Designation: B473 – 07 (Reapproved 2018)

Standard Specification for UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire[1]

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 specification[2] covers UNS N08020, UNS N08026, and UNS N08024 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

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 of Terms Specific to This Standard:*

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

3.1.2 *bars, n*—hot-finished rounds, squares, octagons, and hexagons: ¼ in. (6.35 mm) and over in diameter or size. Hot-finished flats: ¼ to 10 in. (254 mm), inclusive, in width, ⅛ in. (3.175 mm) and over in thickness. Cold-finished rounds, squares, octagons, hexagons, and shapes: over ½ in. (12.7 mm) in diameter or size. Cold-finished flats: ⅜ in. (9.525 mm) and over in width (see Discussion (*1*)), ⅛ in. and over in thickness (see Discussion (*2*)).

3.1.2.1 *Discussion*—(*1*) Widths less than ⅜ in. (9.525 mm) and thicknesses less than 3⁄16 in. (4.75 mm) are generally described as flat wire.

3.1.2.2 *Discussion*—(*2*) Thicknesses ⅛ in. (3.175 mm) to under 3⁄16 in. (4.75 mm) can be cold-rolled strip as well as bar.

3.1.3 *wire, n*—cold finished only: round, square, octagon, hexagon, and shape wire, ½ in. (12.7 mm) and under in diameter or size. Cold-finished only: flat wire, 3⁄16 in. (4.76 mm) to under ⅜ in. (9.525 mm) in width, 0.010 in. (0.254 mm) to under 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:

4.1.1 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),

[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.

TABLE 1 Chemical Requirements

Element	Composition, %		
	UNS N08026	UNS N08020	UNS N08024
Carbon, max	0.03	0.07	0.03
Manganese, max	1.00	2.00	1.00
Phosphorus, max	0.03	0.045	0.035
Sulfur, max	0.03	0.035	0.035
Silicon, max	0.50	1.00	0.50
Nickel	33.00 to 37.20	32.00 to 38.00	35.00 to 40.00
Chromium	22.00 to 26.00	19.00 to 21.00	22.50 to 25.00
Molybdenum	5.00 to 6.70	2.00 to 3.00	3.50 to 5.00
Copper	2.00 to 4.00	3.00 to 4.00	0.50 to 1.50
Columbium (Nb) + tantalum	...	8 × carbon–1.00	0.15 to 0.35
Nitrogen	0.10 to 0.16	...	...
Iron	remainder[A]	remainder[A]	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 to 120.0 ksi (620 to 830 MPa); no requirements on yield strength, elongation, and reduction of area.
[B] Cold-finished shapes require only 15 %, minimum, elongation.

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 to 14 ft (3.0 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. The product of UNS N08026 alloy shall be furnished in the solution-annealed condition. The product of UNS N08024 alloy shall be furnished in the annealed condition.

NOTE 2—The recommended annealing temperatures all followed by quenching in water or rapidly cooling by other means are as follows: 1700 to 1850°F (927 to 1010°C) for UNS N08020, 2050 to 2200°F (1121 to 1204°C) for UNS N08026, and 1925 to 1975°F (1052 to 1079°C) for UNS N08024.

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.

11.2.2 *Mechanical Properties*—Samples of the material to provide test specimens shall be taken from such locations in each lot as to be representative of that lot.

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	
¼ (6.35) to 5⁄16 (7.94), incl[C,D]	[E]	[E]	[E]
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 1⅛ (28.58), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1⅛ (28.58) to 1¼ (31.75), incl	0.011 (0.28)	0.011 (0.28)	0.016 (0.41)
Over 1¼ (31.75) to 1⅜ (34.92), incl	0.012 (0.30)	0.012 (0.30)	0.018 (0.46)
Over 1⅜ (34.92) to 1½ (38.10), incl	0.014 (0.36)	0.014 (0.36)	0.021 (0.53)
Over 1½ (38.10) to 2 (50.80), incl	1⁄64 (0.40)	1⁄64 (0.40)	0.023 (0.58)
Over 2 (50.80) to 2½ (63.50), incl	1⁄32 (0.79)	0	0.023 (0.58)
Over 2½ (63.50) to 3½ (88.90), incl	3⁄64 (1.19)	0	0.035 (0.89)
Over 3½ (88.90) to 4½ (114.30), incl	1⁄16 (1.59)	0	0.046 (1.17)
Over 4½ (114.30) to 5½ (139.70), incl	5⁄64 (1.98)	0	0.058 (1.47)
Over 5½ (139.70) to 6½ (165.10), incl	⅛ (3.18)	0	0.070 (1.78)
Over 6½ (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 ¼ to 5⁄16 in. (6.35 to 7.94 mm), inclusive. Size tolerances have not been evolved for round sections in the size range of ¼ in. to approximately 5⁄8 in. (6.35 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	
¼ (6.35) to ½ (12.70), incl	0.007 (0.18)	0.007 (0.18)	0.011 (0.28)
Over ½ (12.70) to 1 (25.40), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1 (25.40) to 1½ (38.10), incl	0.021 (0.53)	0.021 (0.53)	0.025 (0.64)
Over 1½ (38.10) to 2 (50.80), incl	1⁄32 (0.79)	1⁄32 (0.79)	1⁄32 (0.79)
Over 2 (50.80) to 2½ (63.50), incl	3⁄64 (1.19)	3⁄64 (1.19)	3⁄64 (1.19)
Over 2½ (63.50) to 3½ (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)					
	⅛ (3.18) to ½ (12.70), incl		Over ½ (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 (154.00), 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)