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Standard Specification for General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube[1]

This standard is issued under the fixed designation B829; 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~~ Scope*

1.1 This specification contains various requirements that, with the exception of Sections 5 and 10, are mandatory requirements to the following ASTM nickel and nickel alloy, seamless pipe and tube specifications:

Title of Specification	ASTM Designation[2]
Nickel Seamless Pipe and Tube	B161
Seamless Nickel and Nickel Alloy, Condenser and Heat Exchanger Tubes	B163
Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube	B165
Nickel-Chromium-Iron Alloys (UNS N06600, N06601, and N06690) Seamless Pipe and Tube	B167
Nickel-Iron-Chromium Alloy Seamless Pipe and Tube	B407
Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825 and N08221) Seamless Pipe and Tube	B423
Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625) Pipe and Tube	B444
Nickel-Chromium-Iron-Columbium-Molybdenum-Tungsten Alloy (UNS N06102) Seamless Pipe and Tube	B445
Nickel-Iron-Chromium-Silicon Alloys (UNS N08330 and UNS N08332) Seamless Pipe	B535
Copper-Beryllium Alloy Forgings and Extrusion	B570
Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube	B622
UNS N08028 Seamless Tubes	B668
UNS N08904, UNS N08925 and UNS N08926 Seamless Pipe and Tube	B677
Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Seamless Pipe and Tube	B690
Ni-Cr-Mo-Co-W-Fe-Si Alloy (UNS N06333) Seamless Pipe and Tube	B722
Seamless UNS N08020, UNS N08026, and UNS N08024 Nickel-Alloy Pipe and Tube	B729

1.2 One or more of the test requirements of Section 5 apply only if specifically stated in the product specification or in the purchase order.

1.3 In case of conflict between a requirement of the product specification and a requirement of this general specification, only the requirement of the product specification needs to be satisfied.

1.4 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.

1.5 The following safety hazards caveat pertains only to the test requirements portion, Section 5, 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 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~~ safety, health, and ~~health~~environmental practices, and determine the applicability of regulatory limitations prior to use.*

[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 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.

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

1.6 *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:*[2]

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
E18 Test Methods for Rockwell Hardness of Metallic Materials
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E39 Methods for Chemical Analysis of Nickel (Withdrawn 1995)[3]
E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]
E112 Test Methods for Determining Average Grain Size
E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing
E426 Practice for Electromagnetic (Eddy Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys
E571 Practice for Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products
E1473 Test Methods for Chemical Analysis of Nickel, Cobalt and High-Temperature Alloys

2.2 *ANSI Standards:*[4]

B1.20.1 Pipe Threads
B36.10 Welded and Seamless Wrought Steel Pipe
B36.19 Stainless Steel Pipe

3. Terminology

3.1 *Definitions:*

3.1.1 *average diameter, n*—the average of the maximum and minimum outside diameters, as determined at any one cross section of the pipe or tube.

3.1.2 *nominal wall, n*—a specified wall thickness with a plus or minus tolerance from the specified thickness.

3.1.3 *seamless pipe, n*—a round hollow produced with a continuous periphery in all stages of manufacture, and produced to the particular dimensions commercially known as pipe sizes (NPS).

3.1.4 *seamless tube, n*—a tube produced with a continuous periphery in all stages of the operation.

3.1.5 *thin wall tube, n*—tube with specified wall thickness 3 % or less of the specified outside diameter.

4. Chemical Composition

4.1 In case of disagreement, the chemical composition shall be determined in accordance with the following methods.

UNS No. Prefixes	ASTM Method
N02	E39
N04	E76
N06, N08	E1473

4.2 The ladle analysis of the material shall conform to the chemical requirements prescribed by the individual product specification.

4.3 The product (check) analysis of the material shall meet the requirements for the ladle analysis within the tolerance limits prescribed in Specification B880.

5. Test Requirements

5.1 *Flare Test*—The flare test shall consist of flaring a test specimen with an expanding tool having an included angle of 60° until the specified outside diameter has been increased by 30 %. The flared specimen shall not exhibit cracking through the wall.

5.2 *Hydrostatic Test*—Each pipe or tube shall be tested by the manufacturer to an internal hydrostatic pressure of 1000 psi (6.9 MPa) provided that the fiber stress, calculated from the following equation, does not exceed the allowable fiber stress for the material:

$$P = 2St/D \quad (1)$$

where:

P = hydrostatic test pressure, psi (MPa),

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

S = allowable fiber stress, for material in the condition (temper) furnished as specified in the product specification (S is calculated as the lower of ⅔ of the specified minimum 0.2 % offset yield strength or ¼ of the specified minimum ultimate strength for the material),
t = minimum wall thickness permitted, in. (mm), including minus tolerance, if any, and
D = nominal outside diameter of the pipe or tube, in. (mm).

5.2.1 The test pressure must be held for a minimum of 5 s.

NOTE 1—Testing at a pressure greater than 1000 psi may be performed upon agreement between purchaser and manufacturer provided that the allowable fiber stress is not exceeded.

5.2.2 If any pipe or tube shows leaks during hydrostatic testing, it shall be rejected.

5.3 *Nondestructive Electric Test:*

5.3.1 *Eddy Current Testing*—Testing shall be conducted in accordance with Practices E426 or E571. The eddy current examination reference in this specification has the capability of detecting significant discontinuities, especially of the short, abrupt type.

5.3.1.1 Unless otherwise specified by the purchaser, the calibration standard shall contain, at the option of the manufacturer, any one of the following discontinuities to establish a minimum sensitivity level for rejection.

5.3.1.2 *Drill Hole*—A hole not larger than 0.031 in. (0.79 mm) diameter shall be drilled radially and completely through the wall, care being taken to avoid distortion of the material while drilling.

5.3.1.3 *Transverse Tangential Notch*—Using a round file or tool with a ¼ in. (6 mm) diameter, a notch shall be filed or milled on the tube or pipe outside diameter tangential to the surface and transverse to the longitudinal axis of the material. Said notch shall have a depth not exceeding 12.5 % of the specified wall thickness of the material, or 0.004 in. (0.10 mm), whichever is greater.

5.3.2 *Ultrasonic Testing*—Testing shall be conducted in accordance with Practice E213. The ultrasonic examination referred to in this specification is intended to detect longitudinal discontinuities having a reflective area similar to or larger than the calibration reference notches specified in 5.3.2.1. The examination may not detect circumferentially oriented imperfections or short, deep defects.

5.3.2.1 For ultrasonic testing, longitudinal calibration notches shall be machined on the outside and inside diameter surfaces. The depth of the notches shall not exceed 12.5 % of the specified wall thickness or 0.004 in. (0.10 mm), whichever is greater.

5.3.3 *Calibration Frequency*—The frequency of calibration checks shall be as follows:

5.3.3.1 At the beginning of each production run or lot.

5.3.3.2 At least every four hours during testing.

5.3.3.3 At the end of each production run or lot.

5.3.3.4 After any suspected equipment malfunction or work stoppage.

5.3.3.5 If, during any check, the equipment fails to detect the calibration defects, the instrument must be recalibrated and all material tested since the last satisfactory check shall be retested.

5.3.4 *Acceptance and Rejection*—Material producing a signal equal to or greater than the calibration defect shall be subject to rejection.

5.3.4.1 Test signals produced by imperfections that cannot be identified or produced by cracks or crack-like imperfections shall result in rejection of the pipe or tube, subject to rework and retest.

5.3.4.2 If the imperfection is judged as not fit for use, the tube shall be rejected, but may be reconditioned and retested providing the wall thickness requirements are met. To be accepted, retested material shall meet the original electric test requirements.

5.3.4.3 If the imperfection is explored to the extent that it can be identified, and the pipe or tube is determined to be fit for use, the material may be accepted without further testing, providing the imperfection does not encroach on minimum wall thickness requirements.

5.4 When specified by the purchaser, a nondestructive electric test, in accordance with Practices E213, E426, or E571, may be used for seamless pipe or tube, instead of the hydrostatic test.

5.5 *Tension Test*—Tension testing shall be conducted in accordance with Test Methods E8/E8M.

5.5.1 The material shall conform to the tensile properties prescribed in the individual product specification.

5.6 *Hardness Test*—Hardness testing shall be conducted in accordance with Test Methods E18.

5.7 *Grain Size*—The measurement of average grain size may be carried out by the planimetric method, the comparison method, or the intercept method described in Test Methods E112. In case of dispute, the "referee" method for determining average grain size shall be the intercept method.

5.8 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded in accordance with the rounding method of Practice E29:

Requirements	Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances	nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	nearest 1000 psi (7 MPa)
Elongation	nearest 1 %
Grain size	
0.0024 in. (0.060 mm) or larger	nearest multiple of 0.0002 in. (0.005 mm)
Less than 0.0024 in. (0.060 mm)	nearest multiple of 0.0001 in. (0.002 mm)

6. Dimensions and Permissible Variations

6.1 Dimensions of pipe are shown in Table 1.

6.1.1 Permissible variations in outside diameter and wall thickness are shown in Table 2, Table 3, and Table 4.

6.2 *Length*—When material is ordered as cut-to-length, the length shall conform to the permissible variations prescribed in Table 5. When material is ordered to random lengths, the lengths and variations shall be agreed upon between the manufacturer and purchaser.

6.3 *Straightness*—Material shall be reasonably straight and free of bends and kinks.

6.4 *Ends*—Ends shall be plain cut and deburred.

7. Workmanship, Finish, and Appearance

7.1 The material shall be uniform in quality and temper, smooth, and free from imperfections that would render it unfit for use.

8. Sampling

8.1 *Lot Definition:*

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

8.1.2 A lot for all other testing shall consist of all material from the same heat, nominal size (excepting length), and condition (temper). When final heat treatment is in a batch-type furnace, a lot shall include only those pipes or tubes of the same size and the same heat that are heat-treated in the same furnace charge. When heat treatment is in a continuous furnace, a lot shall include all pipes or tubes of the same size and heat, heat-treated in the same furnace at the same temperature, time at temperature, and furnace speed during one production run. At no time shall a lot consist of more than 20 000 lb (9100 kg).

TABLE 1 Dimensions of Pipe

NOTE 1—The following table is a reprint of Table 1 of ANSI B36.19.

NOTE 2—The decimal thicknesses listed for the respective pipe sizes represent their nominal wall dimensions.

NPS Designator	Outside Diameter		Nominal Wall Thickness							
			Schedule 5S^A		Schedule 10S^A		Schedule 40S		Schedule 80S	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1/8	0.405	10.29	...	...	0.049	1.24	0.068	1.73	0.095	2.41
1/4	0.540	13.72	...	...	0.065	1.65	0.088	2.24	0.119	3.02
3/8	0.675	17.15	...	...	0.065	1.65	0.091	2.31	0.126	3.20
1/2	0.840	21.34	0.065	1.65	0.083	2.11	0.109	2.77	0.147	3.73
3/4	1.050	26.67	0.065	1.65	0.083	2.11	0.113	2.87	0.154	3.91
1.0	1.315	33.40	0.065	1.65	0.109	2.77	0.133	3.38	0.179	4.55
1 1/4	1.660	42.16	0.065	1.65	0.109	2.77	0.140	3.56	0.191	4.85
1 1/2	1.900	48.26	0.065	1.65	0.109	2.77	0.145	3.68	0.200	5.08
2	2.375	60.33	0.065	1.65	0.109	2.77	0.154	3.91	0.218	5.54
2 1/2	2.875	73.03	0.083	2.11	0.120	3.05	0.203	5.16	0.276	7.01
3	3.500	88.90	0.083	2.11	0.120	3.05	0.216	5.49	0.300	7.62
3 1/2	4.000	101.60	0.083	2.11	0.120	3.05	0.226	5.74	0.318	8.08
4	4.500	114.30	0.083	2.11	0.120	3.05	0.237	6.02	0.337	8.56
5	5.563	141.30	0.109	2.77	0.134	3.40	0.258	6.55	0.375	9.52
6	6.625	168.28	0.109	2.77	0.134	3.40	0.280	7.11	0.432	10.97
8	8.625	219.08	0.109	2.77	0.148	3.76	0.322	8.18	0.500	12.70
10	10.750	273.05	0.134	3.40	0.165	4.19	0.365	9.27	0.500^B	12.70^B
12	12.750	323.85	0.156	3.96	0.180	4.57	0.375^B	9.52^B	0.500^B	12.70^B
14	14.000	355.60	0.156	3.96	0.188^B	4.78^B	...	...	...	...
16	16.000	406.40	0.165	4.19	0.188^B	4.78^B	...	...	...	...
18	18.000	457.20	0.165	4.19	0.188^B	4.78^B	...	...	...	...
20	20.000	508.00	0.188	4.78	0.218^B	5.54^B	...	...	...	...
22	22.000	558.80	0.188	4.78	0.218^B	5.54^B	...	...	...	...
24	24.000	609.60	0.218	5.54	0.250	6.35	...	...	...	...
30	30.000	762.00	0.250	6.35	0.312	7.92	...	...	...	...

^A Schedules 5S and 10S wall thicknesses do not permit threading in accordance with ANSI B1.20.1.
^B These do not conform to ANSI B36.10.