Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube

1. Scope

1.1 This specification covers nickel-copper alloy UNS N04400 in the form of cold-worked seamless pipe and tube in the conditions shown in Table 1 and Table X1.1.

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

1.2 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.

1.3 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 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:

B829 Specification for General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube

E8 Test Methods for Tension Testing of Metallic Materials

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

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 average diameter, n—average of the maximum and minimum outside diameters, as determined at any one cross-section of the pipe or tube.

3.1.2 pipe, n—tube conforming to the particular dimensions commercially known as pipe sizes, see Table X2.1.

3.1.3 seamless pipe or tube, n—pipe or tube produced with a continuous periphery in all stages of the operations.

3.1.4 tube, n—hollow product of round or any other cross-section having a continuous periphery.

4. Ordering Information

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

4.1.1 Alloy name or UNS number.

4.1.2 ASTM designation and year of issue.

4.1.3 Condition (see Appendix X3).

4.1.4 Finish (see Appendix X3).

4.1.5 Dimensions:

4.1.5.1 Tube—Specify outside diameter and nominal or minimum wall.

4.1.5.2 Pipe—Specify standard pipe size and schedule.

4.1.5.3 Length—Cut to length or random.

4.1.6 Quantity—Feet or number of pieces.

4.1.7 Hydrostatic Test or Nondestructive Electric Test—Specify type of test (see 6.2).

4.1.8 Hydrostatic Pressure Requirements—Specify test pressure if other than required by 12.3.1.

4.1.9 Certification—State if certification or a report of test results is required (Section 15).

4.1.10 Samples for Product (Check) Analysis—State whether samples for product (check) analysis should be furnished (see 5.2).

4.1.11 Purchaser Inspection—If purchaser wishes to witness tests or inspection of material at place of manufacture, the

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

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purchase order must so state indicating which tests or inspections are to be witnessed (Section 13).

4.1.12 **Small-Diameter and Light-Wall Tube (Converter Sizes)**—See Appendix X1.

5. Chemical Composition

5.1 The material shall conform to the composition limits specified in Table 2.

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

6. Mechanical and Other Requirements

6.1 **Tension Test**—The material shall conform to the tensile properties specified in Table 1.

6.1.1 Tensile properties for material specified as small-diameter and light-wall tube (converter sizes) shall be in accordance with Table X1.1.

6.2 **Hydrostatic or Nondestructive Electric Test**—Each pipe or tube shall be subjected to either the hydrostatic test or the nondestructive electric test. The type of test to be used shall be at the option of the manufacturer, unless otherwise specified in the purchase order.

7. Dimensions and Permissible Variations

7.1 **Diameter and Wall Thickness**—The permissible variations in the outside diameter and wall thickness shall conform to the permissible variations prescribed in Table 3.

7.2 **Length**—When material is ordered cut-to-length, the length shall conform to the permissible variations prescribed in Table 4.

7.3 **Straightness**—Material shall be reasonably straight and free of bends and kinks.

7.4 **Ends**—Ends shall be plain cut and deburred.

7.5 Permissible variations for material specified as small-diameter and light-wall tube (converter size) shall conform to the permissible variations prescribed in Table X1.2.

8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and temper, smooth, commercially straight, and free of injurious imperfections.

9. Sampling

9.1 **Lot Definition:**

9.1.1 A lot for chemical analysis shall consist of one heat.

9.1.2 A lot for all other testing shall consist of all material from the same heat, nominal size (excepting length), and condition.

9.1.2.1 Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material in the same condition and nominal size (excepting length).

9.2 **Test Material Selection:**

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

9.2.1.1 Product (Check) Analysis shall be wholly the responsibility of the purchaser.

9.2.2 **Mechanical and other Properties**—Samples of the material to provide test specimens for mechanical and other properties shall be taken from such locations in each lot as to be representative of that lot. Test specimens shall be taken from material in the final condition.

10. Number of Tests

10.1 **Chemical Analysis**—One test per lot.

10.2 **Tension**—One test per lot.

10.3 **Hydrostatic or Nondestructive Electric Test**—Each piece in each lot.

11. Specimen Preparation

11.1 **Room Temperature Tensile Specimen**—Material shall be tested in the direction of fabrication. Whenever possible, all pipe and tube shall be tested in full tubular size. When testing in full tubular size is not possible, longitudinal strip specimens, or the largest possible round specimen, shall be used. In the event of disagreement when full tubular testing is not possible, a longitudinal strip specimen with reduced gauge length as contained in Test Methods E8 shall be used.

12. Test Methods

12.1 **Chemical Composition**—In case of disagreement, the chemical composition shall be determined in accordance with Test Methods E76.

12.2 **Tension Test**—Tension testing shall be conducted in accordance with Test Methods E8.
TABLE 3 Permissible Variations for Outside Diameter and Wall Thickness of Seamless Cold Worked Pipe and Tube\textsuperscript{A,B}

<table>
<thead>
<tr>
<th>Nominal Outside Diameter, in. (mm)</th>
<th>Permissible Variations</th>
<th>Outside Diameter, in. (mm)</th>
<th>% of Thickness of Specified Nominal Wall</th>
<th>% of Thickness of Specified Minimum Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
<td>−</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td>Over 0.400 (10) to ½ (16), excl</td>
<td>0.005 (0.13)</td>
<td>0.005 (0.13)</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>½ (16) to 1½ (38), incl</td>
<td>0.0075 (0.19)</td>
<td>0.0075 (0.19)</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Over 1½ (38) to 3 (76), incl</td>
<td>0.010 (0.25)</td>
<td>0.010 (0.25)</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Over 3 (76) to 4½ (114), incl</td>
<td>0.015 (0.38)</td>
<td>0.015 (0.38)</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Over 4½ (114) to 6 (152), incl</td>
<td>0.020 (0.51)</td>
<td>0.020 (0.51)</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Over 6 (152) to 6½ (168), incl</td>
<td>0.025 (0.64)</td>
<td>0.025 (0.64)</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Over 6½ (168) to 8½ (219), incl</td>
<td>0.0305 (0.79)</td>
<td>0.0305 (0.79)</td>
<td>12.5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

\textsuperscript{A} Ovality—The permissible variations in this table apply to individual measurements, including out-of-roundness (ovality) except for the following:

For pipe and tube having a nominal wall thickness of 3 % or less of the nominal outside diameter, the mean outside diameter shall conform to the permissible variations of this table and individual measurements (including ovality) shall conform to the plus and minus values of the table, with the values increased by 0.5 % of the nominal outside diameter.

For pipe and tube over 4½ in. (114 mm) in outside diameter with a nominal wall thickness greater than 3 % of the nominal outside diameter, the mean outside diameter shall conform to the permissible variations of this table and individual measurements shall not exceed twice the permissible variations of the table.

\textsuperscript{B} Eccentricity—The permissible variations in this table apply to individual measurements including eccentricity.

TABLE 4 Permissible Variations in Length\textsuperscript{A}

<table>
<thead>
<tr>
<th>Cut Length, in. (mm)</th>
<th>Over</th>
<th>Under</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 2 (50.8)</td>
<td>½ (3.2)</td>
<td>0</td>
</tr>
<tr>
<td>2 (50.8) and over</td>
<td>⅛ (4.8)</td>
<td>0</td>
</tr>
</tbody>
</table>

\textsuperscript{A} These permissible variations in length apply to pipe or tube in straight lengths. They apply to cut lengths up to and including 24 ft (7.3 m). For lengths over 24 ft, an additional over-tolerance of ½ in. (3.2 mm) for each 10 ft (3.0 m) or fraction thereof shall be permissible up to a maximum additional over-tolerance of ½ in. (12.7 mm).

12.4 Nondestructive Electric Test—Each pipe or tube shall be examined with a nondestructive electric test in accordance with Specification B829.

12.5 Rounding Method—For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value, or a calculated value, shall be rounded as indicated below, in accordance with the rounding method of Practice E29:

<table>
<thead>
<tr>
<th>Test</th>
<th>Rounded Unit for Observed or Calculated Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical composition and tolerances</td>
<td>nearest unit in the last right-hand place of figures of the specified limit</td>
</tr>
<tr>
<td>Tensile strength, yield strength</td>
<td>exact number following the specified limit</td>
</tr>
<tr>
<td>Elongation</td>
<td>nearest 1000 psi (6.9 MPa)</td>
</tr>
</tbody>
</table>

13. Inspection

13.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

15. Certification

15.1 When specified in the purchase order or contract, a manufacturer’s certification shall be furnished to the purchaser stating that material has been manufactured, tested, and inspected in accordance with this specification, and that the test results on representative samples meet specification requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

16. Product Marking

16.1 The following information shall be marked on the material or included on the package, or on a label or tag
attached thereto: The name of the material or UNS number, heat number, condition (temper), this specification number, the size, gross, tare and net weight, consignor and consignee address, contract or order number, or such other information as may be defined in the contract or order.

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order, for agencies of the U. S. Government.

S1. Referenced Documents

S1.1 The following documents of the issue in effect on date of material purchased form a part of this specification to the extent referenced herein:

- Federal Standards:
  - Fed. Std. No. 102 Preservation, Packaging and Packing Levels⁵
  - Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁵
  - Fed. Std. No. 182 Continuous Identification Marking of Nickel and Nickel-Base Alloys⁵

- Military Standard:
  - MIL-STD-129 Marking for Shipment and Storage⁵

S2. Quality Assurance

S2.1 Responsibility for Inspection:

S2.1.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections or tests set forth when such inspections and tests are deemed necessary to assure that the material conforms to prescribed requirements.

S3. Identification Marking

S3.1 All material shall be properly marked for identification in accordance with Fed. Std. No. 182, except that the ASTM specification number and the alloy number shall be used.

S4. Preparation for Delivery

S4.1 Preservation, Packaging, Packing:

S4.1.1 Military Agencies—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, level A or C, packed level A, B, or C as specified in the contract or purchase order.

S4.1.2 Civil Agencies—The requirements of Fed. Std. No. 102 shall be referenced for definitions of the various levels of packaging protection.

S4.2 Marking:

S4.2.1 Military Agencies—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with MIL-STD-129.

S4.2.2 Civil Agencies—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

APPENDIXES

(Nonmandatory Information)

X1. CONVERTER SIZES

X1.1 Small-diameter and light-wall tube in outside diameters 1½ in. (31.8 mm) and under may be furnished in the conditions listed in Table X1.1 when so specified. The material is furnished in a limited range of sizes and the manufacturer should be consulted as to the various outside diameters and wall thicknesses that may be furnished. Material will have a bright finish. Such material shall conform to the applicable requirements in Table X1.1 and Table X1.2.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tensile Strength, psi (MPa)</th>
<th>Yield Strength (0.2 % offset) min, psi (MPa)</th>
<th>Elongation in 2 in. or 50 mm, (or 4 D), min, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annealed⁵</td>
<td>85 000 (585) max 28 000 (195)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half-hard⁶</td>
<td>85 000 (585) min 55 000 (380)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full hard⁷</td>
<td>110 000 (760) min 90 000 (620)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


⁶ This condition is sometimes designated as “No. 1 Temper.”

⁷ This condition is sometimes designated as “No. 2 Temper.”

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X2. PIPE SCHEDULES

X2.1 The schedules of pipe shown in Table X2.1 are regularly available. Other schedules may be furnished, and the manufacturer should be consulted. Table X2.1 is published for information only.

<table>
<thead>
<tr>
<th>Specified Outside Diameter, in. (mm)</th>
<th>Outside Diameter</th>
<th>Inside Diameter, in. (mm)</th>
<th>Wall Thickness, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Under 3/32 (2.4)</td>
<td>0.002 (0.05)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>3/32 to 5/32 (2.4 to 4.8), excl</td>
<td>0.003 (0.08)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>5/32 to 1/4 (4.8 to 12.7), excl</td>
<td>0.004 (0.10)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1/4 to 11/4 (12.7 to 31.8), incl</td>
<td>0.005 (0.13)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Note: The pipe schedules shown above conform with standards adopted by the American National Standards Institute.
X3. CONDITIONS AND FINISHES NORMALLY SUPPLIED

X3.1 This appendix lists the conditions and finishes in which pipe and tube (other than converter sizes) are normally supplied. These are subject to change, and the manufacturer should be consulted for the latest information available.

X3.2 Nickel-Copper Alloy (UNS N04400)

X3.2.1 Annealed—Soft, with a dull matte finish.

X3.2.2 Stress-Relieved—Thermally treated below the annealing temperature to relieve the major portion of the internal stresses, with a thin, light- to medium-dark surface.

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B165 – 93 (2003)\(^1\)) that may impact the use of this standard.

(1) Introduction of nondestructive electric test in lieu of hydrostatic test at the option of the manufacturer.

(2) Revisions of 2.1, 4.1, 6.2, 10.3, 12.3, and 12.4.