Designation: ~~B425 – 11~~ B425 – 11 (Reapproved 2017)

Standard Specification for Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825, UNS N08221, and UNS N06845) Rod and Bar[1]

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

1. ~~Scope*~~Scope

1.1 This specification[2] covers nickel-iron-chromium-molybdenum-copper alloy (UNS N08825, UNS N08221, and UNS N06845)[3] 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)~~(SDS) for this product/material as provided by the manufacturer, to establish appropriate ~~safety~~ safety, health, and ~~health~~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:*[4]

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

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 ⅛ 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.

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[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 related Specification SB-425 in Section II of that code.

[3] New designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

[4] 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~~standard's Document Summary page on the ASTM website.

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

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),

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.

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.

TABLE 1 Chemical Requirements[A]

Element	UNS N08825	UNS N08221	UNS N06845
Nickel	38.0–46.0	39.0–46.0	44.0–50.0
Chromium	19.5–23.5	20.0–22.0	20.0–25.0
Iron[B]	22.0 min	balance	balance
Manganese	1.0	1.0	0.5
Carbon	0.05	0.025	0.05
Copper	1.5–3.0	1.5–3.0	2.0–2.4
Silicon	0.5	0.5	0.5
Sulfur	0.03	0.03	0.010
Aluminum	0.2	0.2	...
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

[A] 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.
[B] 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^D, min,%
UNS N08825	*Annealed:* Hot-finished, cold–drawn	85 (586)	35 (241)	30[A]
	Forging Quality:	[B]	[B]	[B]
UNS N08221	All sizes annealed	79 (544)	34 (235)	30
UNS N06845	All sizes annealed	100 (690)	40 (276)	30

[A] Not applicable to diameters or cross sections under 3⁄32 in. (2.4 mm).
[B] 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)[A]	Permissible Variations From 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 1 15⁄16 (49.2), incl	0.0015 (0.04)	0.003 (0.08)
Over 1 15⁄16 (49.2) to 2 1⁄2 (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 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)

[A] 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.~~ in.(mm) ~~(mm)~~[A]	Permissible Variations From Specified Dimension, in. (mm)	
	Plus	Minus
Rod and bar, hot-worked:		
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)
Rod, rough-turned or ground:		
Under 1 (25.4)	0.005 (0.13)	0.005 (0.13)
1 (25.4) and over	0.031 (0.79)	0
Forging quality rod:[B]		
Under 1 (25.4)	0.005 (0.13)	0.005 (0.13)
1 (25.4) and over	0.031 (0.79)	0

[A] Dimensions apply to diameter of rods, to distance between parallel surfaces of hexagons and squares, and separately to width and thickness of rectangles.
[B] 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.

7.6 *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—*~~*Lot—Definition:* ~~*Definition :*~~

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

TABLE 5 Normal Machining Allowances for Hot-Worked Material

Finished-Machined Dimensions for Finishes As Indicated Below, in. (mm)[A]	Normal Machining Allowance, in. (mm)			
	On Diameter, for Rods	Distance Between Parallel Surfaces, for Hexagonal and Square Bars	For Rectangular Bar	
			On Thickness	On Width
Hot-worked:[B]				
Up to 7/8 (22.2), incl	1/8 (3.2)	1/8 (3.2)	1/8 (3.2)	3/16 (4.8)
Over 7/8 to 1 7/8 (22.2 to 47.6), incl	1/8 (3.2)	3/16 (4.8)	1/8 (3.2)	3/16 (4.8)
Over 1 7/8 to 2 7/8 (47.6 to 73.0), incl.	3/16 (4.8)	1/4 (6.4)	...	3/16 (4.8)
Over 2 7/8 to 3 13/16 (73.0 to 96.8), incl	1/4 (6.4)	...	...	3/16 (4.8)
Over 3 13/16 (96.8)	1/4 (6.4)	...	...	3/8 (9.5)
Hot-worked rods, rough-turned or rough ground:[C]				
15/16 to 4 (23.8 to 101.6), incl in diameter	1/16 (1.6)	...	...	...
Over 4 to 12 (101.6 to 304.8), incl in diameter	1/8 (3.2)	...	...	...

[A] Dimensions apply to diameter of rods, to distance between parallel surfaces of hexagonal and square bar, and separately to width and thickness of rectangular bar.
[B] The allowances for hot-worked material in Table 5 are recommended for rods machined in lengths of 3 ft (0.91 m) or less and for bars machined in lengths of 2 ft (0.61 m) or less. Hot-worked material to be machined in longer lengths should be specified showing the finished cross-sectional dimension and the length in which the material will be machined in order that the manufacturer may supply material with sufficient oversize, including allowance for out-of-straightness.
[C] Applicable to 3 ft (0.91 m) max length.

TABLE 6 Permissible Variations in Length of Rods and Bars

Random mill lengths:	
~~Random mill lengths:~~	
Hot-worked	6 to 24 ft (1.83 to 7.31 m) long with not more than 25 weight % between 6 and 9 ft (1.83 and 2.74 m)[A]
Cold-worked	6 to 20 ft (1.83 to 6.1 m) long with not more than 25 weight % between 6 and 10 ft (1.83 and 3.05 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. (6.4 mm) will be made for cutting, unless otherwise specified. At the manufacturer's option, individual specified unit lengths may be furnished.~~
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. (6.4 mm) will 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.[B]
Cut lengths	A specified length to which all rods and bars will be cut with a permissible variation of plus 1/8 in. (3.2 mm), minus 0 for sizes 8 in. (203 mm) and less in diameter or distance between parallel surfaces. For larger sizes, the permissible variation shall be + 1/4 in. (6.4 mm), – 0.

[A] For hot-worked sections weighing over 25 lb/ft (37 kg/m) and for smooth forged products, all sections, short lengths down to 2 ft (610 mm) may be furnished.
[B] For cold-worked rods and bars under 1/2 in. (12.7 mm) in diameter or distance between parallel surfaces ordered to nominal or stock lengths with a 2-ft (610-mm) range, at least 93 % of such material shall be within the range specified; the balance may be in shorter lengths but in no case shall lengths less than 4 ft (1220 mm) be furnished.

9.1.2 A lot for mechanical properties testing shall consist of all material from the same heat, nominal diameter or thickness, and condition.

9.1.2.1 Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material in the same size and condition. A single piece weighing over 500 lb shall be considered as one lot.

9.2 *Test Material Selection:*

9.2.1 *Chemical Analysis*—Representative samples from each lot shall be taken during pouring or subsequent processing.

9.2.1.1 Product (check) analysis shall be wholly the responsibility of the purchaser.