



Standard Specification for Tantalum and Tantalum Alloy Rod and Wire¹

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1. Scope

1.1 This specification covers unalloyed and alloyed tantalum rod and wire.

1.2 The materials covered by this specification are:

1.2.1 R05200, unalloyed tantalum, electron-beam furnace or vacuum-arc melt, or both,

1.2.2 R05400, unalloyed tantalum, powder-metallurgy consolidation,

1.2.3 R05255, tantalum alloy, 90 % tantalum 10 % tungsten, electron-beam furnace or vacuum-arc melt, or both,

1.2.4 R05252, tantalum alloy, 97.5 % tantalum 2.5 % tungsten, electron-beam furnace or vacuum-arc melt, or both, and

1.2.5 R05240 tantalum alloy, 60 % tantalum 40 % columbium, electron-beam furnace or vacuum-arc melt, or both.

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

1.4 The following precautionary caveat pertains only to the test methods portion, Section 13, of this specification: *This standard does not purport to address all of the safety problems, 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:*²

E 8 Test Methods for Tension Testing of Metallic Materials

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *lot, n*—all material produced from the same ingot or a single powder blend at one time, with the same cross section and with the same nominal metallurgical parameters.

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.

3.1.2 *rod, n*—material 0.125 to 2.5 in. (3.18 to 63.50 mm) in diameter in round, hexagonal, or octagonal cross section supplied in straight lengths.

3.1.3 *wire, n*—material 0.010 to 0.124 in. (0.254 to 3.15 mm) in diameter furnished in coils or on spools or reels. Material less than 0.010 in. in diameter is not covered by this specification.

4. Ordering Information

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

4.1.1 Quantity (weight or number of pieces),

4.1.2 Name of material (tantalum rod or wire),

4.1.3 Type (see 1.2),

4.1.4 Method of manufacture (Section 5),

4.1.5 ASTM designation,

4.1.6 Finish and appearance (Section 9), and

4.1.7 Additions to the specification and supplementary requirements if required.

5. Materials and Manufacture

5.1 Material covered by this specification shall be made from vacuum-arc melted or electron-beam melted ingots or powder-metallurgy consolidated unalloyed tantalum.

5.2 The various tantalum mill products covered by this specification are formed with the conventional extrusion, forming, swaging, rolling, and drawing equipment normally available in metal working plants.

6. Chemical Composition

6.1 The tantalum and tantalum alloy ingots and the tantalum powder-metallurgy consolidated ingots for conversion to finished products covered by this specification shall conform to the requirements for chemical composition as prescribed in Table 1.

6.1.1 Analysis for elements not listed in Table 1 and not normally expected in tantalum shall not be required unless specified at time of purchase.

6.2 The manufacturer's ingot analysis shall be considered the chemical analysis for products supplied under this specification.

6.3 When requested by the purchaser at the time of purchase, the seller shall furnish a report certifying the values of carbon, oxygen, nitrogen, and hydrogen as specified in Table 2



TABLE 1 Chemical Requirements

Element	Content, max, weight %				
	Electron-Beam Cast (R05200) Vacuum-Arc Cast (R05200) Unalloyed Tantalum	Sintered (R05400) Unalloyed Tantalum	Electron-Beam Cast (R05255) Vacuum-Arc Cast (R05255) 90 % Tantalum 10 % Tungsten	Electron-Beam Cast (R05252) Vacuum-Arc Cast (R05252) 97.5 % Tantalum 2.5 % Tungsten	Electron-Beam Cast (R05240) Vacuum-Arc Cast (R05240) 60 % Tantalum 40 % Columbium
C	0.010	0.010	0.010	0.010	0.010
O	0.015	0.03	0.015	0.015	0.020
N	0.010	0.010	0.010	0.010	0.010
H	0.0015	0.0015	0.0015	0.0015	0.0015
Nb	0.10	0.10	0.10	0.50	35.0–42.0
Fe	0.010	0.010	0.010	0.010	0.010
Ti	0.010	0.010	0.010	0.010	0.010
W	0.050	0.050	9.0–11.0	2.0–3.5	0.050
Mo	0.020	0.020	0.020	0.020	0.020
Si	0.005	0.005	0.005	0.005	0.005
Ni	0.010	0.010	0.010	0.010	0.010
Ta	remainder	remainder	remainder	remainder	remainder

TABLE 2 Additional Chemical Requirements for Finished Product (When Specified by the Purchaser)

Element	Content, max, % weight Grades				
	Electron-Beam Case (R05200) Vacuum-Arc Cast (R05200) Unalloyed Tantalum	Sintered (R05400) Unalloyed Tantalum	Electron-Beam Cast (R05255) Vacuum-Arc Cast (R05255) 90 % Tantalum 10 % Tungsten	Electron-Beam-Cast (R05252) Vacuum-Arc Cast (R05252) 97.5 % Tantalum 2.5 % Tungsten	Electron-Beam Cast (R05240) Vacuum-Arc Cast (R05240) 60 % Tantalum 40 % Columbium
O	0.025	0.035	0.025	0.025	0.025
N	0.010	0.010	0.010	0.010	0.010
H	0.0015	0.0015	0.0015	0.0015	0.0015
C	0.020	0.020	0.020	0.020	0.020

for each lot of material supplied. The performance of this special provision will be negotiated.

7. Mechanical Properties

7.1 Materials supplied under this specification shall conform to the requirements for mechanical properties as specified in Table 3.

7.2 The performance of mechanical tests to this requirement will be negotiated at time of purchase.

8. Dimensions, Mass, and Permissible Variations

8.1 *Tolerances on Rounds*—Tolerances on tantalum and tantalum alloy round products covered by this specification shall be as specified in Table 4.

8.2 *Tolerances for Square, Rectangular, or Other Shapes*—Tolerances for forged or rolled square, rectangular, or other shapes shall be as agreed upon between purchaser and seller at the time of purchase.

8.3 Other Tolerances and Limitations:

8.3.1 The permissible variation in cut lengths shall not exceed a total of 0.25 in. (6.35 mm).

8.3.2 The permissible variation in straightness of rounds shall not exceed 0.050 in. (1.27 mm)/ft (304.8 mm) in any length.

8.4 *Quantity or Weight*—For orders requiring up to 100 lb (45.4 kg), the manufacturer may overship by 10 %. When the

order is for quantities up to 500 lb (226.8 kg), the manufacturer may overship by 5 %. The permissible overship for quantities larger than this shall be negotiated between the purchaser and the manufacturer.

9. Workmanship, Finish, and Appearance

9.1 The finished rod and wire shall be free of injurious external and internal imperfections of a nature that will interfere with the purpose for which it is intended in accordance with standards of acceptability agreed upon between the manufacturer and the purchaser.

9.2 Material may be finished as forged, rolled, swaged, drawn in the as-cleaned, as-machined, or as-ground conditions. The manufacturer shall be permitted to remove minor surface imperfections provided such removal does not reduce the dimensions below the minimum permitted by the tolerances established in Section 8 of this specification.

9.3 Methods of testing for defects and standards of acceptability shall be as agreed upon between the manufacturer and the purchaser at time of purchase.

10. Sampling

10.1 Samples shall be taken from the material to determine conformity to this specification. The samples shall be taken so as to be representative of the finished products.

TABLE 3 Mechanical Properties for Rod and Wire, Annealed Condition

	Rod		
	0.125 in. (3.18 mm) to 2.5 in. (63.5 mm) Diameter		
	Ultimate Tensile Strength, min, psi (MPa)	Yield Strength, min, psi (MPa)	Elongation, min, % 1 in. (25.4 mm) Gage Length
Unalloyed tantalum (R05200 and R05400)	25 000 (172)	15 000 (103)	25
97.5 % tantalum 2.5 % tungsten (R05252)	40 000 (276)	28 000 (193)	20
90 % tantalum 10 % tungsten R05255	70 000 (482)	55 000 (379)	20
60 % tantalum 40 % columbium (R05240)	35 000 (244)	15 000 (103)	25

	Diameter, in. (mm)	Ultimate Tensile Strength, min, psi (MPa)	Elongation min, % ^A
Unalloyed tantalum (R05200 and R05400)	0.010 (0.254) to 0.0149 (0.379)	35 000 (241)	10
	0.015 (0.381) to 0.0249 (0.633)	35 000 (241)	15
	0.025 (0.635) to 0.124 (3.14)	30 000 (207)	20
97.5 % tantalum 2.5 % tungsten (R05252)	0.010 (0.254) to 0.0149 (0.379)	40 000 (276)	5
	0.015 (0.381) to 0.0249 (0.633)	40 000 (276)	10
	0.025 (0.635) to 0.124 (3.14)	40 000 (276)	15
90 % tantalum 10 % tungsten (R05255)	0.010 (0.254) to 0.0149 (0.379)	70 000 (482)	5
	0.015 (0.381) to 0.0249 (0.633)	70 000 (482)	10
	0.025 (0.635) to 0.124 (3.14)	70 000 (482)	15
60 % tantalum 40 % columbium (R05240)	0.010 (0.254) to 0.0149 (0.379)	35 000 (244)	10
	0.015 (0.381) to 0.0249 (0.633)	35 000 (244)	15
	0.025 (0.635) to 0.124 (3.14)	35 000 (244)	20

^A10-in. (254-mm) gage length to 0.050 in. (1.27-mm) diameter and 1-in. (25.4-mm) or 2-in. (50.8-mm) gage length over 0.050-in. (1.27-mm) diameter.

TABLE 4 Permissible Variations in Dimensions for Rolled, Swaged or Drawn Rod and Wire

Diameter, in. (mm)	Tolerance, ±, in. (mm)
0.010 to 0.020 excl (0.254 to 0.508)	0.0005 (0.013)
0.020 to 0.030 excl (0.508 to 0.762)	0.00075 (0.019)
0.030 to 0.060 excl (0.762 to 1.524)	0.001 (0.025)
0.060 to 0.090 excl (1.524 to 2.286)	0.0015 (0.038)
0.090 to 0.125 excl (2.286 to 3.175)	0.002 (0.051)
0.125 to 0.187 excl (3.175 to 4.750)	0.003 (0.076)
0.187 to 0.375 excl (4.750 to 9.525)	0.004 (0.102)
0.375 to 0.500 excl (9.525 to 12.70)	0.005 (0.127)
0.500 to 0.625 excl (12.70 to 15.88)	0.007 (0.178)
0.625 to 0.750 excl (15.88 to 19.05)	0.008 (0.203)
0.750 to 1.000 excl (19.05 to 25.40)	0.010 (0.254)
1.000 to 1.500 excl (25.40 to 38.10)	0.015 (0.381)
1.500 to 2.000 excl (38.10 to 50.80)	0.020 (0.508)
2.000 to 2.500 excl (50.80 to 63.50)	0.030 (0.762)

10.2 Care shall be taken 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 technique, or to the testing thereof, the methods of sampling and testing shall be as agreed upon between the purchaser and the manufacturer.

11. Number of Tests

11.1 If mechanical testing is required (7.2), perform a longitudinal or transverse tension test on each lot of rod and a longitudinal tension test on each lot of wire.

11.2 If end-product chemical tests are required (6.3), make one chemical test from each lot of finished product.

12. Significance of Numerical Limits

12.1 For the purpose of determining compliance with the specified limits for requirements on the properties listed in this

specification, observed and calculated values shall be rounded as indicated by the rounding method of Practice E 29.

13. Test Methods

13.1 *Tension Tests*—Prepare and test test specimens in accordance with Test Methods E 8. Determine tensile properties using a strain rate of 0.003 to 0.007 in./in.·min to the yield point and 0.02 to 0.05 in./in.·min to failure.

13.2 *Chemical Tests*—Conduct the chemical analysis in accordance with established methods.

13.3 *Retests*—If any sample or specimen exhibits obvious surface contamination or improper preparation disqualifying it as a truly representative sample, discard it and substitute a new sample or specimen.

13.3.1 In case of a failure, retest two additional specimens. If both retest specimens conform to this specification, discard the original values and consider the material acceptable.

13.3.2 If the results of the tests are not in conformance with the requirements of this specification, a lot may be reworked at the option of the manufacturer. The lot shall be acceptable if results of all tests, after reworking, conform to this specification.

14. Reports

14.1 If requested, the manufacturer shall supply at least three copies of a report of the chemical analysis and reports of the results of tests of representative finished product to determine properties required in Section 13. The reports should include the purchase order number, this specification number, and the quantity and number of items covered in the shipment and a statement that the material was manufactured, sampled, tested, and inspected in accordance with the specification and has been found to meet the requirements.

15. Inspection

15.1 The manufacturer shall inspect the material covered by this specification prior to the shipment.

15.2 If so specified on the purchase order, the purchaser or his representative may witness the testing and inspection of the material at the place of manufacture. In such cases, the purchase order shall indicate which test or tests to be witnessed and the manufacturer shall give ample notice to the purchaser as to the time and place of the designated test. If the purchaser's representative does not present himself at the agreed-upon time for the testing, and if no new date is agreed upon, the manufacturer shall consider the requirement for purchaser's inspection at place of manufacture to be waived. When the inspector representing the purchaser does appear at the appointed place and time, the manufacturer shall afford him, without charge, all reasonable facilities to see that the material is being furnished in accordance with this specification. This inspection shall be conducted so as not to interfere unnecessarily with production operations.

16. Rejection and Rehearing

16.1 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.

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17. Referee

17.1 In the event of disagreement between the manufacturer and the purchaser of the conformance of the material to the requirements of this specification or any special test specified by the purchaser, a mutually accepted 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.

18. Packaging and Package Marking

18.1 Each rod, bundle, box, coil, or spool shall be legibly and conspicuously marked or tagged with the number of this specification, type, temper, lot number, manufacturer's identification, nominal size, gross, net, and tare weights. If marking fluids are used, they shall be of such a nature as to be easily removed with cleaning solutions. The markings or their removal shall have no deleterious effect upon the material or its performance. The characters shall be sufficiently stable to withstand ordinary handling.

18.2 Unless otherwise specified, material purchased under this specification must be packed by box or suitable protective containers, and should be so marked as to indicate the nature of the best method of handling.

19. Keywords

19.1 chemistry; mechanical properties; tantalum; tantalum alloy