



# B704-23

## Standard Specification for Welded Nickel Alloy Tubes

This standard is issued under the fixed designation B704; 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 (<sup>ε</sup>) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification covers welded UNS N06219, UNS N06625, UNS N08642, UNS N08825, and UNS N08827 nickel alloy boiler, heat exchanger, and condenser tubes for general corrosion resisting and low or high-temperature service.

1.2 This specification covers tubes 1/8 in. to 5 in. (3.18 mm to 127 mm), inclusive, in outside diameter and 0.015 in. to 0.500 in. (0.38 mm to 12.70 mm), inclusive, in wall thickness. Specification B751 lists the dimensional requirements of these sizes. Tubes having other dimensions may be furnished provided such tubing complies with all other requirements of this specification.

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 Material Safety Data Sheet (MSDS) 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.*

<sup>1</sup> 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. Referenced Documents

#### 2.1 *ASTM Standards:*<sup>2</sup>

- B751 Specification for General Requirements for Nickel and Nickel Alloy Welded Tube
- B899 Terminology Relating to Non-ferrous Metals and Alloys
- E8/E8M Test Methods for Tension Testing of Metallic Materials

### 3. Terminology

#### 3.1 Definitions:

3.1.1 For definitions of terms used in this specification, refer to Terminology B899.

### 4. Ordering Information

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

- 4.1.1 Quantity (feet or number of lengths),
- 4.1.2 UNS number,
- 4.1.3 Size (outside diameter, minimum or average wall thickness),
- 4.1.4 Length (random or specific),
- 4.1.5 Class, and
- 4.1.6 Grade if UNS N06625 is specified. If neither grade of N06625 is specified, grade 1 will be supplied.
- 4.1.7 ASTM designation.
- 4.1.8 *Product Analysis*—State if required.
- 4.1.9 *Purchaser Inspection*—State which tests or inspections are to be witnessed, if any.

### 5. Materials and Manufacture

5.1 Tube shall be made from flat-rolled alloy by an automatic welding process with no addition or filler metal. Subsequent to welding and prior to final annealing, the material shall be cold-worked in either the weld metal only or both weld and base metal.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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



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5.2 Tube shall be furnished with oxide removed. When bright annealing is used, descaling is not necessary.

### 6. Chemical Composition

6.1 The material shall conform to the composition limits specified in Table 1. One test is required for each lot as defined in Specification B751.

6.2 If a product analysis is performed, it shall meet the chemistry limits prescribed in Table 1, subject to the analysis tolerances of Specification B751.

### 7. Mechanical and Other Properties

7.1 *Mechanical Properties*—The material shall conform to the mechanical property requirements specified in Table 2. One test is required for each lot as defined in Specification B751.

7.2 *Flattening Test*—A flattening test shall be made on each end of one tube per lot. Superficial ruptures resulting from surface imperfections shall not be cause for rejection.

7.3 *Flange Test*—A flange test shall be made on each end of one tube per lot.

#### 7.4 Nondestructive Test Requirements:

7.4.1 *Class 1*—Each piece in each lot shall be subject to one of the following four tests: hydrostatic, pneumatic (air underwater), eddy current, or ultrasonic.

7.4.2 *Class 2*—Each piece in each lot shall be subjected to a leak test and an electric test as follows:

7.4.2.1 *Leak Test*—Hydrostatic or pneumatic (air underwater).

7.4.2.2 *Electric Test*—Eddy current or ultrasonic.

7.5 The manufacturer shall have the option to test to Class 1 or 2 and select the nondestructive test methods, if not specified by the purchaser.

**TABLE 2 Mechanical Property Requirements**

Alloy	Grade	Tensile Strength min, psi (MPa)	Yield Strength <sup>A</sup> 0.2 % Offset, min, psi (MPa)	Elongation in 2 in. or 50 mm, min, %
UNS N06625	1 (annealed)	120 000 (827)	60 000 (414)	30
UNS N06625	2 (solution annealed) <sup>B</sup>	100 000 (690)	40 000 (276)	30
UNS N06219	...	96 000 (660)	39 000 (270)	30
UNS N08642	...	85 000 (586)	35 000 (241)	30
UNS N08825	...	85 000 (586)	35 000 (241)	30
UNS N08827	...	85 000 (586)	35 000 (241)	30

<sup>A</sup> Yield strength shall be determined by the offset method at 0.2 % limiting permanent set in accordance with Test Methods E8/E8M.

<sup>B</sup> Solution annealed at 2000 °F (1093 °C) minimum, with or without subsequent stabilization anneal at 1800 °F (982 °C) minimum to increase resistance to sensitization.

### 8. General Requirements

8.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B751 unless otherwise provided herein.

### 9. Product Marking

9.1 In addition to the requirements of Specification B751, UNS N06625 tubes shall be marked with grade information.

### 10. Certification

10.1 A manufacturer's certification shall be furnished to the purchaser stating that the material was manufactured, tested, and inspected in accordance with this specification and that test results on representative samples meet specification requirements. A report of the test results shall be furnished.

**TABLE 1 Chemical Requirements<sup>A</sup>**

	Composition Limits, %				
	UNS N06219	UNS N06625	UNS N08642	UNS N08825	UNS N08827
Nickel	Bal <sup>B</sup>	58.0 min <sup>B</sup>	42.0 to 46.0	38.0–46.0	39.0–43.0
Chromium	18.0–22.0	20.0–23.0	21.0 to 23.0	19.5–23.5	21.0–23.0
Iron	2.0–4.0	5.0	Bal <sup>B</sup>	22.0 min <sup>B</sup>	Bal <sup>B</sup>
Molybdenum	7.0–9.0	8.0–10.0	5.0 to 6.5	2.5–3.5	4.5–6.5
Niobium <sup>C</sup>	...	3.15–4.15	0.15	...	0.15
Carbon	0.05	0.10	0.030	0.05	0.015
Manganese	0.50	0.50	1.0	1.0	0.5–0.9
Silicon	0.70–1.10	0.5	0.75	0.5	0.2–0.5
Phosphorous	0.020	0.015	...	...	...
Sulfur	0.010	0.015	0.010	0.03	0.005
Aluminum	0.50	0.4	0.2	0.2	0.06–0.25
Titanium	0.50	0.40	...	0.6–1.2	...
Cobalt (if determined)	1.0	1.0	1.0 to 3.0	...	0.5
Copper	0.50	...	0.5 to 2.0	1.5–3.0	1.6–2.3
Nitrogen	...	...	0.15	...	0.03
Boron	...	...	...	...	0.002–0.004
Magnesium	...	...	...	...	0.006–0.015

<sup>A</sup> Maximum unless range or minimum is given. Where ellipses ( ) appear in this table, there is no requirement and analysis for the element need not be determined or reported.

<sup>B</sup> Element may be determined arithmetically by difference.

<sup>C</sup> The terms Niobium (Nb) and Columbium (Cb) are alternate names for the same element.



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## 11. Keywords

11.1 UNS N06219; UNS N06625; UNS N08642; UNS N08825; UNS N08827; welded tube

## SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B704 – 19) that may impact the use of this standard. (Approved November 1, 2023.)

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|---|---|
| (1) UNS N08642 was added to the Scope, Table 1, Table 2, and Keywords.  | (3) Table 1 was revised to change Columbium (Nb) to Niobium and remove “Columbium (Nb) + Tantalum”. |
| (2) Section 3 on Terminology was added and B899 was added to Section 2. | (4) Footnote C added to Table 1.  |

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