



Designation: B407 – 22

Standard Specification for Nickel-Iron-Chromium Alloy Seamless Pipe and Tube¹

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1. Scope*

1.1 This specification² covers UNS N08120, UNS N08800, UNS N08801, UNS N08810, UNS N08811, UNS N08890, and UNS N06811 in the form of cold-worked and hot-finished annealed seamless pipe and tube. Alloys UNS N08800 and UNS N06811 are normally employed in service temperatures up to and including 1100 °F (593 °C). Alloys UNS N08120, UNS N08810, UNS N08811, and UNS N08890 are normally employed in service temperatures above 1100 °F (593 °C) where resistance to creep and rupture is required, and they are annealed to develop controlled grain size for optimum properties in this temperature range.

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 safety hazards caveat pertains only to the test method portion, Section 7, of this specification. *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 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

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-407 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.

B829 Specification for General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

3. General Requirements

3.1 Material furnished under this specification shall conform to the applicable requirements of Specification B829 unless otherwise specified herein.

4. Ordering Information

4.1 Orders for material to this specification should include information with respect to the following:

4.1.1 Alloy (Table 1).

4.1.2 Condition temper (Table 2, Table X3.1, Appendix X2, and Appendix X3).

4.1.3 Finish (Table X1.1 and Table X3.2).

4.1.4 Dimensions:

4.1.4.1 Tube—May be specified in two dimensions only (length excepted) as follows: outside diameter and average or minimum wall, inside diameter and average wall, or outside diameter and inside diameter.

NOTE 1—Tube produced to outside diameter and minimum wall may be furnished upon agreement between the manufacturer and the purchaser.

4.1.4.2 Pipe—Standard pipe size and schedule (Table X3.1).

4.1.5 Fabrication Details—Not mandatory but helpful to the manufacturer:

4.1.5.1 Cold bending or coiling.

4.1.5.2 Hot forming.

4.1.5.3 Welding or Brazing—Process to be employed.

4.1.5.4 Pressure Requirements—Test pressure if other than required by 7.3.

4.1.5.5 Machining—Indicate finished size and length in which to be machined and whether to be chucked to outside diameter or inside diameter.

4.1.5.6 Ends—Plain ends cut and deburred will be furnished. If threaded ends or ends beveled for welding are desired, give details.

4.1.6 Certification—State if certification or a report of test results is required.

4.1.7 Samples for Product (Check) Analysis—State whether samples for product (check) analysis should be furnished (6.2).

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

TABLE 1 Chemical Requirements^A

Element	Composition Limits, %						
	UNS N08120	UNS N08800	UNS N08810	UNS N08811	UNS N08801	UNS N08890	UNS N06811
Nickel	35.0 – 39.0	30.0 – 35.0	30.0 – 35.0	30.0 – 35.0	30.0 – 34.0	40.0 – 45.0	38.0 – 46.0
Chromium	23.0 – 27.0	19.0 – 23.0	19.0 – 23.0	19.0 – 23.0	19.0 – 22.0	23.5 – 28.5	27.0 – 31.0
Iron	remainder	39.5 min ^B	39.5 min ^B	39.5 min ^B	39.5 min ^B	remainder	remainder
Manganese	1.5	1.5	1.5	1.5	1.5	1.5	2.0
Carbon	0.02 – 0.10	0.10	0.05 – 0.10	0.06 – 0.10	0.10	0.06 – 0.14	0.03
Copper	0.5	0.75	0.75	0.75	0.5	0.75	...
Silicon	1.0	1.0	1.0	1.0	1.0	1.0 – 2.0	0.60
Sulfur	0.03	0.015	0.015	0.015	0.015	0.015	0.010
Aluminum	0.40	0.15 – 0.60	0.15 – 0.60	0.25 – 0.60 ^C	...	0.05 – 0.60	...
Titanium	0.20	0.15 – 0.60	0.15 – 0.60	0.25 – 0.60 ^C	0.75 – 1.50	0.15 – 0.60	...
Molybdenum	2.50	...	...	...	...	1.0 – 2.0	0.50 – 1.50
Niobium ^D	0.4 – 0.9	...	...	...	...	0.2 – 1.0	...
Tantalum	...	...	...	...	...	0.10 – 0.60	...
Phosphorus	0.040	0.045	0.045	0.045	...	...	0.030
Tungsten	2.50	...	...	...	...	...	...
Cobalt	3.0	...	...	...	...	...	...
Nitrogen	0.15 – 0.30	...	...	...	...	...	0.10 – 0.20
Boron	0.010	...	...	...	...	...	...

^A All values are maximums unless specified as a minimum or a range is provided.

^B Iron shall be determined arithmetically by difference.

^C Alloy UNS N08811: Al + Ti = 0.85 – 1.20.

^D Columbium and Niobium are interchangeable names for the same element and both names are acceptable for use in B02.07 specifications.

TABLE 2 Mechanical Properties^A of Pipe and Tube

Alloy	Condition (Temper)	Tensile Strength, min, psi (MPa)	Yield Strength, (0.2 % offset), min, psi (MPa)	Elongation in 2 in. or 50 mm (or 4D), min, %
UNS N08120	hot-finished annealed or cold-worked annealed	90 000 (621)	40 000 (276)	30
UNS N08800	cold-worked annealed	75 000 (520)	30 000 (205)	30
UNS N08800	hot-finished annealed or hot-finished	65 000 (450)	25 000 (170)	30
UNS N08810 and UNS N08811	hot-finished annealed or cold-worked annealed	65 000 (450)	25 000 (170)	30
UNS N08801	hot-finished annealed or cold-worked annealed	65 000 (450)	25 000 (170)	30
UNS N08890	hot-finished annealed or cold-worked annealed	75 000 (520)	30 000 (205)	35
UNS N06811	hot-finished annealed or cold-worked annealed	85 000 (585)	35 000 (240)	30

^A For properties of small-diameter and light-wall tubing, see [Table X3.1](#).

4.1.8 *Purchaser Inspection*—If the purchaser wishes to witness tests or inspection of material at place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed.

4.1.9 *Small-Diameter and Light-Wall Tube*—(Converter Sizes) ([Table X3.2](#)).

4.1.10 *Optional Requirement*—Hydrostatic or Nondestructive Electric Test (see [7.3](#)).

5. Materials and Manufacture

5.1 *Heat Treatment*—The final heat treatment of UNS N08120 shall be 2150 °F (1177 °C) minimum, UNS N08810, 2050 °F (1121 °C) minimum, UNS N08811, UNS N08890, 2100 °F (1149 °C) minimum, and UNS N06811, 1920 °F (1050 °C) minimum.

6. Chemical Composition

6.1 The material shall conform to the composition limits specified 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 in Specification [B829](#).

7. Mechanical Properties and Other Requirements

7.1 *Mechanical Properties*—The material shall conform to the mechanical properties specified in [Table 2](#).

7.2 *Grain Size*—Annealed UNS alloys N08120, N08810, N08811, and UNS N08890 shall conform to an average grain size of ASTM No. 5 or coarser.

7.3 *Hydrostatic Test or Nondestructive Electric Test*—Each pipe or tube shall be subjected to either the hydrostatic test or the nondestructive electric test. The type of test to be used shall be at the option of the manufacturer, unless otherwise specified in the purchase order.

7.4 *Annealing Temperature*—Alloy UNS N08120 shall be annealed at 2150 °F (1177 °C) minimum, and UNS N08810 at 2050 °F (1120 °C) minimum.

8. Dimensions and Permissible Variations

8.1 Diameter and Wall Thickness:

8.1.1 The permissible variations in the outside and inside diameter and wall thickness of pipe and tube shall not exceed those prescribed in [Table 3](#) and [Table X3.2](#), as applicable.

8.1.2 Permissible variations given in [Table 3](#) and [Table X3.2](#) are applicable only to two dimensions. Thus, if outside

TABLE 3 Permissible Variations in Outside and Inside Diameter and Wall Thickness (Average Wall)

Specified Outside Diameter or Calculated Nominal Outside Diameter (When Ordered to Inside Diameter and Average Wall)	Permissible Variations			
	Outside Diameter or Inside Diameter		Wall Thickness, %	
	+	-	+	-
Cold-Finished ^{A,B,C,D} Pipe and Tube				
Inches				
0.500 to 5/8, excl	0.005	0.005	15.0	15.0
5/8 to 1 1/2, incl	0.0075	0.0075	10.0	10.0
Over 1 1/2 to 3 1/2, incl	0.010	0.010	10.0	10.0
Over 3 1/2 to 4 1/2, incl	0.015	0.015	10.0	10.0
Over 4 1/2 to 6, incl	0.020	0.020	12.5	12.5
Over 6 to 6 3/8, incl	0.025	0.025	12.5	12.5
Millimetres				
12.7 to 15.8, excl	0.127	0.127	15.0	15.0
15.8 to 38.1, incl	0.190	0.190	10.0	10.0
Over 38.1 to 88.9, incl	0.254	0.254	10.0	10.0
Over 88.9 to 114.3, incl	0.381	0.381	10.0	10.0
Over 114.3 to 152.4, incl	0.508	0.508	12.5	12.5
Over 152.4 to 168.3, incl	0.635	0.635	12.5	12.5
Hot-Finished Tube ^{E,F,G,H}				
Inches				
2 1/2 to 5 1/2, excl	0.031	0.031	12.5	12.5
5 1/2 to 9 1/4, incl	0.047	0.047	12.5	12.5
Millimetres				
63.5 to 139.7, excl	0.787	0.787	12.5	12.5
139.7 to 234.9, incl	1.19	1.19	12.5	12.5

^A The permissible variations in this table apply to individual measurements, including out-of-roundness (ovality), except for the following conditions.

1) *Thin-Wall Pipe and Tube*—For thin-wall pipe and tube having a nominal wall thickness of 3 % or less of the nominal outside diameter, in all conditions (temper), the mean outside diameter or mean inside diameter shall conform to the permissible variations of this table, and individual measurements (including ovality) shall conform to the plus and minus values of this table, with the values increased by 0.5 % of the nominal outside diameter.

2) *Annealed Pipe and Tube Over 4 1/2 in. (114.3 mm) in Nominal Outside Diameter*—For annealed pipe and tubing over 4 1/2 in. (114.3 mm) in nominal outside diameter with a nominal wall thickness greater than 3 % of the nominal outside diameter, the mean outside diameter or mean inside diameter shall conform to the permissible variations of this table, and individual measurements shall not exceed twice the permissible variations of this table.

^B For pipe and tube, in all tempers, with an inside diameter of less than 1/2 in. (12.70 mm) which cannot be successfully drawn over a mandrel, the inside diameter shall be governed by the outside diameter and the wall thickness variations.

^C For pipe and tube in all tempers with an inside diameter less than 50 % of the outside diameter, which cannot be successfully drawn over a mandrel, the inside diameter may vary over or under by an amount equal to 10 % of the nominal wall thickness and the wall thickness may vary ± 15 %.

^D *Eccentricity*—The variation in wall thickness in any one cross section of any one cold-finished pipe or tube shall not exceed ± 10 % of the actual (measured) average wall of that section (defined as the average of the thickest and the thinnest wall in that section).

^E For tube 5 in. (127.0 mm) and under in outside diameter the tolerance on the outside diameter applies for individual measurements and includes ovality. For tubes over 5 in. (127.0 mm) in outside diameter the mean outside diameter shall conform to the permissible variations of this table and individual measurements shall not exceed twice the permissible variations of this table.

^F The diameter tolerances for tube with machined outside and inside diameters shall be +0.031 in. (0.787 mm), -0 for the outside diameter and +0, -0.062 in. (1.57 mm) for the inside diameter.

^G If tube is specified as minimum wall, the tolerance shall be +28.5 %, -0.

^H The wall thickness tolerance includes eccentricity tolerance up to ± 12.5 %.

diameter and wall are specified, the inside diameter may not conform to the permissible variations shown. Similarly, if outside diameter and inside diameter are specified, the wall may not conform to the permissible variations shown.

8.2 *Length*—When pipe or tube is ordered cut to length, the length shall not be less than that specified, but a variation of +1/8 in. (3.2 mm) will be permitted for cold-worked material and +3/16 in. (4.8 mm) for hot-finished tube, except that for lengths over 30 ft (9.1 m), a variation of +1/4 in. (6.4 mm) will be permitted. For small-diameter and light-wall tube, material shall conform to the applicable requirements of **Table X3.2**.

8.3 *Straightness*—Cold-drawn material shall be reasonably straight and free of bends and kinks. For small-diameter and light-wall tube, material shall conform to the applicable requirements of **Table X3.2**. The camber (depth of chord) of hot-finished tube 5 in. (127 mm) in outside diameter and under

shall not exceed 0.01 in./ft (0.8 mm/m). For sizes over 5 in. in outside diameter, the camber shall not exceed 0.015 in./ft (1.4 mm/m).

9. Number of Tests

9.1 *Chemical Analysis*—One test per lot.

9.2 *Mechanical Properties*—One test per lot.

9.3 *Grain Size*—One test per lot.

9.4 *Hydrostatic or Nondestructive Electric Test*—Each piece per lot.

10. Keywords

10.1 seamless pipe; seamless tube; UNS N08120; UNS N08800; UNS N08801; UNS N08810; UNS N08811; UNS N08890; UNS N06811