



Standard Specification for Niobium-Hafnium Alloy Ingots¹

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1. Scope

1.1 This specification covers hafnium alloyed niobium ingots prepared by vacuum- or plasma- arc melting or electron-beam furnace melting, or a combination of these methods, to produce consolidated metal for processing to various mill shapes.

1.2 The material covered by this specification is Grade R04295, niobium-base alloy containing approximately 10 % hafnium and 1 % titanium.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards*:²

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

E2626 Guide for Spectrometric Analysis of Reactive and Refractory Metals

3. Terminology

3.1 *Lot Definitions*:

3.1.1 *ingot, n*—a quantity of metal cast into a shape suitable for subsequent processing to various mill products.

4. Ordering Information

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

4.1.1 General alloy description (see 1.2) and ASTM designation and year of issue,

4.1.2 Quantity in weight or pieces,

4.1.3 Size: diameter and length,

4.1.4 Chemistry (Section 6),

4.1.5 Quality and finish (see 8.2, 8.4, and 8.6),

4.1.6 Certifications and Reports (Section 14),

4.1.7 Packaging (Section 16), and

4.1.8 Disposition of rejected material (Section 12).

5. Materials and Manufacture

5.1 The ingot metal for this material may be vacuum- or plasma-arc melted, electron-beam melted, or a combination of these methods.

6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition prescribed in Table 1. Analysis for elements, not listed in Table 1 and not normally expected in niobium hafnium alloy, shall not be required unless specified at time of purchase. Guide E2626 may be used as a guide for chemical analysis techniques.

7. Permissible Variations in Quantity

7.1 For orders requiring up to 100 lb [45 kg] of ingots, the manufacturer may overship up to a maximum of 20 %. For orders up to 1000 lb [450 kg], the manufacturer may overship up to a maximum of 10 %. The permissible overshipment shall be negotiated for orders larger than 1000 lb [450 kg].

8. Workmanship, Finish, and Appearance

8.1 The manufacturer shall use care to have each lot of ingot material as uniform in quality as possible.

8.2 When specified, the ingots shall be conditioned on the surface to standards agreed upon between the purchaser and the manufacturer.

8.3 In the conditioned ingot, no abrupt changes in diameter or local depressions that will impair subsequent fabrication will be permitted. The difference between maximum and minimum radius of the conditioned ingot shall not exceed 5 % of the maximum radius. Lands, grooves, and local depressions shall be blended to a maximum angle of 30° to the axis of the ingot.

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 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.

**TABLE 1 Chemical Requirements (Ingot)**

Niobium-Hafnium Alloy Grade R04295		
Element	Content, Maximum Weight % (Except for Hf and Ti)	
Carbon	0.015	
Oxygen	0.025	
Nitrogen	0.010	
Hydrogen	0.0015	
Hafnium	9–11	
Titanium	0.7–1.3	
Zirconium	0.700	
Tungsten	0.500	
Tantalum	0.500	
Niobium by difference		

8.4 Each ingot should be tested for soundness by nondestructive test methods, such as dye penetrant and ultrasonic tests, as mutually agreed upon between the purchaser and the manufacturer.

8.5 Defects in ingots that exceed the acceptance standards shall be removed by cropping or surface conditioning, whichever is appropriate. The manufacturer shall be permitted to remove surface imperfections provided that after such removal, the requirements of conditioning are met (8.3).

8.6 The ingots shall be free of imperfections that would be deemed injurious by the standards of acceptability agreed upon between the purchaser and the manufacturer.

9. Number of Tests

9.1 Each ingot shall be tested for chemical composition in at least three positions along the length of the ingot.

10. Significance of Numerical Limits

10.1 The following applies to all specified limits in this standard for purposes of determining conformance with this specification: The observed value or a calculated value shall be rounded off to the nearest unit in the last right-hand digit used in expressing the specification limit, in accordance with the rounding-off method of Practice E29.

11. Sampling

11.1 Care shall be exercised to ensure that the sample selected for testing is representative of the material, and that it is not contaminated by the sampling procedure. If there is any

question relating to the sampling techniques or to the analysis thereof, the methods for sampling and analysis shall be as agreed upon between the purchaser and the manufacturer.

12. Rejection

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

13. Rehearing

13.1 In the event of disagreement between the manufacturer and the purchaser on the conformance of the material to the requirements of this specification or any special test specified by the purchaser, a mutually acceptable referee shall perform the tests in question. The results of the referee's testing shall be used in determining conformance of the material to this specification.

14. Certification

14.1 A producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. A report of the test results shall be furnished.

15. Product Marking

15.1 Each ingot shall be marked for identification by metal die stamping the manufacturer's ingot number on the top of the ingot. Each box or skid shall be marked or tagged legibly and conspicuously with the number, type of material, ingot number(s), manufacturer's identification, nominal size, and the gross, net, and tare weights.

16. Packaging

16.1 Unless otherwise specified, material purchased under this specification must be boxed or banded on skids in such a manner as to secure safe delivery to their destination when properly transported by any common carrier.

17. Keywords

17.1 niobium-hafnium alloy ingots

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