Designation: B 445 – 87

Standard Specification for NICKEL-CHROMIUM-IRON-COLUMBIUM-MOLYBDENUM-TUNGSTEN ALLOY (UNS N06102)* SEAMLESS PIPE AND TUBE[1]

This standard is issued under the fixed designation B 445; 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 cold-worked nickel-chromium-iron-columbium-molybdenum-tungsten alloy (UNS N06102)* seamless pipe and tube in the conditions shown in Table 1.

1.2 The values stated in inch-pound are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

E 8 Methods of Tension Testing of Metallic Materials[2]

E 29 Recommended Practice for Indicating Which Places Are to Be Considered Significant in Specified Limiting Values[3]

E 38 Method for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys[4]

E 139 Recommended Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials[2]

E 354 Methods for Chemical Analysis of High-Temperature Electrical, Magnetic and Other Similar Iron, Nickel, and Cobalt Alloys[4]

3. Descriptions of Terms Specific to This Standard

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

3.2 *pipe*—tube conforming to the particular dimensions commercially known as pipe sizes (see Appendix X1).

3.3 *seamless pipe or tube*—tube or pipe produced with a continuous periphery in all stages of the operations.

3.4 *tube*—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 ASTM designation and year of issue.

4.1.2 Alloy name or UNS number.

4.1.3 Condition (see Appendix X2).

4.1.4 Finish (see Appendix X2).

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 Pressure Requirements*—Specify test pressure if other than required by 12.4.1.

4.1.8 *Ends*—Plain ends cut and deburred will

[1] This specification is under the jurisdiction of ASTM Committee B-2 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt and Alloys Containing Nickel or Cobalt or Both as Principal Constituents.

Current edition approved Sept. 25, 1987. Published November 1987. Originally published as B 445 – 66. Last previous edition B 445 – 81.

* New designation established in accordance with ASTM E 527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

[2] *Annual Book of ASTM Standards*, Vol 03.01.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] *Annual Book of ASTM Standards*, Vol 03.05.

be furnished. If threaded ends or ends beveled for welding are desired, give details.

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

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 Properties

6.1 *Tensile Properties*—Annealed and solution annealed material shall conform to the tensile properties specified in Table 1.

6.2 *Stress Rupture*—Solution-annealed material shall conform to the stress rupture properties specified in Table 3.

6.3 *Hydrostatic Test*—If any pipe or tube shows leaks during hydrostatic testing, it shall be rejected.

7. Dimensions and Permissible Variations

7.1 The permissible variations in the outside diameter and wall thickness of pipe and tube shall not exceed those prescribed in Table 4.

7.2 *Length*—When pipe or tube is ordered cut-to-length, the length shall conform to the permissible variations prescribed in Table 5.

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

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 tension and stress rupture 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 Tension and stress rupture testing samples of the material to provide test specimens for tensile and stress rupture testing shall be taken from such locations in each lot as to be representative of that lot.

10. Number of Tests

10.1 *Chemical Analysis*—One test per lot.

10.2 *Tension*—One per lot.

10.3 *Stress Rupture*—One per lot.

10.4 *Hydrostatic*—Each piece in each lot.

11. Specimen Preparation

11.1 Tension and stress rupture test specimens shall be taken from material in the final condition and tested in the direction of fabrication.

11.2 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 gage length as contained in Methods E 8 shall be used.

11.2.1 Stress rupture specimens shall be tension specimens modified as necessary for stress rupture testing in accordance with Recommended Practice E 139.

12. Test Methods

12.1 *Chemical Composition*—In case of disagreement, the chemical composition shall be determined in accordance with Methods E 354 or Methods E 38. Methods E 38 is to be used only for elements not covered by Methods E 354.

12.2 *Tension Test*—Tension testing shall be conducted in accordance with Methods E 8.

12.3 *Stress-Rupture*—Stress rupture testing shall be conducted in accordance with Methods

E 139.

12.4 *Hydrostatic:*

12.4.1 Each pipe or tube with an outside diameter ⅛ in. (3 mm) and larger and tubes 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 below:

$$P = 2St/D$$

where:

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

S = allowable fiber stress, for material in the condition furnished, as follows:

Annealed = 30 000 psi (207 MPa)
Solution annealed = 27 500 psi (190 MPa)

t = minimum wall thickness, in. (or mm), equal to the specified nominal wall, minus the permissible minus wall tolerance, Table 4, or the specified minimum wall thickness, and

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

12.4.2 When so agreed upon between the manufacturer and purchaser, pipe or tube may be tested to 1½ times the allowable fiber stress given in 12.4.1.

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 Recommended Practice E 29:

Test	Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances (when expressed in decimals)	Nearest unit in the last right-hand place of figures of the specified limit. If two choices are possible, as when the digits dropped are exactly a 5 or a 5 followed only by zeros, choose the one ending in an even digit with zero defined as an even digit.
Tensile strength, yield strength	nearest 1000 psi (6.9 MPa)
Elongation	nearest 1 %
Rupture life	nearest 1 h

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.