



Standard Specification for Nickel-Chromium-Molybdenum-Tungsten Alloys (UNS N06110) Welded Tube¹

This standard is issued under the fixed designation B758; 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 N06110² tube in the annealed condition (temper) for general corrosion applications.

1.2 This specification covers outside diameter and nominal wall tube.

1.2.1 The tube sizes covered by this specification are $\frac{1}{8}$ to 5 in. (3.2 to 127 mm) in outside diameter and 0.015 to 0.148 in. (0.4 to 3.8 mm), inclusive, in wall thickness.

1.3 The values stated in inch-pound units are to be regarded as the standard. The SI units in parentheses are provided for information only.

1.4 The following precautionary caveat pertains only to the test method portion, Section 13, of this specification: *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.*

2. Referenced Documents

2.1 ASTM Standards:³

E8 Test Methods for Tension Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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 Practice E527 and SAE J1086, Recommended 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.

E38 Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys (Withdrawn 1989)⁴

E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing

E354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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

E571 Practice for Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products

3. Classification

3.1 *Class 1*—Welded, cold-worked, annealed, and nondestructively tested in accordance with 11.5.1.

3.2 *Class 2*—Welded, cold-worked, annealed, and nondestructively tested in accordance with 11.5.2.

4. Ordering Information

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

4.1.1 Alloy name or UNS number.

4.1.2 ASTM designation and year of issue.

4.1.3 Dimensions:

4.1.3.1 Outside diameter and nominal wall thickness.

NOTE 1—Tube produced to outside diameter and minimum wall may be furnished upon agreement between the manufacturer and the purchaser.

4.1.3.2 Length (specific or random).

4.1.4 Class (see 11.5).

4.1.5 Quantity (feet or number of pieces).

4.1.6 Certification—State if certification is required (Section 16).

4.1.7 Samples for Product (Check) Analysis—State whether samples for product (check) analysis should be furnished (10.2).

⁴ The last approved version of this historical standard is referenced on www.astm.org.

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

5. Material and Manufacture

5.1 Tube shall be made from flat-rolled alloy by an automatic welding process with no addition of 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.

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations in Table 2.

7. Mechanical and Other Properties

7.1 *Mechanical Properties*—The material shall conform to the mechanical properties specified in Table 3.

7.2 *Flattening Test*—A section of tube not less than 4 in. (102 mm) in length shall be capable of withstanding, without cracking, flattening under a load applied gradually at room temperature until the distance between the platens is five times the wall thickness. The weld shall be positioned 90° from the direction of the applied flattening force.

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

7.3 *Flange Test*—A section of tube shall be capable of having a flange turned over at a right angle to the body of the

TABLE 2 Product (Check) Analysis Chemical Composition Variations

Element	Specified Limit of Element %	Variation under min or over max of the Specified Limit of Element
Nickel	over 20.00 to 30.00, incl over 30.00 to 40.00, incl	0.25 0.30
Tungsten	over 1.00 to 4.00, incl	0.04
Iron	over 0.75 to 2.50, incl	0.05
Manganese	up to 1.00, incl	0.03
Carbon	up to 0.20, incl	0.01
Silicon	over 0.25 to 0.50, incl over 0.50 to 1.00, incl	0.03 0.05
Sulfur	up to 0.02, incl	0.003
Chromium	over 25.00 to 35.00, incl	0.25
Aluminum	over 0.10 to 0.50, incl over 0.50 to 1.00, incl	0.05 0.10
Titanium	over 0.10 to 0.50, incl over 0.50 to 1.00, incl	0.03 0.04
Columbium + Tantalum	up to 1.0, incl	0.04
Molybdenum	over 5.0 to 20.0, incl	0.15
Phosphorus	up to 0.04, incl	0.005

TABLE 3 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, %
UNS N06110	95 000 (655)	45 000 (310)	60

TABLE 1 Chemical Requirements

Element	Composition Limits, %	Product (Check) Analysis Variations under min or over max, of the Specified Limit of Element
C	0.15 max	0.01
Mn	1.0 max	0.05
Si	1.0 max	0.05
P	0.015 max	0.005
S	0.015 max	0.003
Cr	28.0 min 33.0 max	0.25 0.25
Cb	1.0 max	0.05
Co (if determined)	1.0 max	0.05
Mo	9.0 min 12.0 max	0.15 0.15
Fe	1.0 max	0.07
Al	1.0 max	0.05
Ti	1.0 max	0.05
W	1.0 min 4.0 max	0.10 0.10
Ni ^A	51.0 min	0.35
Cu	0.5 max	0.03

^A Element shall be determined arithmetically by difference.

tube without through-wall cracking. The width of the flange shall not be less than 15 % of the tube diameter.

7.4 *Nondestructive Test Requirements*—Tube shall be subjected to nondestructive tests (see 13.2) at the manufacturer's option.

7.4.1 For ultrasonic testing, a longitudinal calibration notch shall be made on the outside diameter and inside diameter. The depth of the notch shall not exceed 12½ % of the specified wall thickness of the material or 0.004 in. (0.10 mm), whichever is greater. Place the notch in the weld if visible.

7.4.2 *Acceptance and Rejection*—Material producing a signal equal to or greater than the calibration imperfections shall be subject to rejection.

7.4.2.1 Test signals produced by imperfections that cannot be identified or produced by cracks or crack-like imperfections shall result in rejection of the tube, subject to rework and retest. To be accepted, the material shall pass the same electric test to which it was originally subjected provided that the dimensional requirements are met.

7.4.2.2 If the imperfection is judged as injurious, the tube shall be rejected but may be reconditioned and retested providing the dimensional requirements are met. To be accepted, retested material shall meet the original electric test requirements.

7.4.2.3 If the imperfection is explored to the extent that it can be identified as noninjurious, the material may be accepted without further test provided the imperfection does not encroach on the minimum wall thickness.