



Standard Specification for Tantalum and Tantalum Alloy Plate, Sheet, and Strip¹

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 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.

1.2.5 R05240, tantalum alloy, 60 % tantalum, 40 % niobium, 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 Materials²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications³

E 112 Test Methods for Determining the Average Grain Size²

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 10), 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 and Table 2.

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.

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.

Current edition approved Nov. 10, 2001. Published January 2002. Originally published as B 708 – 82. Last previous edition B 708 – 98.

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
Fe	0.010	0.010	0.010	0.010	0.010
Mo	0.020	0.020	0.020	0.020	0.020
Nb	0.100	0.100	0.100	0.50	35.0–42.0
Ni	0.010	0.010	0.010	0.010	0.010
Si	0.005	0.005	0.005	0.005	0.005
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
Ta	remainder	remainder	remainder	remainder	remainder

TABLE 2 Additional Chemical Requirements

Element	Chemistry-max content ^A	
	3N5 Purity 99.95 % Minimum Electron Beam Cast (R0XXXX) or Vacuum Arc Cast (R0XXXX) or Sintered (R0ZZZZ) Unalloyed Tantalum (Max. ppm)	4N Purity 99.99 % Minimum Electron Beam Cast (R0XXXX) or Vacuum Arc Cast (R0YYYY) or Sintered (R0ZZZZ) Unalloyed Tantalum (Max. ppm)
C	40	40
O	100	100
N	40	40
H	10	10
S	1	1
Al	5	1
Ca	5	1
Cd	5	1
Cl	5	1
Co	5	1
Cr	5	1
Cu	5	1
Fe	5	1
Hf	5	1
K	1	1
Li	1	1
Mg	5	1
Mn	5	1
Mo	50	30
Na	1	1
Nb	400	80
Ni	5	1
Pb	5	1
Si	5	1
Sn	5	1
Ti	5	1
Th	0.005	0.005
V	5	1
W	150	80
Zn	5	1
Zr	5	1
Y	5	1
U	0.005	0.005
Others (each)	5	1
Total Metallic Elements	500	100

^AMetallic elements analyzed by GDMS, Gases (CONH) by Leco Methods.

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 3

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

7. Mechanical Properties

7.1 Materials supplied under this specification shall conform to the requirements for mechanical properties as specified in Table 4.

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

8. Metallurgical Properties

8.1 Materials supplied under this specification for sputtering target applications (R0XXXX, R0YYYY, or R0ZZZZ) shall conform to the requirements for metallurgical properties described in Table 5.

9. Weight and Permissible Variations

9.1 Tolerances for thickness, width, and length for flat-rolled products covered by this specification shall be as shown in Table 6.

9.2 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):

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

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 1/32in. (0.794 mm) shall not be caused for rejection.)

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

TABLE 3 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

TABLE 4 Mechanical Properties for Plate, Sheet, and Strip

NOTE 1—Tantalum for sputtering target applications (R0XXXX, R0YYYY, or R0ZZZZ) is not tested and does have to meet the requirements of Table 4).

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 5 Metallurgical Properties for Tantalum plate for Sputtering Target Application (R0XXXX, R0YYYY, or R0ZZZZ)

Nominal Gauge	Grain Size and Structure Requirements - Sputtering Applications Only	
	Average Through Thickness Grain Size ^A	Recrystallization ^B
.125"-.299"	ASTM 4 (90μ) or finer	98 % min.
.300"-.500"	ASTM 3 (125μ) or finer	98 % min.
.501"-.650"	ASTM 2 (180μ) or finer	98 % min.
.651"-1.25"	Not Specified	90 % min.

^AThe structure of all material shall be uniform throughout the thickness of the plate. The grain size in individual areas shall not vary more than 2 ASTM grain size numbers from the average through thickness grain size. Grain Size shall be tested according to Test Methods E 112

^BPercent Recrystallization shall be measured through the thickness of the plate. The total thickness of unrecrystallized areas (bands) divided by the thickness of the plate and multiplied by 100 shall be less than the stated requirement.

10. Workmanship, Finish, and Appearance

10.1 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 3.

10.2 Methods of testing for these defects and standards of

acceptability shall be as agreed upon between the manufacturer and the purchaser.

11. Number of Tests

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

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

12. Test Methods

12.1 *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.

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

12.3 *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. Significance of Numerical Limits

13.1 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.

TABLE 6 Dimensional Tolerances for Tantalum Sheet and Plate

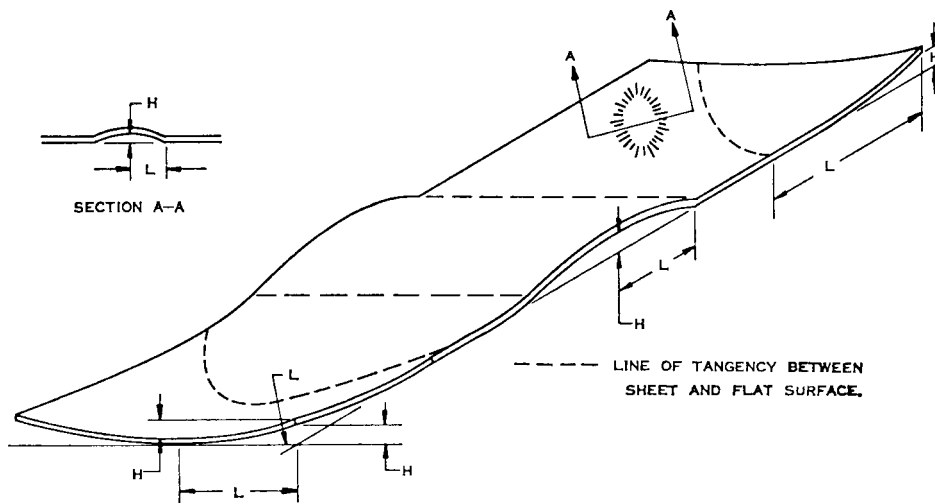
Thickness of Tantalum in. (mm)	Tolerance on Thickness, ^A plus or minus, in. (mm)		Tolerance on Width (Slit), ^B plus or minus, in. (mm)		Tolerance on Sheared Lengths, in. (mm)			
	Width under 6 in. (152.4 mm)	Width 6 to 24 in. (152.4 to 609.6 mm)	Width under 6 in. (152.4 mm)	Width 6 to 24 in. (152.4 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	1/4 (6.35)	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	1/4 (6.35)	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	1/4 (6.35)	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	1/4 (6.35)	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	1/4 (6.35)	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	1/4 (6.35)	0
0.091 to 0.125 (2.311 to 3.175)	0.006 (0.1524)	0.007 (0.1778)	1/16 (1.59)	0	1/4 (6.35)	0
0.126 to 0.187 (3.200 to 4.750)	0.010 (0.2540)	0.010 (0.2540)	1/16 (1.59)	0	1/4 (6.35)	0

^ATolerance on thickness of sheet over 24 in. (609.6 mm) wide shall be ± 10 % of the thickness.

^BTolerance on width of sheared sheet shall be + 1/4 in. (6.35 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.

$$\text{Flatness, percent} = (H/L) \times 100$$

FIG. 1 Plate and Sheet Flatness Tolerances

14. Sampling

14.1 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.

14.2 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.

15. Report

15.1 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.

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.

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 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 $\frac{3}{8}$ 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.

18.2 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.

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

18.4 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.

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