	
Carbon	0.05 max	0.025 max	
Carbon	0.05	0.025	0.05
Copper	1.5–3.0	1.5–3.0	
Copper	1.5–3.0	1.5–3.0	2.0–2.4
Silicon	0.5 max	0.5 max	
Silicon	0.5	0.5	0.5
Sulfur	0.03 max	0.03 max	
Sulfur	0.03	0.03	0.010
Aluminum	0.2 max	0.2 max	
Aluminum	0.2	0.2	...
Titanium	0.6–1.2	0.6–1.0	
Titanium	0.6–1.2	0.6–1.0	...
Molybdenum	2.5–3.5	5.0–6.5	5.0–7.0
Tungsten	...	...	2.0–5.0

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

<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.

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

Specified Dimension, in. (mm) <sup>A</sup>	Permissible Variations From Specified Dimension, in. (mm)	
	Plus	Minus
<b>Rounds:</b>		
1/16 (1.6) to 3/16 (4.8), excl	0	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 2 1/2 (63.5), incl	0.002 (0.05)	0.004 (0.10)
<b>Hexagons, squares, rectangles:</b>		
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 1 1/4 (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.

**TABLE 4 Permissible Variations in Diameter or Distance  
Between Parallel Surfaces of Hot-Worked Rod and Bar**

Specified Dimension, in. (mm) <sup>A</sup>	Permissible Variations From Specified Dimension, in. (mm)	
	Plus	Minus
<b>Rod and bar, hot-worked:</b>		
1 (25.4) and under	0.016 (0.41)	0.016 (0.41)
over 1 (25.4) to 2 (50.8), incl	0.031 (0.79)	0.016 (0.41)
over 2 (50.8) to 4 (101.6), incl	0.047 (1.19)	0.031 (0.79)
over 4 (101.6)	0.125 (3.18)	0.063 (1.60)
<b>Rod, rough-turned or ground:</b>		
Under 1 (25.4)	0.005 (0.13)	0.005 (0.13)
1 (25.4) and over	0.031 (0.79)	0
<b>Forging quality rod:<sup>B</sup></b>		
Under 1 (25.4)	0.005 (0.13)	0.005 (0.13)
1 (25.4) and over	0.031 (0.79)	0

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

<sup>B</sup> Spot grinding is permitted to remove minor surface imperfections. The depth of these spot ground areas shall not exceed 3 % of the diameter of the rod.

7.5.1 Rods and bars ordered to random or nominal lengths will be furnished with either cropped or saw-cut ends; material ordered to cut lengths will be furnished with square saw-cut or machined ends.

#### 7.6 Straightness:

7.6.1 The permissible variations in straightness of cold-worked rod and bar as determined by the departure from straightness shall be as prescribed in Table 7.

7.6.2 The permissible variations in straightness of hot-worked rod and bar as determined by the departure from straightness shall be as specified in Table 8.

### 8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and condition, smooth, commercially straight or flat, and free of injurious imperfections.

### 9. Sampling

#### 9.1 Lot—Definition :