



Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube¹

This standard is issued under the fixed designation B622; 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.

^{ε1} NOTE—The Si max for R20033 in Table 1 was corrected editorially in March 2014.

1. Scope

1.1 This specification² covers seamless pipe and tube of nickel and nickel-cobalt alloys (UNS N10001, UNS N10242, UNS N10665, UNS N12160, UNS N10675, UNS N10276, UNS N06455, UNS N06007, UNS N08320, UNS N06975, UNS N06002, UNS N06985, UNS N06022, UNS N06035, UNS N08135, UNS N06255, UNS N06058, UNS N06059, UNS N06200, UNS N10362, UNS N06030, UNS N08031, UNS R30556, UNS N08535, UNS N06250, UNS N06060, UNS N06230, UNS N06686, UNS N10629, UNS N06210, UNS N10624, and UNS R20033)* as shown in **Table 1**.

1.2 Pipe and tube shall be supplied in the solution annealed and descaled condition. When atmosphere control is used, descaling is not necessary.

1.3 This specification is limited to tubes up to and including 3.5 in. (88.9 mm) outside diameter.

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 *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.*

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-622 in Section II of that Code.

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

2. Referenced Documents

2.1 ASTM Standards:³

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

E8 Test Methods for Tension Testing of Metallic Materials

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. Terminology

3.1 Definitions:

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

3.1.2 *pipe, n*—seamless tube conforming to the particular dimensions commercially known as standard pipe sizes (**Appendix X2**).

3.1.3 *tube, n*—a hollow product of round or any other cross section having a continuous periphery.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification **B829** unless otherwise provided herein.

5. Ordering Information

5.1 It is the responsibility of the purchaser to specify all requirements that are necessary for the material ordered under this specification. Examples of such requirements include, but are not limited to the following:

5.1.1 *Alloy* (**Table 1**).

5.1.2 *Dimensions*:

5.1.2.1 *Tube*—Outside diameter, minimum or average wall thickness, and length.

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

Composition Limits, %																								
	Ni	Cr	Mo	Fe	W	C	Si max	Co	Mn	V	P max	S max	Ti	Cu	Cb (Nb) +Ta	Al	Zr	La	N	B	Cb (Nb)	Ta	Ni+ Mo	Mg
Ni-Mo Alloys	Ni0001	remainder A	1.0 max	26.0- 30.0	4.0-6.0	...	0.05 max	1.0	2.5 max	1.0 max	0.2- 0.4	0.03	...	...	...									
	Ni0665	remainder A	1.0 max	26.0- 30.0	2.0 max	...	0.02 max	0.10	1.0 max	1.0 max	...	0.04	0.03	...	...									
	Ni0675	65.0 min	1.0- 27.0- 3.0	27.0- 32.0	1.0-3.0	3.0 max	0.01 max	0.10	3.0 max	3.0 max	0.20 max	0.030	0.010	0.20 max	0.20 max	...	0.50 max	0.10 max	...	...	...	0.20 max	0.20 max	94.0- 98.0
	Ni0629	remainder A	0.5- 26.0	32.0	1.0-6.0	...	0.01 max	0.05	2.5 max	1.5 max	...	0.04	0.01	...	0.5 max	...	0.1- 0.5	...	...	...	...	...	...	...
	Ni0624	remainder A	6.0- 21.0- 10.0	21.0- 25.0	5.0-8.0	...	0.01 max	0.10	1.0 max	1.0 max	...	0.025	0.01	...	0.5 max	...	...	...	...	...	...	...	...	...
Ni-Mo-Cr-Fe Alloy	Ni0242	remainder A	7.0- 24.0- 9.0	24.0- 26.0	2.0 max		0.03 max	0.80	0.80 max		0.030	0.015		0.50 max		0.50 max				0.006 max				
	Ni0276	remainder A	14.5- 16.5	15.0- 17.0	4.0-7.0	3.0- 4.5	0.010 max	0.08	2.5 max	1.0 max	0.35 max	0.04	0.03	...	...	...								
	N06022	remainder A	20.0- 12.5- 22.5	12.5- 14.5	2.0-6.0	2.5- 3.5	0.015 max	0.08	2.5 max	0.50 max	0.35 max	0.02	0.02	...	...	...								
	N06035	remainder A	32.25- 34.25	7.60- 9.00	2.00 max	0.60 max	0.050 max	0.60	1.00 max	0.50 max	0.20 max	0.030	0.015	...	0.30 max	...	0.40 max	...	...	...	...	...	...	...
	N06455	remainder A	14.0- 18.0	14.0- 17.0	3.0 max	...	0.015 max	0.08	2.0 max	1.0 max	...	0.04	0.03	0.70 max	...	...				...	...	...	...	...
Ni-Cr-Fe-Mo-Cu Alloys	Ni06007	remainder A	21.0- 23.5	5.5- 7.5	18.0-21.0	1.0 max	0.05 max	1.0	2.5 max	1.0- 2.0	...	0.04	0.03	...	1.5- 2.5	1.75- 2.5								
	N06975	47.0-52.0	23.0- 26.0	5.0- 7.0	remainder A	...	0.03 max	1.0	...	1.0 max	...	0.03	0.03	0.70- 1.50	0.70- 1.20	...								
	N06985	remainder A	21.0- 23.5	6.0- 8.0	18.0-21.0	1.5 max	0.015 max	1.0	5.0 max	1.0 max	...	0.04	0.03	...	1.5- 2.5	0.50 max								
	N06030	remainder A	28.0- 31.5	4.0- 6.0	13.0-17.0	1.5- 4.0	0.03 max	0.8	5.0 max	1.5 max	...	0.04	0.02	...	1.0- 2.4	0.30- 1.50								
	N06255	47.0-52.0	23.0- 26.0	6.0- 9.0	remainder A	3.0 max	0.03 max	1.0	...	1.0 max	...	0.03	0.03	0.69 max	1.2 max	...								
Ni-Fe-Cr-Mo Alloys	N06250	50.0-54.0	20.0- 23.0	10.1- 12.0	remainder A	0.25- 1.25	0.020 max	0.09	1.00 max	...	0.030	0.005	...	0.25- 1.25	...									
	Ni08320	25.0-27.0	21.0- 23.0	4.0- 6.0	remainder A	...	0.05 max	1.0	...	2.5 max	...	0.04	0.03	4xC min	...	...								
	N08135	33.0-38.0	20.5- 23.5	4.0- 5.0	remainder A	0.20- 0.80	0.030 max	0.75	...	1.00 max	...	0.03	0.03	...	...									
	N06002	remainder A	20.5- 23.0	8.0- 10.0	17.0-20.0	0.20- 1.0	0.05- 0.15	1.0	0.5- 2.5	1.0 max	...	0.04	0.03	...	...	...								
	N06060	54.0-60.0	19.0- 22.0	12.0- 14.0	remainder A	0.25- 1.25	0.03 max	0.50	...	1.50 max	...	0.030	0.005 max	...	0.25- 1.25	0.50- 1.25								
Ni-Fe-Cr-Co Alloy	R30556	19.0-22.5	21.0- 23.0	2.5- 4.0	remainder A	2.0- 3.5	0.05- 0.15	0.20- 0.80	0.50- 2.00	...	0.04	0.015	...	...	...	0.10- 0.50	0.001- 0.10	0.005- 0.10	0.10- 0.30	0.02 max	0.30 max	0.3- 1.25		



TABLE 1 Continued

Composition Limits, %																								
	Ni	Cr	Mo	Fe	W	C	Si max	Co	Mn	V	P max	S max	Ti	Cu	Cb (Nb) +Ta	Al	Zr	La	N	B	Cb (Nb)	Ta	Ni+ Mo	Mg
Ni-Cr-W-Mo Alloys																								
N06230	remainder A	20.0- 24.0	1.0- 3.0	3.0 max	13.0- 15.0	0.05- 0.15	0.25- 0.75	5.0 max	0.30- 1.00	...	0.03	0.015	...	...	...	0.50 max	...	0.005- 0.050	...	...	0.015 max	...	...	...
Low C-Ni- Cr-Mo																								
N06058	balance	20.0- 23.0	19.0- 21.0	1.5 max	0.3 max	0.010 max	0.10 max	0.3 max	0.50 max	...	0.015	0.005	...	0.50 max	...	0.40 max	...	...	0.02- 0.15	...	...	...	...	...
N06059	balance	22.0- 24.0	15.0- 16.5	1.5 max	...	0.010 max	0.10 max	0.3 max	0.5 max	...	0.015	0.010	...	0.50 max	...	0.1- 0.4	...	...	...	...	...	...	...	...
Low C-Ni- Cr-Mo-Cu Alloy																								
N06200	remainder A	22.0- 24.0	15.0- 17.0	3.0 max	...	0.010 max	0.08	2.0 max	0.50 max	...	0.025	0.010	...	1.3- 1.9	...	0.50 max	...	...	...	...	...	...	...	...
Low C-Ni- Mo-Cr Alloy																								
N10362	remainder A	13.8- 15.6	21.5- 23.0	1.25 max	...	0.010 max	0.08	...	0.60 max	...	0.025	0.010	...	...	...	0.50 max	...	...	...	...	...	...	...	...
Low C-Ni- Fe-Cr- Mo-Cu Alloys																								...
N08031	30.0-32.0	26.0- 28.0	6.0- 7.0	balance	...	0.015 max	0.3	...	2.0 max	...	0.020	0.010	...	1.0- 1.4	...	...	...	...	0.15- 0.25	...	...	...	...	...
N08535	29.0-36.5	24.0- 27.0	2.5- 4.0	remainder A	...	0.03 max	0.50	...	1.0 max	...	0.03	0.03	...	1.50 max	...	...	...	...	...	...	...	...	...	...
Low C-Ni- Cr-Mo-W Alloy																								...
N06686	remainder A	19.0- 23.0	15.0- 17.0	5.0 max	3.0- 4.4	0.010 max	0.08	...	0.75 max	...	0.04	0.02	0.02- 0.25	...	...	...	...	...	...	...	...	...	...	...
Ni-Co-Cr-Si Alloy																								...
N12160	remainder A	26.0- 30.0	1.0 max	3.5 max	1.0 max	0.15 max	2.4- 3.0	27.0- 33.0	1.5 max	...	0.030	0.015	0.20- 0.80	...	...	...	...	...	...	...	1.0 max	...	...	...
Cr-Ni-Fe-N Alloy																								...
R20033	30.0-33.0	31.0- 35.0	0.50- 2.0	balance	...	0.015 max	0.50†	...	2.0 max	...	0.02	0.01	...	0.3- 1.20	...	...	...	...	0.35- 0.60	...	...	...	...	...
Low C-Ni- Mo-Cr-Ta Alloy																								...
N06210	remainder A	18.0- 20.0	18.0- 20.0	1.0 max	...	0.015 max	0.08	1.0 max	0.5 max	0.35 max	0.02	0.02	...	...	...	...	...	...	...	...	...	1.5- 2.2	...	...

^A See 12.1.

†Corrected editorially.

TABLE 2 Mechanical Properties of Pipe and Tube

Alloy	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % Offset) min, ksi (MPa)	Elongation in 2 in. (50.8 mm) or 4D, ^A min, %
Ni-Mo			
UNS N10001	100 (690)	45 (310)	40
UNS N10665	110 (760)	51 (350)	40
UNS N10675	110 (760)	51 (350)	40
UNS N10629	110 (760)	51 (350)	40
UNS N10624	104 (720)	46 (320)	40
Ni-Mo-Cr-Fe			
UNS N10242	105 (725)	45 (310)	40
Low C Ni-Cr-Mo			
UNS N10276	100 (690)	41 (283)	40
UNS N06022	100 (690)	45 (310)	45
UNS N06035	85 (586)	35 (241)	30
UNS N06455	100 (690)	40 (276)	40
Ni-Cr-Fe-Mo-Cu			
UNS N06007	90 (621)	35 (241)	35
UNS N06975	85 (586)	32 (221)	40
UNS N06985	90 (621)	35 (241)	40
UNS N06030	85 (586)	35 (241)	30
UNS N06255	85 (586)	32 (221)	40
UNS N06250	90 (621)	35 (241)	40
Ni-Fe-Cr-Mo			
UNS N08320	75 (517)	28 (193)	35
UNS N08135	73 (503)	31 (214)	40
Ni-Cr-Mo-Fe			
UNS N06002	100 (690)	40 (276)	35
UNS N06060	90 (621)	35 (241)	40
Ni-Fe-Cr-	100 (690)	45 (310)	40
Co-R30556			
Ni-Cr-W-Mo			
UNS N06230 ^B	110 (760)	45 (310)	40
Low C-Ni-Cr-Mo			
UNS N06058	110 (760)	52 (360)	40
UNS N06059	100 (690)	45 (310)	45
Low C-Ni-Cr-			
Mo-Cu			
UNS N06200	100 (690)	45 (310)	45
Low C-Ni-Mo-Cr			
UNS N10362	105 (725)	45 (310)	40
Ni-Fe-Cr-Mo-Cu			
low carbon			
UNS N08031	94 (650)	40 (276)	40
UNS N08535	73 (503)	31 (214)	40
Low C Ni-Cr-			
Mo-W			
UNS N06686	100 (690)	45 (310)	45
Ni-Co-Cr-Si			
UNS N12160	90 (620)	35 (240)	40
low carbon Cr-Ni-			
Fe-N			
UNS R20033	109 (750)	55 (380)	40
Low carbon Ni-Mo-Cr-Ta			
UNS N06210	100 (690)	45 (310)	45

^A D refers to the diameter of the tension specimen.

^B Solution annealed at a minimum temperature of 2200°F (1204°C) followed by a water quench or rapidly cooled by other means.

5.1.2.2 *Pipe*—Standard pipe size and schedule (**Appendix X2**).

5.1.3 *Ends*—Plain ends cut and deburred will be furnished.

5.1.4 *Certification*—State if certification or a report of test results is required (**Section 15**).

5.1.5 *Samples for Check Analysis*—State whether samples for check analysis should be furnished.

5.1.6 *Purchaser Inspection*—If the purchaser wishes to witness tests or inspection of material at the place of manufacture, the purchase order must so state, indicating which tests or inspections are to be witnessed (**Section 14**).

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 made by the purchaser, the material shall conform to the requirements specified in **Table 1** subject to the permissible tolerances per Specification **B829**.

7. Mechanical Properties

7.1 The mechanical properties of the material at room temperature shall conform to those shown in **Table 2**.

8. Hydrostatic Test or Non-Destructive Electric Test

8.1 Each pipe or tube shall be tested by the manufacturer by either hydrostatic or a non-destructive electric test in accordance with Specification **B829**. Hydrostatic testing at a pressure greater than 1000 psi may be performed upon agreement between the purchaser and manufacturer or at the option of the manufacturer provided that the allowable fiber stress per Specification **B829** is not exceeded.

9. Weight

9.1 For calculation of mass or weight, the following densities shall be used:

Alloy	Density	
	lb/in. ³	g/cm ³
Nickel-molybdenum:		
UNS N10001	0.334	9.24
UNS N10242	0.327	9.05
UNS N10665	0.333	9.22
UNS N10675	0.333	9.22
UNS N10629	0.333	9.22
UNS N10624	0.322	8.9
Low carbon nickel-chromium-molybdenum:	0.296	8.18
UNS N10276	0.321	8.87
UNS N06022	0.314	8.69
UNS N06035	0.296	8.18
UNS N06455	0.312	8.64
Nickel-chromium-iron-molybdenum-copper:		
UNS N06007	0.300	8.31
UNS N06975	0.295	8.17
UNS N06985	0.300	8.31
UNS N06030	0.297	8.22
UNS N06255	0.299	8.29
UNS N06250	0.307	8.58
Nickel-iron-chromium-molybdenum:		
UNS N08320	0.291	8.05
UNS N08135	0.292	8.10
Nickel-chromium-molybdenum-iron:		
UNS N06002	0.297	8.23
UNS N06060	0.315	8.71
Nickel-iron-chromium-cobalt:		
UNS R30556	0.297	8.23
Nickel-chromium-tungsten-molybdenum:		
UNS N06230	0.324	8.97
Low carbon nickel-chromium-molybdenum:		
UNS N06058	0.318	8.80
UNS N06059	0.311	8.6
UNS N06200	0.307	8.50
Low carbon nickel-molybdenum-chromium:		
UNS N10362	0.319	8.83
Low carbon nickel-iron-chromium-molybdenum-copper:		
UNS N08031	0.29	8.1
UNS N08535	0.291	8.07
Low carbon nickel-chromium-molybdenum-tungsten:		
UNS N06686	0.315	8.73
Nickel-cobalt-chromium-silicon:		
UNS N12160	0.292	8.08
Low carbon chromium-nickel-iron-nitrogen:		
UNS R20033	0.29	8.1
Low carbon nickel-molybdenum-chromium-tantalum:		
UNS N06210	0.316	8.76

10. Sampling

10.1 *Lots for Chemical Analysis and Mechanical Testing are as defined in Specification B829.*

10.2 *Sampling of Chemical Analysis:*

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

10.2.2 Product (check) analysis shall be wholly the responsibility of the purchaser.

10.3 *Sampling for Mechanical Testing:*

10.3.1 A representative sample shall be taken from each lot of finished material.

11. Number of Tests and Retests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Tension Test*—One test per lot.

11.3 *Retests*—If the specimen used in the mechanical test of any lot fails to meet the specified requirements, two additional specimens shall be taken from different sample pieces and tested. The results of the tests on both of these specimens shall meet the specified requirements.

12. Specimen Preparation

12.1 Tension test specimens shall be taken from material after final heat treatment and tested in the direction of fabrication.

12.2 Whenever possible, all pipe and tube shall be tested in full tubular size. When testing in full tubular size is not possible, longitudinal strip specimens, or the largest possible round specimen prepared in accordance with Test Methods E8, shall be used.

13. Test Methods

13.1 The chemical composition and mechanical properties of the material as enumerated in this specification shall be determined in accordance with the methods in Specification B829.

14. Inspection

14.1 Inspection of the material shall be in accordance with this specification and agreements between the manufacturer and the purchaser as part of the purchase contract.

15. Certification

15.1 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.

16. Keywords

16.1 seamless pipe; seamless tube; UNS N06002; UNS N06007; UNS N06022; UNS N06030; UNS N06035; UNS N06058; UNS N06059; UNS N06060; UNS N06200; UNS N06210; UNS N06230; UNS N06250; UNS N06255; UNS N10362; UNS N06455; UNS N06686; UNS N06975; UNS N06985; UNS N08031; UNS N08135; UNS N08320; UNS N08535; UNS N10001; UNS N10242; UNS N10276; UNS N10624; UNS N10629; UNS N10665; UNS N10675; UNS N12160; UNS R20033; UNS R30556

APPENDIXES

(Nonmandatory Information)

X1. HEAT TREATMENT

X1.1 Proper heat treatment during or subsequent to fabrication is necessary for optimum performance and the manufacturer shall be consulted for details.

X2. PIPE SCHEDULES

X2.1 The schedules listed in **Table X2.1** are regularly available. This table is published for information only.

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TABLE X2.1 Pipe Schedules^A

Nominal Pipe Size, in.	Outside Diameter	Nominal Wall Thickness		
		Schedule No. 10	Schedule No. 40	Schedule No. 80
		Inches		
1/4	0.540	0.065	0.088	...
3/8	0.675	0.065	0.091	0.126
1/2	0.840	0.083	0.109	0.147
3/4	1.050	0.083	0.113	0.154
1	1.315	0.109	0.133	0.179
1 1/4	1.660	0.109	0.140	0.191
1 1/2	1.900	0.109	0.145	0.200
2	2.375	0.109	0.154	0.218
2 1/2	2.875	0.120	0.203	0.276
3	3.500	0.120	0.216	0.300
		Millimetres		
1/4	13.72	1.65	2.24	...
3/8	17.14	1.65	2.31	3.20
1/2	21.34	2.11	2.77	3.73
3/4	26.67	2.11	2.87	3.91
1	33.40	2.77	3.38	4.55
1 1/4	42.16	2.77	3.56	4.85
1 1/2	48.26	2.77	3.68	5.08
2	60.32	2.77	3.91	5.54
2 1/2	73.02	3.05	5.16	7.04
3	88.90	3.05	5.49	7.62

^A The pipe schedules shown conform with standards adopted by the American National Standards Institute.

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