



Standard Specification for Welded Nickel-Chromium-Iron Alloy (UNS N06600, UNS N06601, UNS N06603, UNS N06025, UNS N06045, UNS N06690, and UNS N06693) Tubes¹

This standard is issued under the fixed designation B516; 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 UNS N06600,² N06601, N06603, N06025, N06045, UNS N06690, and UNS N06693 alloy boiler, heat exchanger, and condenser tubes for general corrosion resisting and low or high-temperature service.

1.2 This specification covers tubes $\frac{1}{8}$ to 5 in. (3.18 to 127 mm), inclusive, in outside diameter and 0.015 to 0.500 in. (0.38 to 12.70 mm), inclusive, in wall thickness. Table 2 of 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 and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:³

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

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.

B751 Specification for General Requirements for Nickel and Nickel Alloy Welded Tube
B899 Terminology Relating to Non-ferrous Metals and Alloys

3. Terminology

3.1 Terms defined in Terminology B899 shall apply unless defined otherwise in this standard.

4. Ordering Information

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

- 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,
- 4.1.6 ASTM designation,
- 4.1.7 *Product Analysis*—State if required,
- 4.1.8 *Certification*—State if a certification or a report of test results is required, and
- 4.1.9 *Purchaser Inspection*—State which tests or inspections are to be witnessed, if any.

5. Material 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.

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.

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

TABLE 1 Chemical Requirements

Element	Composition Limits, %						
	N06600	N06601	N06603	N06025	N06045	N06690	N06693
Nickel ^A	72.0 min	58.0-63.0	Bal	Bal	45.0 min	58.0 min	Bal
Chromium	14.0 min 17.0 max	21.0-25.0	24.0–26.0	24.0–26.0	26.0–29.0	27.0-31.0	27.0-31.0
Iron	6.0 min 10.0 max	Bal ^A	8.0–11.0	8.0–11.0	21.0–25.0	7.0-11.0	2.5-6.0
Manganese	1.0 max	1.0 max	0.15 max	0.15 max	1.0 max	0.5 max	1.0 max
Carbon	0.15 max	0.10 max	20.0-40.0	0.15–0.25	0.05–0.12	0.05 max	0.15 max
Copper	0.5 max	1.0 max	0.50 max	0.10 max	0.3 max	0.5 max	0.5 max
Silicon	0.5 max	0.5 max	0.50 max	0.5 max	2.5–3.0	0.5 max	0.5 max
Sulfur	0.015 max	0.015 max	0.010 max	0.010 max	0.010 max	0.015 max	0.01 max
Aluminum	...	1.0-1.7	2.4-3.0	1.8–2.4	...	...	2.5-4.0
Titanium	...	...	0.01–0.25	0.1–0.2	...	...	1.0 max
Niobium	...	...	...	...	...	...	0.5-2.5
Phosphorus	...	...	0.020 max	0.02 max	0.02 max	...	...
Zirconium	...	...	0.01–0.40	0.01–0.10	...	...	...
Yttrium	...	...	0.01–0.15	0.05–0.12	...	...	...
Cerium	...	...	...	...	0.03–0.09	...	...

^A Element shall be determined arithmetically by difference.

TABLE 2 Mechanical Property Requirements

Alloy	Tensile Strength min, psi (MPa)	Yield Strength 0.2 % Offset, min, psi (MPa)	Elongation in 2 in. or 50 mm, min, %
N06600	80 000 (550)	35 000 (240)	30
N06601	80 000 (550)	30 000 (205)	30
N06603	94 000 (650)	43 000 (300)	25
N06025	98 000 (680)	39 000 (270)	30
N06045	90 000 (620)	35 000 (240)	30
N06690	85 000 (586)	35 000 (240)	30
N06693	100 000 (690)	50 000 (345)	30

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

7. Mechanical Properties and Other Requirements

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 Class 2 and select the nondestructive test methods, if not specified by the purchaser.

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. Keywords

9.1 welded tube; N06600; N06601; N06603; N06025; N06045; N06690; N06693

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B516–03(2014)) that may impact the use of this standard. (Approved May 1, 2015.)

(1) Addition of alloys N06601, N06690, and N06693 to Title, Scope, Table 1, including table footnote (A) changes, Table 2, and Keywords.

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