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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Tantalum and Tantalum Alloy Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation B 708; 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 unalloyed and alloyed tantalum plate, sheet, and strip.

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 of 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.

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

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:*

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

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *plate*—a flat product more than 0.1853 in. (4.7 mm) in thickness.

3.1.2 *sheet*—a flat product 6 in. (152.4 mm) or more in width and from 0.005 in. (0.13 mm) to 0.1875 in. (4.76 mm) in thickness.

3.1.3 *strip*—a flat product, may be supplied in coil, less than 6 in. (152.4 mm) in width and from 0.005 in. (0.13 mm) to 0.1875 in. (4.76 mm) in thickness.

3.1.4 *lot*—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.

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 plate, sheet, or strip),

4.1.3 Type (see 1.2),

4.1.4 Method of manufacture (Section 5),

4.1.5 ASTM designation,

4.1.6 Quality and finish (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, forging, and rolling 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 for each lot of material supplied. The performance of this special provision shall be negotiated.

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[1] This specification is under the jurisdiction of ASTM Committee B-10 on Reactive and Refractory Metals and Alloysand is the direct responsibility of Subcommittee B10.03on Niobium and Tantalum.

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

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

TABLE 1 Chemical Requirements Content, max, weight %

Element	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	0.100	0.100	0.100	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	0.05	0.05	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 %				
	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
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

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. Weight and Permissible Variations

8.1 Tolerances for thickness, width, and length for flat-rolled products covered by this specification shall be as shown in Table 4.

8.2 Flatness tolerance for sheet and plate products supplied under this specification shall be a maximum of 6 % as determined by the following equation (see Fig. 1):

$$\text{Flatness, \%} = (H / L) \times 100 \quad (1)$$

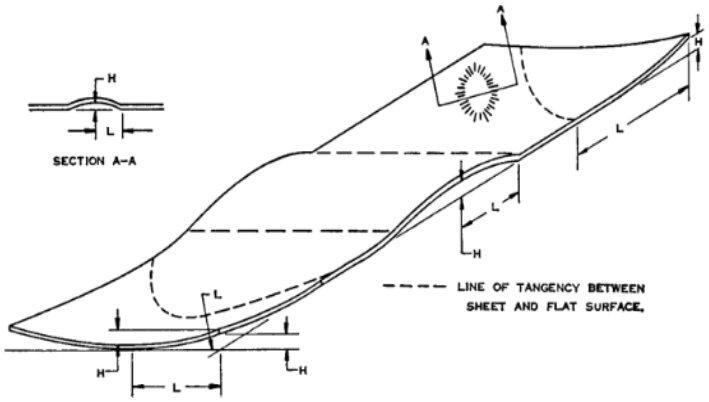
TABLE 3 Mechanical Properties for Plate, Sheet, and Strip

Grade and Form	Annealed Condition		
	Ultimate Tensile Strength, min, psi (MPa)	Yield Strength, min, psi (MPa) (2 % Offset)	Elongation, min, % (1-in. Gage Length)
Unalloyed tantalum (R05200) (R05400)			
Plate, sheet and strip			
<0.060 in. thick	30 000 (207)	20 000 (138)	20
≥0.060 in. thick	25 000 (172)	15 000 (103)	30
90 % tantalum 10 % tungsten (R05255)			
Sheet and strip	70 000 (482)	60 000 (414)	15
Plate	70 000 (482)	55 000 (379)	20
97.5 % tantalum 2.5 % tungsten (R05252)			
<0.125 in. thick	40 000 (276)	30 000 (207)	20
≥0.125 in. thick	40 000 (276)	22 000 (152)	25
60 % tantalum 40 % columbium (R05240)			
<0.060 in. thick	35 000 (241)	20 000 (138)	25
≥0.060 in. thick	35 000 (241)	15 000 (103)	25

TABLE 4 Dimensional Tolerances for Tantalum Sheet and Plate

Thickness of Tantalum in. (mm)	Tolerance on Thickness,[A] plus or minus, in. (mm)		Tolerance on Width (Slit),[B] plus or minus, in. (mm)		Tolerance on Sheared Lengths, in. (mm)			
	Width under 6 in (152.4 mm)	Width 6 to 24 in. (152.4 to 609.6 mm)	Width under 6 in. (152.4 mm)	Width 6 to 24 in. (152.4 to 609.6 mm)	Length 12 in. (304.8 mm) and Under		Length over 12 in. (304.8 mm)	
					Plus	Minus	Plus	Minus
0.0051 to 0.010 (0.129 to 0.254)	0.0005 (0.0127)		0.012 (0.305)		1/16 (1.59)	0	3/32 (2.381)	0
0.011 to 0.015 (0.279 to 0.381)	0.0007 (0.0178)	0.001 (0.0254)	0.015 (0.381)	0.015 (0.381)	1/16 (1.59)	0	3/32 (2.381)	0
0.016 to 0.020 (0.406 to 0.508)	0.0008 (0.0203)	0.0015 (0.0381)	0.015 (0.381)	0.015 (0.381)	1/16 (1.59)	0	3/32 (2.381)	0
0.021 to 0.030 (0.533 to 0.762)	0.0015 (0.0381)	0.0025 (0.0635)	0.020 (0.508)	0.025 (0.635)	1/16 (1.59)	0	3/32 (2.381)	0
0.031 to 0.060 (0.787 to 1.524)	0.0025 (0.0635)	0.0035 (0.0889)	0.025 (0.635)	0.030 (0.762)	1/16 (1.59)	0	3/32 (2.381)	0
0.061 to 0.090 (1.549 to 2.286)	0.004 (0.1016)	0.005 (0.1270)	0.025 (0.635)	0.035 (0.889)	1/16 (1.59)	0	3/32 (2.381)	0
0.091 to 0.125 (2.311 to 3.175)	0.006 (0.1524)	0.007 (0.1778)	...	...	1/16 (1.59)	0	3/32 (2.381)	0
0.126 to 0.187 (3.200 to 4.750)	0.010 (0.2540)	0.010 (0.2540)	...	...	1/16 (1.59)	0	3/32 (2.381)	0

[A] Tolerance on thickness of sheet over 24 in. (609.6 mm) wide shall be ± 10 % of the thickness.
[B] Tolerance on width of sheared sheet shall be + 1/16 in. (1.59 mm), – 0 in. (0 mm).
H = maximum distance between flat surface and lower surface of sheet.
L = minimum distance between highest point on sheet and point of contact with flat surface.



H = maximum distance between flat surface and lower surface of sheet.
L = minimum distance between highest point on sheet and point of contact with flat surface.
Flatness, percent = *(H/L) × 100*

FIG. 1 Plate and Sheet Flatness Tolerances

where:

H = maximum vertical distance between a flat reference surface and the lower surface of the sheet, and

L = minimum horizontal distance between the highest point on the sheet and the point of contact with a flat reference surface. (Figure 1 is included to illustrate the method for taking measurements for calculation of sheet flatness; however, a value of *H* less than 1/32 in. (0.794 mm) shall not be caused for rejection.)

8.3 *Quantity or Weight*—For orders requiring up to 100 lb (45.4 kg), the manufacturer may overship by 10 %. When the order is for guarantees up to 500 lb (226.8 kg), the manufacturer may overship an order by 5 %. The permissible overshipment for quantities larger than this shall be negotiated between the purchaser and the manufacturer.

9. Workmanship, Finish, and Appearance

9.1 Tantalum and tantalum alloy plate, sheet, and strip shall be free of injurious internal and external imperfections of a nature that will interfere with the purpose for which it is intended. Material may be finished as-rolled, as-cleaned, or as-ground. The manufacturer shall be permitted to remove minor surface imperfections if such removal does not reduce the dimensions below the minimum permitted by the tolerances specified in Table 2.

9.2 Methods of testing for these defects and standards of acceptability shall be as agreed upon between the manufacturer and the purchaser.

10. Number of Tests

10.1 If mechanical testing is required (see 7.2), perform a

longitudinal or transverse tension test on each lot of material.

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

11. Test Methods

11.1 *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.

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

11.3 *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.

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. Sampling

13.1 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.

13.2 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.

14. Report

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 Sections 6 and 7. The reports shall 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. Rejection and Rehearing

15.1 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.

16. Referee

16.1 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.

17. Packaging and Package Marking

17.1 When specified, each plate, sheet, and strip shall be marked with the number of this specification, type, temper, lot number, manufacturer's identification, nominal thickness in inches, and gross, net, and tare weights. Characters shall be not less than ⅜ in. (9.5 mm) in height, applied with a suitable marking fluid and capable of being removed without rubbing. The markings or their removal shall have no deleterious effect the material or its performance. The characters shall be sufficiently stable to withstand ordinary handling.

17.2 When specified, plate and flat sheet shall be marked in lengthwise rows of characters recurring at intervals not greater than 2 ft (0.6 m), the rows spaced not more than 3 in. (76 mm) apart and alternately staggered.

17.3 When specified, coiled strip and sheet shall be marked near the outside of the coil.

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