



Designation: B473 – 24

Standard Specification for Nickel-Iron-Chromium-Molybdenum-Copper Alloy Bar and Wire¹

This standard is issued under the fixed designation B473; 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 specification² covers UNS N08020 bar and wire other than required for reforging.

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 *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.*

1.4 *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:*³

[A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels](#)

[B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys](#)

[B889 Specification for Solid Hard-Drawn Aluminum Wire](#)

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-473 in Section II of that Code.

³ 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.

[for Electrical Purposes \(Withdrawn 2003\)](#)⁴

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys](#)

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions for terms defined in Terminology B889 shall apply unless otherwise defined by the requirements of this document.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 The terms bar and wire as used in this specification are described as follows:

3.2.2 *bars, n*—hot-finished rounds, squares, octagons, and hexagons: $\frac{1}{4}$ in. (6.35 mm) and over in diameter or size. Hot-finished flats: $\frac{1}{4}$ in. to 10 in. (254 mm), inclusive, in width, $\frac{1}{8}$ in. (3.175 mm) and over in thickness. Cold-finished rounds, squares, octagons, hexagons, and shapes: over $\frac{1}{2}$ in. (12.7 mm) in diameter or size. Cold-finished flats: $\frac{3}{8}$ in. (9.525 mm) and over in width (see Discussion (1)), $\frac{1}{8}$ in. and over in thickness (see Discussion (2)).

3.2.2.1 *Discussion*—(1) Widths less than $\frac{3}{8}$ in. (9.525 mm) and thicknesses less than $\frac{3}{16}$ in. (4.75 mm) are generally described as flat wire.

3.2.2.2 *Discussion*—(2) Thicknesses $\frac{1}{8}$ in. (3.175 mm) to under $\frac{3}{16}$ in. (4.75 mm) can be cold-rolled strip as well as bar.

3.2.3 *wire, n*—cold finished only: round, square, octagon, hexagon, and shape wire, $\frac{1}{2}$ in. (12.7 mm) and under in diameter or size. Cold-finished only: flat wire, $\frac{3}{16}$ in. (4.76 mm) to under $\frac{3}{8}$ in. (9.525 mm) in width, 0.010 in. (0.254 mm) to under $\frac{3}{16}$ in. in thickness.

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 The last approved version of this historical standard is referenced on www.astm.org.

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

TABLE 1 Chemical Requirements

Element	Composition, %	
	UNS N08020	
Carbon, max	0.07	
Manganese, max	2.00	
Phosphorus, max	0.045	
Sulfur, max	0.035	
Silicon, max	1.00	
Nickel	32.00 to 38.00	
Chromium	19.00 to 21.00	
Molybdenum	2.00 to 3.00	
Copper	3.00 to 4.00	
Columbium (Nb) + tantalum	8 × carbon–1.00	
Nitrogen	...	
Iron	remainder ^A	

^A By difference.

TABLE 2 Mechanical Property Requirements^A

Condition	Diameter or Thickness, in. (mm)	Tensile Strength, min		Yield Strength, min		Elongation in 2 in. (50.8 mm), min, %	Reduction of area, min, %
		ksi	MPa	ksi	MPa		
Annealed, hot finished or cold finished	All	80	551	35	241	30.0 ^B	50.0
Annealed, strain-hardened	Up to 2 (50.8) incl	90	620	60	415	15.0	40.0

^A For wire only, tensile strength 90 ksi to 120.0 ksi (620 MPa to 830 MPa); no requirements on yield strength, elongation, and reduction of area.

^B Cold-finished shapes require only 15 %, minimum, elongation.

- 4.1.1 Quantity (weight or number of pieces),
- 4.1.2 Name of material or UNS number,
- 4.1.3 Form (bar or wire),
- 4.1.4 Dimensions,
- 4.1.5 Condition,
- 4.1.6 Finish,
- 4.1.7 ASTM designation and year of issue,
- 4.1.8 Inspection (15.1),
- 4.1.9 Supplementary requirements, if any, and
- 4.1.10 If possible, the intended end use.

NOTE 1—A typical ordering description is as follows: 200 bars, UNS N08020, 1 in. (25.4 mm) round by 10 ft to 14 ft (3.0 m to 3.6 m), centerless ground, Specification B473.

5. Materials and Manufacture

5.1 *Heat Treatment*—The product of UNS N08020 alloy shall be furnished in the stabilized-annealed condition.

NOTE 2—The recommended annealing temperatures all followed by quenching in water or rapidly cooling by other means are as follows: 1700 °F to 1850 °F (927 °C to 1010 °C) for UNS N08020.

6. Chemical Composition

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

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations prescribed in Specification **B880**.

7. Condition

7.1 Bars shall be furnished annealed and either hot finished or cold finished. Strain-hardened material is available only as cold finished.

7.2 Wire will be furnished only as annealed and cold finished.

8. Mechanical Properties

8.1 The material shall conform to the applicable requirements as to mechanical properties prescribed in **Table 2**.

9. Dimensions and Permissible Variations

9.1 *Bar*—Bars shall conform to the variations in dimensions prescribed in **Tables 3-11**, inclusive, as applicable.

9.2 *Wire*—Wire shall conform to the permissible variations in dimensions prescribed in **Tables 12-16**, inclusive, as applicable.

10. Workmanship, Finish, and Appearance

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

11. Sampling

11.1 *Lot*:

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

11.1.2 A lot for mechanical properties shall consist of all material from the same heat, nominal diameter or thickness, of each heat-treatment charge.

11.2 *Test Material Selection*:

11.2.1 *Chemical Analysis*—Representative samples shall be taken during pouring or subsequent processing.

11.2.1.1 *Check analysis* shall be wholly the responsibility of the purchaser.

TABLE 3 Permissible Variations in Size of Hot-Rolled Round and Square Bars

	Permissible Variations from Specified Size, in. (mm)		Out-of-Round ^A or Out-of-Square, ^B in. (mm)
	Over	Under	
1/4 (6.35) to 5/16 (7.94), incl ^{C,D}	<i>E</i>	<i>E</i>	<i>E</i>
Over 5/16 (7.94) to 7/16 (11.11), incl ^{C,D}	0.006 (0.15)	0.006 (0.15)	0.009 (0.23)
Over 7/16 (11.11) to 5/8 (15.88), incl ^{C,D}	0.007 (0.18)	0.007 (0.18)	0.010 (0.25)
Over 5/8 (15.88) to 7/8 (22.22), incl	0.008 (0.20)	0.008 (0.20)	0.012 (0.30)
Over 7/8 (22.22) to 1 (25.40), incl	0.009 (0.23)	0.009 (0.23)	0.013 (0.33)
Over 1 (25.40) to 1 1/8 (28.58), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1 1/8 (28.58) to 1 1/4 (31.75), incl	0.011 (0.28)	0.011 (0.28)	0.016 (0.41)
Over 1 1/4 (31.75) to 1 3/8 (34.92), incl	0.012 (0.30)	0.012 (0.30)	0.018 (0.46)
Over 1 3/8 (34.92) to 1 1/2 (38.10), incl	0.014 (0.36)	0.014 (0.36)	0.021 (0.53)
Over 1 1/2 (38.10) to 2 (50.80), incl	1/64 (0.40)	1/64 (0.40)	0.023 (0.58)
Over 2 (50.80) to 2 1/2 (63.50), incl	1/32 (0.79)	0	0.023 (0.58)
Over 2 1/2 (63.50) to 3 1/2 (88.90), incl	3/64 (1.19)	0	0.035 (0.89)
Over 3 1/2 (88.90) to 4 1/2 (114.30), incl	1/16 (1.59)	0	0.046 (1.17)
Over 4 1/2 (114.30) to 5 1/2 (139.70), incl	5/64 (1.98)	0	0.058 (1.47)
Over 5 1/2 (139.70) to 6 1/2 (165.10), incl	1/8 (3.18)	0	0.070 (1.78)
Over 6 1/2 (165.10) to 8 (203.20), incl	5/32 (3.97)	0	0.085 (2.18)

^A Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross section.

^B Out-of-square section is the difference in the two dimensions at the same cross section of a square bar, each dimension being the distance between opposite faces.

^C Size tolerances have not been evolved for rounds in the size range of 1/4 in. to 5/16 in. (6.35 mm to 7.94 mm), inclusive. Size tolerances have not been evolved for round sections in the size range of 1/4 in. to approximately 5/8 in. (6.35 mm to 15.88 mm) in diameter which are produced on rod mills in coils.

^D Variations in size of coiled product made on rod mills are greater than size tolerances for product made on bar mills.

^E Squares in this size are not produced as hot-rolled products.

TABLE 4 Permissible Variations in Size of Hot-Rolled Hexagonal and Octagonal Bars

Specified Sizes Measured Between Opposite Sides, in. (mm)	Permissible Variations from Specified Size, in. (mm)		Maximum Difference in 3 Measurements for Hexagons only, in. (mm)
	Over	Under	
1/4 (6.35) to 1/2 (12.70), incl	0.007 (0.18)	0.007 (0.18)	0.011 (0.28)
Over 1/2 (12.70) to 1 (25.40), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1 (25.40) to 1 1/2 (38.10), incl	0.021 (0.53)	0.021 (0.53)	0.025 (0.64)
Over 1 1/2 (38.10) to 2 (50.80), incl	1/32 (0.79)	1/32 (0.79)	1/32 (0.79)
Over 2 (50.80) to 2 1/2 (63.50), incl	3/64 (1.19)	3/64 (1.19)	3/64 (1.19)
Over 2 1/2 (63.50) to 3 1/2 (88.90), incl	1/16 (1.59)	1/16 (1.59)	1/16 (1.59)

TABLE 5 Permissible Variations in Thickness and Width for Hot-Rolled Flat Bars

Specified Width, in. (mm)	Permissible Variations in Thickness for Thicknesses Given, in. (mm)					
	1/8 (3.18) to 1/2 (12.70), incl		Over 1/2 (12.70) to 1 (25.40), incl		Over 1 (25.40) to 2 (50.80), incl	
	Over	Under	Over	Under	Over	Under
To 1 (25.40), incl	0.008 (0.20)	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)	...	...
Over 1 (25.40) to 2 (50.80), incl	0.012 (0.30)	0.012 (0.30)	0.015 (0.38)	0.015 (0.38)	0.031 (0.79)	0.031 (0.79)
Over 2 (50.80) to 4 (101.60), incl	0.015 (0.38)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.031 (0.79)	0.031 (0.79)
Over 4 (101.60) to 6 (152.40), incl	0.015 (0.38)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.031 (0.79)	0.031 (0.79)
Over 6 (152.40) to 8 (203.20), incl	0.016 (0.41)	0.016 (0.41)	0.025 (0.64)	0.025 (0.64)	0.031 (0.79)	0.031 (0.79)
Over 8 (203.20) to 10 (254.00), incl	0.021 (0.53)	0.021 (0.53)	0.031 (0.79)	0.031 (0.79)	0.031 (0.79)	0.031 (0.79)
	Over 2 (50.80) to 4 (101.60), incl		Over 4 (101.60) to 6 (152.40), incl		Over 6 (152.40) to 8 (203.20), incl	
	Over	Under	Over	Under	Over	Under
To 1 (25.40), incl	...	...	...	...	...	...
Over 1 (25.40) to 2 (50.80), incl	...	...	...	...	...	...
Over 2 (50.80) to 4 (101.60), incl	0.062 (1.57)	0.031 (0.79)	...	...	...	...
Over 4 (101.60) to 6 (152.40), incl	0.062 (1.57)	0.031 (0.79)	0.093 (2.36)	0.062 (1.57)	...	...
Over 6 (152.40) to 8 (203.20), incl	0.062 (1.57)	0.031 (0.79)	0.093 (2.36)	0.062 (1.57)	0.125 (3.18)	0.156 (3.96)
Over 8 (203.20) to 10 (254.00), incl	0.062 (1.57)	0.031 (0.79)	0.093 (2.36)	0.062 (1.57)	0.125 (3.18)	0.156 (3.96)
Specified Width, in. (mm)	Permissible Variations in Width, in. (mm)					
	Over			Under		
To 1 (25.40), incl	0.015 (0.38)			0.015 (0.38)		
Over 1 (25.40) to 2 (50.80), incl	0.031 (0.79)			0.031 (0.79)		
Over 2 (50.80) to 4 (101.60), incl	0.062 (1.57)			0.031 (0.79)		
Over 4 (101.60) to 6 (152.40), incl	0.093 (2.36)			0.062 (1.57)		
Over 6 (152.40) to 8 (203.20), incl	0.125 (3.18)			0.156 (3.96)		
Over 8 (203.20) to 10 (254.00), incl	0.156 (3.96)			0.187 (4.75)		