



## **SPECIFICATION FOR WELDED NICKEL AND NICKEL-COBALT ALLOY TUBE**



**SB-626**

(Identical with ASTM Specification B626-17 except certification and test reports have been made mandatory per para. 5.1.6 and in SB-751.)

## Specification for Welded Nickel and Nickel-Cobalt Alloy Tube

### 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 R30556, UNS N06230, UNS N06686, and UNS R20033) 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 and health 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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

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

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	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	...	0.04	0.03	...	...	...									
N10675	65.0 min	1.0- 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	
N10629	remainder	0.5- 1.5	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, %																								
	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 Alloy N06230	remainder	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-Cu Alloy N06200	remainder	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	...	...	...	...	...	...	...	...
Ni-Cr-Co-Mo Alloys N06617	44.5 min	20.0-24.0	8.0-10.0	3.0 max	...	0.05-0.15	1.0	10.0-15.0	1.0 max	...	...	0.015	0.6 max	0.5 max	...	0.8-1.5	...	...	...	0.006	...	...	...	...
Low C-Ni-Mo-Cr Alloy N10362	remainder	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 Alloy 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	...	...	...	...	...
Low C-Ni-Cr-Mo-W Alloy N06686	remainder	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	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	18.0-20.0	18.0-20.0	1.0 max	...	0.015 max	0.08	1.0 max	0.5	0.35 max	0.02	0.02	...	...	...	...	...	...	...	...	...	1.5-2.2	...	...

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*—Certification and a report of test results are required (SB-571),
- 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 <sup>A</sup> , 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 <sup>B</sup>	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
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

<sup>A</sup> D refers to the diameter of the tension specimen.

<sup>B</sup> 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.

**9. Keywords**

9.1 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 N06230; UNS N06686; UNS R30556; UNS R20033; welded tube