



Designation: B626 – 17a

Standard Specification for Welded Nickel and Nickel-Cobalt Alloy Tube¹

This standard is issued under the fixed designation B626; 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 welded tubes made from the nickel and nickel-cobalt alloys (UNS N10001, UNS N10242, UNS N10665, UNS N12160, UNS N10629, UNS N10624, UNS N10675, UNS N10276, UNS N06455, UNS N06007, UNS N06975, UNS N08320, UNS N06985, UNS N06002, UNS N06022, UNS N06030, UNS N06035, UNS N06044, UNS N06058, UNS N06059, UNS N06200, UNS N06617, UNS N10362, UNS N06210, UNS N08031, UNS N08034, UNS R30556, UNS N06230, UNS N06686, and UNS R20033)² listed in **Table 1** intended for heat exchanger and condenser tubes and tubes for general corrosive service for heat-resisting applications.

1.2 This specification covers tube $\frac{1}{8}$ to $3\frac{1}{2}$ in. (3.2 to 88.9 mm) in outside diameter and 0.015 to 0.148 in. (0.41 to 3.7 mm) inclusive, in wall thickness.

1.3 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.

1.4 *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, health and environmental practices, and determine the applicability of regulatory limitations prior to use.*

1.5 *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.*

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

2. Referenced Documents

2.1 *ASTM Standards*:³

B751 Specification for General Requirements for Nickel and Nickel Alloy Welded Tube

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

3. General Requirements

3.1 Material furnished in accordance with this specification shall conform to the applicable requirements of the current edition of Specification **B751** unless otherwise provided herein.

4. Classification

4.1 Five classes of tube are covered as follows:

4.1.1 *Class IA*—Welded, sized, solution annealed, and non-destructively tested in accordance with 4.2.1.

4.1.2 *Class IB*—Welded, sized, and solution annealed.

4.1.3 *Class IIA*—Welded, cold worked, solution annealed, and nondestructively tested in accordance with 4.2.1.

4.1.4 *Class IIB*—Welded, cold worked, and solution annealed.

4.1.5 *Class III*—Welded, cold worked, solution annealed, and nondestructively tested in accordance with 4.2.2.

4.2 *Nondestructive Tests*:

4.2.1 *Class IA and Class IIA Tubes*—Each finished tube shall be subjected to the hydrostatic test, the pneumatic test, or the eddy current test at the manufacturer's option.

4.2.2 *Class III Tubes*—Each finished tube shall be subjected to the pneumatic test and the eddy current test. Tubes larger than $1\frac{1}{2}$ in. (38.1 mm) in outside diameter may be subjected to the hydrostatic test in lieu of the pneumatic test at the manufacturer's option.

5. Ordering Information

5.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this

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.

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

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 N10001	remainder	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	0.04	0.03	...	...	...	...	...	...	...	...	...	...	...	...
N10665	remainder	1.0 max	26.0- 30.0	2.0 max	...	0.02 max	0.10	1.0 max	1.0 max	0.4	0.04	0.03	...	...	...	...	...	...	...	...	...	...	...	...
N10675	65.0 min	1.0- 3.0 max	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	...
N10629	remainder	0.5- 1.5 max	26.0- 30.0	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	...	...	...	...	...	...	...	...
N10624	remainder	6.0- 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 N10242	remainder	7.0- 9.0	24.0- 26.0	2.0 max	...	0.03 max	0.80	1.00 max	0.80 max	...	0.030	0.015	...	0.50 max	...	0.50 max	...	...	...	0.006 max	...	...	...	...
Low C Ni- Cr-Mo Alloys N10276	remainder	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	20.0- 22.5	12.5- 14.5	2.0-6.0	2.5- 3.5	0.015 max	0.08	2.5 max	0.5 max	0.35 max	0.02	0.02	...	...	...	...	...	...	...	...	...	...	...	...
N06035	remainder	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	...	...	...	...	...	...	...	...
N06044	balance	43.5- 45.3	0.80- 1.20	0.3 max	...	0.02 max	0.20	...	0.07- 0.30	...	0.020	0.020	0.10- 0.30	...	...	0.30 max	...	...	...	...	...	...	...	...
N06058	balance	20.0- 23.0	18.5- 21.0	1.5 max	0.3 max	0.010 max	0.10	0.3 max	0.50 max	...	0.015	0.010	...	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	0.3 max	0.5 max	...	0.015	0.010	...	0.50 max	...	0.1- 0.4	...	...	...	...	...	...	...	...
N06455	remainder	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 N06007	remainder	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	...	0.03 max	1.0	...	1.0 max	...	0.03	0.03	0.70- 1.50	0.70- 1.20	...	...	...	...	...	...	...	...	...	...
N06985	remainder	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	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	...	...	...	...	...	...	...	...	...
Ni-Fe-Cr-Mo Alloys N08320	25.0-27.0	21.0- 23.0	4.0- 6.0	remainder	...	0.05 max	1.0	...	2.5 max	...	0.04	0.03	4xC min	...	...	...	...	...	...	...	...	...	...	...
Ni-Cr-Mo-Fe Alloy N06002	remainder	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	...	...	...	...	...	...	...	...	...	...	...	...
Ni-Fe-Cr-Co Alloy R30556	19.0-22.5	21.0- 23.0	2.5- 4.0	remainder	2.0- 3.5	0.05- 0.15	0.20- 0.80	16.0- 21.0	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, %		Mg	Ni+ Mo	Ta	Cb (Nb)	B	N	La	Zr	Al	Cb (Nb +Ta)	Cu	Ti	S max	P max	V	Mn	Co	Si max	C	W	Fe	Mo	Cr	Ni
Ni-Cr-W-Mo Alloy N06230	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	0.50 max	...	...	...	0.015	0.03	...	0.30- 1.00	5.0 max	0.25- 0.75	0.05- 0.15	13.0- 15.0	3.0 max	1.0- 3.0	20.0- 24.0	remainder
Low C-Ni- Cr-Mo-Cu Alloy N06200	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	0.50 max	...	1.3- 1.9	...	0.010	0.025	...	0.50 max	2.0 max	0.08	0.010 max	...	3.0 max	15.0- 17.0	22.0- 24.0	remainder
Ni-Cr-Co-Mo Alloys N06617	44.5 min	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	0.8- 1.5	...	0.5 max	0.6 max	0.015	...	...	1.0 max	10.0- 15.0	1.0	0.05- 0.15	...	3.0 max	8.0- 10.0	20.0- 24.0	44.5 min
Low C-Ni- Mo-Cr Alloy N10362	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	0.50 max	...	...	...	0.010	0.025	...	0.60 max	...	0.08	0.010 max	...	1.25 max	21.5- 23.0	13.8- 15.6	remainder
Low C-Ni- Fe-Cr- Mo-Cu Alloy N08031	30.0-32.0	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	...	...	1.0- 1.4	...	0.010	0.020	...	2.0 max	...	0.3	0.015 max	...	balance	6.0- 7.0	26.0- 28.0	30.0-32.0
N08034	33.5-35.0	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	0.3 max	...	0.5- 1.0	...	0.010	0.020	...	1.0- 4.0	...	0.1	0.01 max	...	balance	6.0- 7.0	26.0- 27.0	33.5-35.0
Low C-Ni- Cr-Mo-W Alloy N06686	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	...	...	...	0.02- 0.25	0.02	0.04	...	0.75 max	...	0.08	0.010 max	3.0- 4.4	5.0 max	15.0- 17.0	19.0- 23.0	remainder
Ni-Co-Cr-Si Alloy N12160	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	...	...	...	0.20- 0.80	0.015	0.030	...	1.5 max	27.0- 33.0	2.4- 3.0	0.15 max	1.0 max	3.5 max	1.0 max	26.0- 30.0	remainder
Cr-Ni-Fe-N Alloy R20033	30.0-33.0	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	...	...	0.3- 1.20	...	0.01	0.02	...	2.0 max	...	0.50	0.015 max	...	balance	0.50- 2.0	31.0- 35.0	30.0-33.0
Low C-Ni- Mo-Cr-Ta Alloy N06210	remainder	0.015 max	...	...	...	0.015 max	...	0.005- 0.050	...	...	...	...	...	0.02	0.02	...	0.5 max	1.0 max	0.08	0.015 max	...	1.0 max	18.0- 20.0	18.0- 20.0	remainder

specification. Examples of such requirements include, but are not limited to the following:

- 5.1.1 *Alloy* (Table 1),
- 5.1.2 *Class* (see 4),
- 5.1.3 *Quantity* (feet or number of lengths),
- 5.1.4 *Size* (outside diameter and average wall thickness),
- 5.1.5 *Length* (cut or random),
- 5.1.6 *Certification*—State if certification or a report of test results is required,
- 5.1.7 *Purchaser Inspection*—State which tests or inspections are to be witnessed,
- 5.1.8 *Ends*—Plain ends cut and deburred will be furnished, unless otherwise specified, and
- 5.1.9 *Samples for Product (Check) Analysis*—State whether samples shall be furnished.

6. Materials and Manufacture

6.1 The tubes shall be made from flat-rolled alloy by an automatic welding process with no addition of filler metal.

6.2 Subsequent to welding and prior to final heat treatment, Class II and Class III tubes shall be cold worked either in both weld and base metal or in weld metal only. The method and amount of cold working may be specified by the purchaser. When cold drawn, the purchaser may specify the minimum amount of reduction in cross-sectional area or wall thickness, or both.

6.3 All tubes shall be furnished in the solution annealed and descaled condition. When atmosphere control is used, descaling is not necessary.

7. Chemical Composition

7.1 The material shall conform to the requirements for chemical composition prescribed in Table 1. One test is required for each lot as defined in Specification B751.

7.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the requirements specified in Table 1 subject to permissible variations specified in Specification B751.

8. Mechanical Properties and Other Requirements

8.1 *Mechanical Properties*—The material shall conform to the mechanical properties prescribed in Table 2. One test is required for each lot as defined in Specification B751.

8.2 Flattening Test Requirements:

8.2.1 Evidence of laminated or unsound material or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

8.2.2 Surface imperfections in the test specimens before flattening, but revealed during the flattening test, shall be judged in accordance with the finish requirements.

8.2.3 Superficial ruptures resulting from surface imperfections shall not be cause for rejection.

8.2.4 One test is required for each lot as defined in Specification B751.

8.3 Flange Test Requirements:

TABLE 2 Mechanical Properties

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 N06044	90 (620)	45 (310)	20
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)	45
UNS N06030	85 (586)	35 (241)	30
Ni-Fe-Cr-Mo			
UNS N08320	75 (517)	28 (193)	35
Ni-Cr-Mo-Fe			
UNS N06002	100 (690)	40 (276)	35
Ni-Fe-Cr-Co			
UNS R30556	100 (690)	45 (310)	40
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
Ni-Cr-Co-Mo			
UNS N06617	95 (665)	35 (240)	35
Low C-Ni-Mo-Cr			
UNS N10362	105 (725)	45 (310)	40
Low-carbon Ni-Fe-Cr-Mo-Cu			
UNS N08031	94 (650)	40 (276)	40
UNS N08034	94 (650)	40 (280)	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-C 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.

8.3.1 Flange test specimens shall show no cracking or flaws. Superficial ruptures resulting from surface imperfections shall not be cause for rejection.

8.3.2 For tube less than 0.093 in. (2.36 mm) in inside diameter and tube having a wall thickness equal to or greater than the inside diameter, the flange test shall not be required.

8.3.3 One test is required for each lot as defined in Specification B751.

8.4 *Hydrostatic Test*—When tested by the manufacturer, each tube shall be subjected to the hydrostatic test per Specification B751.

8.5 *Pneumatic Test*—When tested by the manufacturer, each tube shall be subjected to the pneumatic test per Specification **B751**.

8.6 *Eddy Current Test*—When tested by the manufacturer, each tube shall be subjected to an electromagnetic (eddy current) test per Specification **B751**.

N10276; UNS N06455; UNS N06007; UNS N06975; UNS N08320; UNS N06985; UNS N06002; UNS N06022; UNS N06030; UNS N06035; UNS N06044; UNS N06058; UNS N06059; UNS N06200; UNS N06617; UNS N10362; UNS N06210; UNS N08031; UNS N08034; UNS N06230; UNS N06686; UNS R30556; UNS R20033; welded tube

9. Keywords

9.1 UNS N10001; UNS N10242; UNS N10665; UNS N12160; UNS N10629; UNS N10624; UNS N10675; UNS

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B626–17) that may impact the use of this standard. (Approved July 1, 2017.)

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|---|--|
| (1) Added new alloy UNS N08034 to scope (Section 1.) | (4) Added UNS N08034 to Keywords in Section 9. |
| (2) Added chemistry data for UNS N08934 to Table 1. | |
| (3) Added Mechanical property data to Table 2 for UNS N08034. | |

Committee B02 has identified the location of selected changes to this standard since the last issue (B626–15) that may impact the use of this standard. (Approved June 1, 2017.)

- (1) Revised Scope, Table 1, Table 2, and Keywords to add new Ni-Cr-Mo alloy N06044.

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