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

This standard is issued under the fixed designation B759; 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 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 per-
missible tolerances are to be agreed upon between the manu-
facturer 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 limi-
tations 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) Examina-
tion of Seamless and Welded Tubular Products, Austenitic

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 wit-
ness tests or inspection of material at place of manufacture, the
purchase order must so state indicating which tests or inspec-
tions 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.
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 ¼ 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:

$$P = \frac{2St}{D}$$

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 1½ 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 ¼ 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 12½ % of the specified wall thickness of the tube or 0.004 in. (0.102 mm), whichever is greater.

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**TABLE 1 Mechanical Properties**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tensile Strength, min, ksi (MPa)</th>
<th>Yield Strength, (0.2 % offset), min, ksi (MPa)</th>
<th>Elongation, in 2 in. or 50 mm (or 4D), min, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold-worked annealed</td>
<td>95 (655)</td>
<td>45 (310)</td>
<td>60</td>
</tr>
</tbody>
</table>

**TABLE 2 Chemical Requirements**

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition Limits, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.15 max</td>
</tr>
<tr>
<td>Mn</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Si</td>
<td>1.0 max</td>
</tr>
<tr>
<td>P</td>
<td>0.015 max</td>
</tr>
<tr>
<td>S</td>
<td>0.015 max</td>
</tr>
<tr>
<td>Cr</td>
<td>28.0 min/33.0 max</td>
</tr>
<tr>
<td>Cb</td>
<td>1.0 max</td>
</tr>
<tr>
<td>W</td>
<td>1.0 min/4.0 max</td>
</tr>
<tr>
<td>Mo</td>
<td>9.0 min/12.0 max</td>
</tr>
<tr>
<td>Fe</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Al</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Ti</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Ni&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.0 min</td>
</tr>
<tr>
<td>Cu</td>
<td>0.50 max</td>
</tr>
</tbody>
</table>

<sup>a</sup>Element shall be determined arithmetically by difference.