



Standard Specification for Niobium and Niobium Alloy Seamless and Welded Tubes¹

This standard is issued under the fixed designation B 394; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers wrought niobium and niobium alloy seamless and welded tubes as follows:

NOTE 1—Committee B10 has adopted “niobium” as the designation for Element No. 41, formerly named “columbium.”

- 1.1.1 R04200-Type 1—Reactor grade unalloyed niobium,
- 1.1.2 R04210-Type 2—Commercial grade unalloyed niobium,
- 1.1.3 R04251-Type 3—Reactor grade niobium alloy containing 1 % zirconium, and
- 1.1.4 R04261-Type 4—Commercial grade niobium alloy containing 1 % zirconium.

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

1.3 *The following precautionary caveat pertains only to the test methods portion 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 establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

- 2.1 ASTM Standards:
 - B 391 Specification for Niobium and Niobium Alloy Ingots²
 - E 8 Test Methods for Tension Testing of Metallic Materials³
 - E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

¹ This specification is under the jurisdiction of ASTM Committee B10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.03 on Niobium and Tantalum.

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² Annual Book of ASTM Standards, Vol 02.04.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 14.02.

3.1.1 *lot*—a lot shall consist of all material produced from the same ingot at one time, with the same cross section, processed with the same nominal metallurgical parameters and heat treated at the same conditions.

4. Ordering Information

4.1 Orders for materials under this specification shall include the following information as applicable:

- 4.1.1 Type and grade (Section 1),
- 4.1.2 ASTM designation and year of issue,
- 4.1.3 Welding (Section 5),
- 4.1.4 Quantity in weight, number of pieces, and dimensions,
- 4.1.5 Chemistry (6.3),
- 4.1.6 Temper designation (Section 8),
- 4.1.7 Permissible variations in length and quantity or weight (9.2, 9.4, and Table 1^B),
- 4.1.8 Quality and finish (10.4),
- 4.1.9 Sampling (11.2),
- 4.1.10 Hydrostatic or pneumatic test (14.2),
- 4.1.11 Inspection (Section 15),
- 4.1.12 Required reports (Section 17), and
- 4.1.13 Additions to the specification and supplementary requirements, as required.

5. Materials and Manufacture

5.1 Material covered by this specification shall be made from ingots that conform to Specification B 391 and that are produced by vacuum or plasma arc melting, vacuum electron-beam melting, or a combination of these three methods.

5.2 Seamless tubes may be made by any seamless method that will yield a product meeting the requirements of this specification, such as, but not limited to, extrusion of billets with subsequent cold working by drawing, swaging, or rocking, with intermediate anneals, until the final dimensions are reached.

5.3 Welded tubing shall be made from flat-rolled products by an automatic or semiautomatic welding process with no addition of filler metal in the welding operation. Other methods of welding, such as the addition of filler metal or hand welding, may be employed if approved by the purchaser and tested by methods agreed upon between the manufacturer and the