Designation: B672 – 02 (Reapproved 2013)

Standard Specification for Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Bar and Wire[1]

This standard is issued under the fixed designation B672; 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 covers nickel-iron-chromium-molybdenum-columbium stabilized alloy (UNS N08700)* bar.

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 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:*[2]

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 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 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 in. to 10 in. (254 mm), inclusive, in width, ⅛ in. (3.18 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. (9.52 mm) and over in width (see 3.1.2), ⅛ in. and over in thickness.

(*1*) Thickness 0.125 in. to under 0.187 in. (3.18 mm to under 4.76 mm) can be cold-rolled as well as bar.

3.1.3 *wire, n*—Cold-finished only: round, square, octagon, hexagon, and shape wire, ½ in. and under in diameter or size. Cold-finished only: flat wire, 3⁄16 in. (4.76 mm) to under 0.375 in. (9.52 mm) in width, 0.010 in. (0.254 mm) to under 3⁄16 in. thickness.

4. Ordering Information

4.1 Orders for material under this specification should include the following information:

4.1.1 Quantity (weight or number of pieces).

4.1.2 Name of material or UNS N08700.

4.1.3 Form (bar).

4.1.4 Dimensions.

4.1.5 Finish.

4.1.6 ASTM designation and year of issue.

4.1.7 *Corrosion Test*—State if intergranular corrosion test is required (Supplementary Requirements).

4.1.8 *Certification or Test Reports*—State if certification or test reports are required (Section 14).

NOTE 1—A typical ordering description is as follows: 200 bars, UNS N08700, 1 in. (25.4 mm) round by 10 to 14 ft (3.0 to 4.3 m), centerless ground, ASTM B672 dated____.

5. Materials and Manufacture

5.1 *Heat Treatment*—The final treatment shall be a solution anneal. Straightening or cold finishing, or both, may be performed after the final solution annealing operation. Cold drawing to more than a minor sizing reduction (preferred maximum 5 % in area) after final solution annealing is not recommended.

[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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* New designation established in accordance with ASTM E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

[2] 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.

NOTE 2—The recommended solution anneal consists of heating to a minimum temperature of 2000°F (1090°C) and cooling rapidly to room temperature.

6. Chemical Composition

6.1 Heat analysis, on samples in accordance with 11.2, shall conform to the requirements as to chemical composition prescribed in Table 1.

6.2 If a product analysis is performed by the purchaser, the material shall conform to the composition limits within the product analysis variation prescribed in Specification B880.

7. Mechanical Properties

7.1 The material shall conform to the requirements as to the mechanical property prescribed in Table 2.

8. Dimensions and Permissible Variations

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

9. Workmanship, Finish, and Appearance

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

10. Sampling

10.1 *Lot*—Definition:

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

10.1.2 A lot for mechanical properties or corrosion testing (Supplementary Requirement S1) shall consist of all material from a heat and cross-sectional size, heat treated by the same practice.

10.2 *Test Material Selection:*

10.2.1 *Chemical Analysis*—A representative sample from each lot shall be taken during pouring or subsequent processing.

10.2.1.1 *Product Check Analysis* shall be wholly the responsibility of the purchaser.

TABLE 1 Chemical Requirements

Element	Composition, %
Nickel	24.0 to 26.0
Iron	remainder[A]
Chromium	19.0 to 23.0
Molybdenum	4.3 to 5.0
Columbium	8 × carbon to 0.40
Carbon, max	0.04
Silicon, max	1.00
Manganese, max	2.00
Phosphorus, max	0.040
Sulfur, max	0.030
Copper, max	0.50

[A] Determined arithmetically by difference.

10.2.2 *Mechanical Properties and Corrosion Test* (Supplementary Requirement S1)—Samples of the material to provide test specimens shall be taken from such locations in each lot as to be representative of that lot.

11. Number of Tests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Mechanical Properties and Corrosion Test (Supplementary Requirement S1)*—One test per lot.

12. Test Methods

12.1 Determine the chemical composition, mechanical properties, and corrosion resistance of the material as enumerated in this specification, in case of disagreement, in accordance with the following methods:

Test	ASTM Designation
Corrosion test (Supplementary Requirement S1)	A262, Practice C
Chemical analysis	E1473[A]
Tension	E8
Rounding procedure	E29

[A] Iron shall be determined arithmetically by difference.

13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

14. Certification

14.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser stating that material has been manufactured, tested, and inspected in accordance with this specification, and that the test results on representative samples meet specification requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

15. Product Marking

15.1 Each bundle, box, or bar shall be properly tagged with metal tags showing heat number, UNS number, condition, specification number, and size to assure proper identification.

16. Packaging and Package Marking

16.1 Bars shall be bundled or boxed in such a manner as to assure safe delivery to their destination when properly transported by any common carrier.

17. Keywords

17.1 bar; nickel-iron-chromium-molybdenum-columbium; UNS N08700

TABLE 2 Mechanical Property Requirements

Condition	Material Dimensions, in.	Test Direction	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % Offset), min, ksi (MPa)	Elongation in 2 in. or 50.8 mm, or 4 *D*, min, %	Reduction of Area, min,%
Annealed, hot-finished or cold-finished	All	Longitudinal	80 (550)	35 (240)	30.0	50.0
Annealed, hot-finished or cold-finished	Widths, 3 and over[A]	Transverse	80 (550)	35 (240)	25.0	40.0

[A] If the material diameter or width is over 3 in. (76.2 mm), material may be tensile tested in the transverse direction.

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	
0.250 (6.35) to 0.312 (7.94), incl[C,D]	*E*	*E*	*E*
Over 0.312 (7.94) to 0.438 (11.11), incl[C,D]	0.006 (0.15)	0.006 (0.15)	0.009 (0.23)
Over 0.438 (11.11) to 0.625 (15.88), incl[C,D]	0.007 (0.18)	0.007 (0.18)	0.010 (0.25)
Over 0.625 (15.88) to 0.875 (22.22), incl	0.008 (0.20)	0.008 (0.20)	0.012 (0.30)
Over 0.875 (22.22) to 1.000 (25.40), incl	0.009 (0.23)	0.009 (0.23)	0.013 (0.33)
Over 1.000 (25.40) to 1.125 (28.58), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1.125 (28.58) to 1.250 (31.75), incl	0.011 (0.28)	0.011 (0.28)	0.016 (0.41)
Over 1.250 (31.75) to 1.375 (34.92), incl	0.012 (0.30)	0.012 (0.30)	0.018 (0.46)
Over 1.375 (34.92) to 1.500 (38.10), incl	0.014 (0.36)	0.014 (0.36)	0.021 (0.53)
Over 1.500 (38.10) to 2.000 (50.80), incl	0.016 (0.40)	0.016 (0.40)	0.023 (0.58)
Over 2.000 (50.80) to 2.500 (63.50), incl	0.031 (0.79)	0	0.023 (0.58)
Over 2.500 (63.50) to 3.500 (88.90), incl	0.047 (1.19)	0	0.035 (0.89)
Over 3.500 (88.90) to 4.500 (114.30), incl	0.063 (1.59)	0	0.046 (1.17)
Over 4.500 (114.30) to 5.500 (139.70), incl	0.078 (1.98)	0	0.058 (1.47)
Over 5.500 (139.70) to 6.500 (165.10), incl	0.125 (3.18)	0	0.070 (1.78)
Over 6.500 (165.10) to 8.000 (203.20), incl	0.156 (3.97)	0	0.085 (2.18)

[A] Out-of-round is the difference between the 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 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 0.250 to 0.312 in. (6.35) to 7.94 mm), inclusive. Size tolerances have not been evolved for round sections in the size range of 0.250 in. to approximately 0.625 in. (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	
0.250 (6.35) to 0.500 (12.70), incl	0.007 (0.18)	0.007 (0.18)	0.011 (0.28)
Over 0.500 (12.70) to 1.000 (25.40), incl	0.010 (0.25)	0.010 (0.25)	0.015 (0.38)
Over 1.000 (25.40) to 1.500 (38.10), incl	0.021 (0.53)	0.021 (0.53)	0.025 (0.64)
Over 1.500 (38.10) to 2.000 (50.80), incl	0.031 (0.79)	0.031 (0.79)	0.031 (0.79)
Over 2.000 (50.80) to 2.500 (63.50), incl	0.047 (1.19)	0.047 (1.19)	0.047 (1.19)
Over 2.500 (63.50) to 3.500 (88.90), incl	0.063 (1.59)	0.063 (1.59)	0.063 (1.59)

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

Specified Width, in. (mm)	Permissible Variations in Thickness for Thickness Given, in. (mm)					
	0.125 (3.18) to 0.500 (12.70), incl		Over 0.500 (12.70) to 1.000 (25.40), incl		Over 1.000 (25.40) to 2.000 (50.80), incl	
	Over	Under	Over	Under	Over	Under
To 1.000 (25.40), incl	0.008 (0.20)	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)		
Over 1.000 (25.40) to 2.000 (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 2.000 (50.80) to 4.000 (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 4.000 (101.60) to 6.000 (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 6.000 (152.40) to 8.000 (203.20), incl	0.016 (0.41)	0.016 (0.41)	0.025 (0.41)	0.025 (0.41)	0.031 (0.79)	0.031 (0.79)
Over 8.000 (203.20) to 10.000 (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 2.000 (50.80) to 4.000 (101.60), incl		Over 4.000 (101.60) to 5.000 (152.40), incl		Over 6.000 (152.40) to 8.000 (203.20), incl	
	Over	Under	Over	Under	Over	Under
To 1.000 (25.40), incl	...	...	...	...	...	...
Over 1.000 (25.40) to 2.000 (50.80), incl	...	...	...	...	...	...
Over 2.000 (50.80) to 4.000 (101.60), incl	0.062 (1.57)	0.031 (0.79)	...	...	...	...
Over 4.000 (101.60) to 6.000 (152.40), incl	0.062 (1.57)	0.031 (0.79)	0.093 (2.36)	0.062 (1.57)	...	...
Over 6.000 (152.40) to 8.000 (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 8.000 (203.20) to 10.000 (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 1.000 (25.40), incl	0.015 (0.38)	0.015 (0.38)
Over 1.000 (25.40) to 2.000 (50.80), incl	0.031 (0.79)	0.031 (0.79)
Over 2.000 (50.80) to 4.000 (101.60), incl	0.062 (1.57)	0.031 (0.79)
Over 4.000 (101.60) to 6.000 (152.40), incl	0.093 (2.36)	0.062 (1.57)
Over 6.000 (152.40) to 8.000 (203.20), incl	0.125 (3.18)	0.156 (3.96)
Over 8.000 (203.20) to 10.000 (254.00), incl	0.156 (3.96)	0.187 (4.75)

TABLE 6 Permissible Variations in Size of Cold-Finished Round Bars

Specified Size, in. (mm)	Permissible Variations from Specified Size, in. (mm)[A,B]	
	Over	Under
Over 0.500 (12.70) to 1.000 (25.40), excl	0.002 (0.05)	0.002 (0.05)
1.000 (25.40) to 1.500 (38.10), excl	0.0025 (0.06)	0.0025 (0.06)
1.500 (38.10) to 4.000 (101.60), incl[C]	0.003 (0.08)	0.003 (0.08)

[A] Unless otherwise specified, size tolerances are over and under as shown in Table 7. When required, however, they may be specified all over and nothing under, or all under and nothing over, or any combination of over and under, if the total spread in size tolerance for a specified size is not less than the total spread shown in the table.

[B] When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown in the table.

[C] Cold-finished bars over 4 in. (101.60 mm) in diameter are produced; size tolerances for such bars have not been evolved.

TABLE 7 Permissible Variations in Size of Cold-Finished Hexagonal, Octagonal, and Square Bars

Specified Size, in. (mm)	Permissible Variations from Specified Size, in. (mm)[A]	
	Over	Under
Over 0.500 (12.70) to 1.000 (25.40), incl	0	0.004 (0.10)
Over 1.000 (25.40) to 2.000 (50.80), incl	0	0.006 (0.15)
Over 2.000 (50.80) to 3.000 (76.20), incl	0	0.008 (0.20)
Over 3.000 (76.20)	0	0.010 (0.25)

[A] When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown in the table.

TABLE 8 Permissible Variations in Width and Thickness of Cold-Finished Flat Bars

Width, in. (mm)	Permissible Variations in Width, over and under, in. (mm)[A]	
	For Thicknesses 0.250 (6.35) and Under	For Thickness Over 0.250 (6.35)
0.375 (9.52) to 1.000 (25.40), incl	0.004 (0.10)	0.002 (0.05)
Over 1.000 (25.40) to 2.000 (50.80), incl	0.006 (0.15)	0.003 (0.08)
Over 2.000 (50.80) to 3.000 (76.20), incl	0.008 (0.20)	0.004 (0.10)
Over 3.000 (76.20) to 4.500 (114.30), incl	0.010 (0.25)	0.005 (0.13)

Thickness, in. (mm)	Permissible Variations in Thickness, over and under, in. (mm)[A]
0.125 (3.18) to 1.000 (25.40), incl	0.002 (0.05)
Over 1.000 (25.40) to 2.000 (50.80), incl	0.003 (0.08)
Over 2.000 (50.80) to 3.000 (76.20), incl	0.004 (0.10)
Over 3.000 (76.20) to 4.500 (114.30), incl[B]	0.005 (0.13)

[A] When it is necessary to heat treat and pickle after cold finishing, size tolerances are double those shown in the table.
[B] Cold-finished flat bars over 4.500 in. (114.30 mm) wide or thick are produced; width and thickness tolerances for such bars have not been evolved.

TABLE 9 Permissible Variations in Length of Hot-Finished or Cold-Finished Bars[A]

NOTE 1—The order should specify random lengths. When random lengths are ordered, the length tolerance is not less than 24 in. (609.60 mm). When specified lengths are ordered, Table 10 or Table 11 shall apply.

Specified Size of Rounds, Squares, Hexagons, and Octagons and Widths of Flats, in. (mm)	Permissible Variations in Length, in. (mm)			
	For Lengths Up to 12 ft (3658 mm), incl		For Lengths Over 12 ft (3658 mm) to 25 ft (7620 mm), incl	
	Over	Under	Over	Under
To 2.000 (50.80), incl	0.500 (12.7)	0	0.750 (19.1)	0
Over 2.000 (50.80) to 4.000 (101.60), incl	0.750 (19.0)	0	1.000 (25.4)	0
Over 4.000 (101.60) to 6.000 (152.40), incl	1.000 (25.4)	0	1.250 (31.8)	0
Over 6.000 (152.40) to 9.000 (228.60), incl	1.250 (31.8)	0	1.500 (38.1)	0
Over 9.000 (228.60) to 12.000 (304.8), incl	1.500 (38.1)	0	2.000 (50.8)	0

[A] The maximum width of bar flats is 10 in. (254.00 mm).

TABLE 10 Permissible Variations in Length of Hot-Finished or Cold-Finished Bars Machine Cut After Machine Straightening

NOTE 1—The order should specify random lengths or specific lengths. When random lengths are ordered, the length tolerance is not less than 24 in. (609.60 mm). When specific lengths are ordered, Table 10 or Table 11 shall apply.

Specified Size of Rounds, Squares, Hexagons, and Octagons and Widths of Flats,[A] in. (mm)	For Lengths Up to 12 ft (3658 mm), incl		For Lengths Over 12 (3658 mm) to 25 ft (7620 mm), incl	
	Over	Under	Over	Under
To 3.000 (76.20), incl	0.125 (3.2)	0	0.063 (4.8)	0
Over 3.000 (76.20) to 6.000 (152.40), incl	0.063 (4.8)	0	0.250 (6.4)	0
Over 6.000 (152.40) to 9.000 (228.60), incl	0.250 (6.4)	0	0.188 (7.9)	0
Over 9.000 (228.60) to 12.000 (304.80), incl	0.500 (12.7)	0	0.500 (12.7)	0

[A] The maximum width of bar flats is 10 in. (254.00 mm).

TABLE 11 Permissible Variations in Straightness of Machine Straightened Hot-Finished or Cold-Finished Bars

Measurement is taken on the concave side of the bar with a straightedge. Unless otherwise specified, hot-finished or cold-finished bars for machining purposes are furnished machine straightened to the following tolerances:
Hot finished:
0.125 in. (3.2 mm) in any 5 ft (1524 mm), but may not exceed 0.125 in. × (length in feet (mm))/(5 ft (1524 mm))
Cold finish:
0.063 in. (1.6 mm) in any 5 ft (1524 mm), but may not exceed 0.063 in. × (length in feet (mm))/(5 ft (1524 mm))

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement may be made a requirement when the purchaser specifies it to be applicable.

S1. Intergranular Corrosion Test

S1.1 Material shall pass an intergranular corrosion test. Specimens taken in the as-supplied condition, sensitized 1 h at 1250°F (677°C), and tested in accordance with Practice C of Practices A262 shall exhibit a corrosion rate equal to or less than 2.5 mils/month (165 mg/dm^2 · day).