

Rod & Bar, Nickel-Chromium-Iron Alloy

EMPIS Material B14H89 identifies age-hardened nickel-chromium-iron alloy rod and bar, similar to UNS N07718 and ASTM B637, as follows:

EMPIS designation	Description
B14H89A (1)	Hot-finished, solution heat-treated
B14H89A2 (2)	Hot-finished, solution heat-treated and artificially aged
B14H89A3	Hot-finished, solution heat-treated and artificially aged

- (1) For Power Systems Gas Turbine Applications B50A809 Class B, with capability to meet Class D requirements, may be supplied for EMPIS Material B14H89A.
- (2) For Power Systems Gas Turbine Applications, B50A809 Class D may be supplied for EMPIS Material B14H89A2.

CHEMICAL COMPOSITION: %

Nickel and cobalt	50.0 - 55.0
Chromium	17.0 - 21.0
Iron	Remainder
Columbium plus tantalum	4.75 - 5.50
Molybdenum	2.80 - 3.30
Titanium	0.65 - 1.15
Aluminum	0.20 - 0.80
Carbon, max	0.08
Boron, max	0.006
Cobalt, max	1.00
Manganese, max	0.35
Silicon, max	0.35
Copper, max	0.30
Phosphorus, max	0.015
Sulfur, max	0.015

MECHANICAL PROPERTIES:

	B14H89A Room temperature (3)	B14H89A2 Room temperature	B14H89A2 1200 °F
Tensile strength, psi, min	-	185,000	145,000
Yield strength, psi, min	-	150,000	125,000
Elongation, % in 2 inch or 4D, min	-	12	12
Reduction of area, %, min	-	15	15
Brinell hardness number, HB:			
Up to 1/2 inch incl (4)	277 max (5)	346-450 (6)	-
Over 1/2 inch (4)	277 max (5)	331 min (7)	-

(3) EMPIS Material B14H89A after aging treatment (anneal at 1700 - 1850 °F, air cool or faster to room temperature, age at 1325 °F for eight hours, furnace cool to 1150 °F per hour, hold at 1150 °F for total aging time of 18 hours and air cool) shall meet the properties specified above for B14H89A2.

(4) Diameter or distance between parallel surfaces.

(5) Rockwell C, HRC 28.5 maximum.

(6) Rockwell C, HRC 38-48.

(7) Rockwell C, HRC 36.

ADDITIONAL REQUIREMENTS:

Process - This steel shall be made by the electric furnace process. Processing may include remelting by the consumable electrode vacuum arc remelt process (VAR). Secondary refining is acceptable. Material may be ingot or strand continuous cast.

Discard - A sufficient discard shall be taken from each ingot to insure freedom from piping and undue segregation.

Heat treatments:

B14H89A2 - Solution treat at 1700 - 1850 °F, air cool or faster to room temperature, age at 1325 °F/8 hr, F.C. to 1150 °F, hold at 1150 °F for total aging time of 18 hr, A.C.

The 1700 - 1850 °F solution treatment with its corresponding aging treatment as shown above is the optimum heat treatment for alloy 718 where a combination of rupture life, notch rupture life and rupture ductility is of greatest concern. The highest room-temperature tensile and yield strengths are also associated with this treatment. In addition, because of the fine grain developed, it produces the highest fatigue strength.

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ADDITIONAL REQUIREMENTS: (Continued)

Heat treatments: (Continued)

B14H89A3 - Solution treat at 1900 - 1950°F, air cool or faster to room temperature, age at 1400 °F/10 hr, F.C. to 1200 °F, hold at 1200 °F for total aging time of 20 hr, A.C.

The 1900 - 1950 °F anneal with its corresponding aging treatment as shown above is the treatment preferred in tensile-limited applications because it produces the best transverse ductility in heavy sections, impact strength, and low-temperature notch tensile strength. However, this treatment has a tendency to produce notch brittleness in stress rupture, and is often used for improved corrosion resistance.

These treatments are based on metal temperatures and have been derived from batch rather than continuous furnace operations. The annealing temperatures outlined above therefore may not be applicable to continuous operations, since continuous annealing is normally accomplished by short exposure in the hot zone of a furnace set at higher temperatures. Continuous annealing has been recognized as a valuable production tool, and society specifications allow flexibility of annealing procedures so that either continuous or batch operations may be used.

Imperfections - Material shall be free from seams, pipes, flaws, cracks, scale, fins, porosity, hard spots, excessive nonmetallic inclusions and segregation and all other imperfections which may be injurious to the intended application.

REFEREE METHODS:

Chemical composition

ASTM E 38

Tension test

ASTM E 8

Brinell hardness

ASTM E 10

Inclusion content

ASTM E 45

TOLERANCES:

Diameter:

Rounds:

Specified size, inch		Size tolerance, inch	
		Over	Under
1	to 1, excl	0.002	0.002
1 1/2	to 1 1/2, excl	0.0025	0.0025
2	to 2, incl	0.003	0.003
Over 2	to 4, incl	0.000	0.031
Over 4	to 6, incl	0.000	0.046
Over 6	to 8 1/4, incl	0.000	0.062

Width and thickness:

Hot - rolled flats

Width, inch		Tolerance, inch			
		Width		Thickness	
Over	To incl	Minus	Plus	Minus	Plus
-	1	0.00	0.030	0.00	0.016
1	2	0.00	0.040	0.00	0.020
2	3	0.00	0.050	0.00	0.035
3	4	0.00	0.060	0.00	0.040
4	6	0.00	0.070	0.00	0.050
6	8	0.00	0.080	0.00	0.060
8	10	0.00	0.090	0.00	0.070

Hammered flats:

Width, inch		Tolerance, inch							
		Width		Thickness, inch					
				To 2 inch, incl		Over 2 to 4 inch, incl		Over 4 inches	
Over	To incl	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus
-	2	0.00	0.078	0.00	0.063	-	-	-	-
2	4	0.00	0.109	0.00	0.078	0.00	0.094	-	-
4	6	0.00	0.172	0.00	0.109	0.00	0.125	0.00	0.156
6	8	0.00	0.203	0.00	0.141	0.00	0.186	0.00	0.219

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TOLERANCES:

Out-of squareness:

Length of the diagonals drawn from opposite corners of the bar shall be equal to within the following limitations:

Width, inch		Tolerance, inch, difference in length of diagonals
Over	To incl	
-	2	0.031
2	4	0.062
4	8	0.075
8	10	0.090

Edgewise curvature, maximum

1/8 inch in 8 feet

Length: (Random)

All sizes

±12 inch

Length: (Specific)

Specific diameter of rounds or width of flats, incl	Length tolerance, inch			
	Length to 12 feet, incl		Lengths over 12 to 25, incl	
	Over	Under	Over	Under
To 3, incl	1/8	0	3/16	0
Over 3 to 6, incl	3/16	0	1/4	0
Over 6 to 9, incl	1/4	0	5/16	0
Over 9 to 12, incl	1/2	0	1/2	0

Camber - 1/8 inch in any 5 ft, but may not exceed 1/8 x $\frac{\text{No. of ft of length}}{5}$

CERTIFICATE OF TEST:

When requested, the supplier shall submit promptly to the purchaser at the point of delivery a certificate of test showing the results of tests for chemical analysis and properties required by this specification. This certificate shall be addressed to the section, unit, or person specified on the purchase order, and shall contain the EMPIS designation, the purchase order number, and the quantity shipped so that the certificate may be identified with the shipment.

PACKING AND MARKING:

Material shall be properly separated by size for shipment and shall be packed in such a manner as to be suitably protected from injury or loss during shipment.

Each box, crate, bundle, etc. shall be legibly marked with the purchase order number, the supplier's name, the weight, the dimensions and the EMPIS designation.