



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

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1. Scope

1.1 This specification² cover nickel-chromium-molybdenum-tungsten alloys (UNS N06110)³ in the form of cold-worked seamless pipe and tube in the conditions shown in [Table 1](#).

1.2 Hot-worked material is available. Properties and permissible tolerances are to be agreed upon between the manufacturer and purchaser.

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 The following precautionary caveat pertains only to the test method portion, [Section 8](#), 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 Material Safety Data Sheet (MSDS) for this product/material as provide 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](#)
[B829 Specification for General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube](#)

[E426 Practice for Electromagnetic \(Eddy-Current\) Examination of Seamless and Welded Tubular Products, Austenitic](#)

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 For ASME Boiler and Pressure Vessel Code application, see related Specification SB-167 in Section II of that Code.

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.

Stainless Steel and Similar Alloys

3. Ordering Information

3.1 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:

3.1.1 *Alloy name or UNS number.*

3.1.2 *ASTM Designation.*

3.1.3 *Condition.*

3.1.4 *Finish.*

3.1.5 *Dimensions.*

3.1.5.1 *Tube*—Specify outside diameter and nominal or minimum wall.

3.1.5.2 *Pipe*—Specify standard pipe size and schedule.

3.1.5.3 *Length*—Cut to length or random.

3.1.6 *Quantity*—Feet (or metres) or number of pieces.

3.1.7 *Hydrostatic Pressure Requirements*—Specify test pressure if other than required by [8.1](#).

3.1.8 *Certification*—State if certification is required.

3.1.9 *Samples for Product (Check) Analysis*—State whether samples for product (check) analysis should be furnished (see [4.2](#)).

3.1.10 *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.

3.1.11 *Small-Diameter and Light-Wall Tube (Converter Sizes).*

4. Chemical Composition

4.1 The material shall conform to the composition limits specified in [Table 2](#).

4.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations in Specification [B829](#).

5. Mechanical and Other Properties

5.1 *Mechanical Properties*—The material shall conform to the tensile properties specified in [Table 2](#).



TABLE 1 Mechanical Properties

Condition	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % offset), min, ksi (MPa)	Elongation in 2 in. or 50 mm (or 4D), min, %
Cold-worked annealed	95 (655)	45 (310)	60

TABLE 2 Chemical Requirements

Element	Composition Limits, %
C	0.15 max
Mn	1.0 max
Si	1.0 max
P	0.015 max
S	0.015 max
Cr	28.0 min/33.0 max
Cb	1.0 max
W	1.0 min/4.0 max
Mo	9.0 min/12.0 max
Fe	1.0 max
Al	1.0 max
Ti	1.0 max
Ni ^A	51.0 min
Cu	0.50 max

^A Element shall be determined arithmetically by difference.

5.2 *Pressure and Nondestructive Electric Test*—Each pipe and tube shall be subjected to either a pressure test or the nondestructive electric test at the manufacturer's option. The purchaser may specify which test is to be used.

5.2.1 Any leaking areas may be cut out and the pipe retested as above.

5.2.2 Test signals produced by imperfections such as the following, may be judged as injurious or noninjurious, depending on visual observation of their severity or the type of signal they produce on the testing equipment used, or both.

5.2.2.1 Dinges,

5.2.2.2 Straightener marks,

5.2.2.3 Scratches,

5.2.2.4 Steel die stamps, and

5.2.2.5 Stop marks.

6. Sampling

6.1 Test Material Selection:

6.1.1 *Chemical Analysis*—Representative samples from each lot shall be taken during pouring or subsequent processing.

6.1.1.1 Product (check) analysis shall be wholly the responsibility of the purchaser.

7. Number of Tests

7.1 *Chemical Analysis*—One test per lot.

7.2 *Tension*—One test per lot.

7.3 *Pressure and Nondestructive Electric Test*—Each tube shall be subjected to either a pressure test or the nondestructive

electric test at the manufacturer's option. The purchaser may specify which test is to be used.

8. Test Methods

8.1 *Hydrostatic Test*—Each pipe or tube with an outside diameter $\frac{1}{8}$ in. (3 mm) and larger and with wall thickness of 0.015 in. (0.38 mm) and over shall be tested by the manufacturer to an internal hydrostatic pressure of 1000 psi (6.9 MPa) provided that the fiber stress calculated in accordance with the following equation does not exceed the allowable fiber stress S , indicated as follows:

$$P = 2St/D \quad (1)$$

where:

P = hydrostatic test pressure, psi (or MPa),

S = allowable fiber stress, for material in the condition (temper) furnished as follows: Cold worked annealed: 30 000 psi (242 MPa)

t = minimum wall thickness, in. (or mm), equal to the specified nominal wall minus the permissible minus wall tolerance, or the specified minimum wall thickness, and,

D = outside diameter of the pipe or tube, in. (or mm).

8.1.1 When so agreed upon by the manufacturer and the purchaser, pipe or tube may be tested to $1\frac{1}{2}$ times the allowable fiber stress given in 8.1.

8.2 Pneumatic Test:

8.2.1 With no foreign material or moisture on the internal surface, pressurize the tube internally to 150 psi (1034 Pa) minimum with uncontaminated compressed air while submerging it in water of a clarity that permits unobstructed examination of the tube.

8.2.2 The tube shall be well-lighted, preferably by underwater illumination.

8.2.3 Correct any evidence of air leakage of the pneumatic couplings prior to testing.

8.2.4 After holding the pressure for not less than 5 s after the surface of the water has become calm, inspect the entire length of the tube.

8.3 Nondestructive Electric Test:

8.3.1 Test each tube with a nondestructive electric test in accordance with Practice E426. It is the intent of this test to reject tube containing injurious defects.

8.3.2 The calibration tube shall contain, at the option of the producer, either of the following discontinuities to establish a minimum sensitivity level for rejection.

8.3.3 *Drilled Hole*—Drill a hole not larger than 0.031 in. (0.79 mm) diameter radially and completely through the tube wall, taking care to avoid distortion of the tube while drilling.

8.3.4 *Transverse Tangential Notch*—Using a round tool or file with a $\frac{1}{4}$ in. (6.4 mm) diameter, file or mill a notch tangential to the surface and transverse to the longitudinal axis of the tube. Said notch shall have a depth not exceeding $12\frac{1}{2}$ % of the specified wall thickness of the tube or 0.004 in. (0.102 mm), whichever is greater.



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