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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7898C

Issued JAN 1964
Revised MAR 1994
Superseding AMS 7898B

Submitted for recognition as an American National Standard

TUNGSTEN SHEET, STRIP, PLATE, AND FOIL
Pressed, Sintered, and Wrought

AN AMERICAN NATIONAL STANDARD

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of March 1994. It is recommended, therefore, that this specification not be specified for new designs.

This cover sheet should be attached to the "B" revision of the subject specification.

"NONCURRENT" refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these as standard materials for future use in new designs. Each of these "NONCURRENT" specifications is available from SAE upon request.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "G"

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AMS 7898B

Issued 1-31-64
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Superseding AMS 7898A

REAFFIRMED
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TUNGSTEN SHEET, STRIP, PLATE, AND FOIL
Pressed, Sintered, and Wrought

UNS R07006

1. SCOPE:

1.1 Form: This specification covers tungsten in the form of pressed, sintered, and wrought sheet, strip, plate, and foil,

1.2 Application: Primarily for parts requiring exposure at ultra-high temperatures. Applications in oxidizing atmospheres necessitate protective coating.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2242 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
MAM 2242 - Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS 2350 - Standards and Test Methods
AMS 2630 - Ultrasonic Inspection, Product Over 0.5 in. (12.5 mm) Thick
AMS 2645 - Fluorescent Penetrant Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E92 - Vickers Hardness of Metallic Materials

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

2.4 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight; carbon Ø shall determined conductometrically, nitrogen and oxygen by the vacuum fusion or conductometric method, hydrogen by the vacuum extraction method, and-metallic elements by spectrographic or other analytical methods approved by purchaser:

	min	max
Molybdenum	--	0.020
Carbon	--	0.008
Nickel	--	0.005
Silicon	--	0.005
Iron	--	0.005
Aluminum	--	0.005
Oxygen	--	0.005 (50 ppm)
Nitrogen	--	0.002 (20 ppm)
Hydrogen	--	0.001 (10 ppm)
Tungsten	remainder	

3.2 Condition: Hot-cold rolled, stress-relieved, and descaled having a surface texture not greater than 125 microin. (3.12 m), determined in accordance with ANSI B46.1.

3.2.1 Edges shall be sheared, machined, or ground straight, with the corners square.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Hardness: Shall be not lower than 400 HV30, or equivalent, for any determination and not lower than 440 HV30, or equivalent, for the average of all determinations, determined in accordance-with ASTM E92.

3.3.2 Tensile Properties at 1000°F (540°C): Shall be as shown in Table I, determined in accordance with ASTM E21 on specimens as in 4.3.2.1, heated to 1000°F ± 15 (540°C ± 8) in an inert atmosphere, held at heat for 10 min. ± 1 before testing, and tested at 1000°F ± 15 (540°C ± 8) at a strain rate of 0.05 in./in. per min. (0.05 mm/mm per min.):

TABLE I

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. %, min
Over 0.010 to 0.060, incl	84,000	75,000	3
Over 0.060 to 0.100, incl	82,000	73,000	3
Over 0.100 to 0.150, incl	80,000	71,000	3
Over 0.150 to 0.200, incl	78,000	69,000	3
Over 0.200 to 0.250, incl	76,000	67,000	3

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yie1d Strength at 0.2% Offset MPa, min	Elongation in 50 mm %, min
Over 0.25 to 1.50, incl	580	515	3
Over 1.50 to 2.50, incl	565	505	3
Over 2.50 to 3.75, incl	550	490	3
Over 3.75 to 5.00, incl	540	475	3
Over 5.00 to 6.25, incl	525	460	3

3.3.2.1 Tensile property requirements for product 0.010 in. (0.25 mm) and under or over 0.250 in. (6.25 mm) in nominal thickness and for specimens taken with the axis of the specimen perpendicular to the direction of rolling shall be as agreed upon by purchaser and vendor.

3.3.3 Specific Gravity: Shall be not less than 19.20 for product up to 0.150 in. (3.75 mm), and under, in nominal thickness and not less than 19.15 for product over 0.150 in. (3.75 mm) in nominal thickness.

3.3.4 Microstructure: Shall exhibit a completely worked structure with no evidence of recrystallization. The product shall not have a mixed grain size or duplex structure. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.3.5 Recrystallization: Specimens heated to 1850°F ± 25 (1010°C ± 15) in an inert atmosphere, he1d at heat for 30 min. ± 3, and cooled to room temperature, shall show no recrystallization as evidenced by a change in average Vickers hardness of more than 20 points from the original average hardness for nominal thicknesses 0.030 in. (0.75 mm) and over and 50 points for thicknesses under 0.030 in. (0.75 mm).

3.3.6 Bend Ductility: Product over 0.010 to 0.250 in. (0.25 to 6.25 mm), incl, in nominal thickness shall withstand, without cracking, bending in accordance with Table II with axis of bend perpendicular to the direction of rolling. The speed of the bending stroke shall be 0.5 to 0.7 in. per min. (0.20 to 0.30 mm/s). Specimens shall be bent to a 90 deg included angle after springback. Specimens shall be bent in dies having the dimensions shown in Fig. 1.

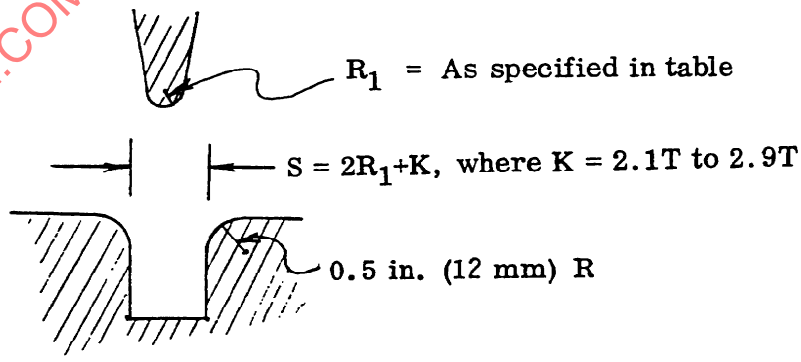
TABLE II

Nominal Thickness (T) Inches	Bend Radius (R_1)	Test Temperature °F, +O, -25
Over 0.010 to 0.060, incl	1T	400
Over 0.060 to 0.100, incl	2T	425
Over 0.100 to 0.150, incl	2T	450
Over 0.150 to 0.200, incl	4T	475
Over 0.200 to 0.250, incl	4T	500

TABLE II (SI)

Nominal Thickness Millimetres	Bend Radius (R_1)	Test Temperature °C, +O, -15
Over 0.25 to 1.50, incl	1T	205
Over 1.50 to 2.50, incl	2T	220
Over 2.50 to 3.75, incl	2T	230
Over 3.75 to 5.00, incl	4T	245
Over 5.00 to 6.25, incl	4T	260

3.3.6.1 Bend ductility requirements for product 0.010 in. (0.25 mm) and under or over 0.250 in. (6.25 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.



Bend Test Apparatus

FIGURE 1

3.4 Quality:

3.4.1 The product, as received by purchaser, shall be uniform in quality and condition, and free from foreign materials and from imperfections detrimental to usage of the product.

3.4.1.1 Minor surface imperfections which are removable within one-half the thickness tolerance are acceptable if removed and smoothly blended into the adjacent surface area.

3.4.2 Each piece shall be fluorescent penetrant inspected in accordance with AMS 2645 and ultrasonically inspected in accordance with AMS 2630. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Shall be as follows:

3.5.1 Thickness: Shall be as specified in Table III.

TABLE III

Nominal Thickness Inch	Tolerance, Inch plus and minus
Up to 0.005, incl	0.0007
Over 0.005 to 0.007, incl	0.0008
Over 0.007 to 0.010, incl	0.0012
Over 0.010 to 0.015, incl	0.0015
Over 0.015 to 0.020, incl	0.0020
Over 0.020 to 0.030, incl	0.0025
Over 0.030 to 0.040, incl	0.0032
Over 0.040 to 0.060, incl	0.0050
Over 0.060 to 0.100, incl	0.0080
Over 0.100 to 0.125, incl	0.0100
Over 0.125 to 0.150, incl	0.0110
Over 0.150 to 0.200, incl	0.0130
Over 0.200 to 0.250, incl	0.0150

TABLE III (SI)

Nominal Thickness Millimetres	Tolerance, Millimetre plus and minus
Up to 0.12, incl	0.018
Over 0.12 to 0.18, incl	0.020
Over 0.18 to 0.25, incl	0.030
Over 0.25 to 0.38, incl	0.038
Over 0.38 to 0.50, incl	0.050
Over 0.50 to 0.75, incl	0.062
Over 0.75 to 1.00, incl	0.080
Over 1.00 to 1.50, incl	0.125
Over 1.50 to 2.50, incl	0.200
Over 2.50 to 3.12, incl	0.250
Over 3.12 to 3.75, incl	0.275
Over 3.75 to 5.00, incl	0.325
Over 5.00 to 6.25, incl	0.375

3.5.1.1 Thickness tolerance for product over 0.250 in. (6.25 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.5.2 Length, Width, and Camber: Shall conform to the requirements of AMS 2242 or MAM 2242.

3.5.3 Flatness: When measured using a straight edge touching the product at two points, the perpendicular distance from the straight edge to the product shall not exceed 0.015 x L at any point between the two points of contact, where "L" is the distance between the two points of contact. The distance from a 12 in, (300 mm) straight edge to the product shall not exceed 0.125 in. (3.12 mm).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all Ø samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classifed as acceptance tests and shall be performed on each lot.

4.3 Sampling: Shall be as follows; a lot shall be all product of one thickness pressed, sintered, and wrought from one batch of powder in a continuous series of operations:

4.3.1 Composition: One specimen from each lot.

4.3.2 Tensile Properties: One specimen from each lot, selected with the axis of specimen parallel to the direction of rolling.

4.3.3. Hardness: Five determinations from each lot. The bend test specimen of 4.3.4 may be used for the hardness test sample.

4.3.4 Bend Ductility: One specimen from each lot. The nominal width of the bend specimen shall be 1.0 in. (25 mm) up to a thickness of 0.100 in. (2.50 mm), incl, and 2.5 in. (62.5 mm) for thicknesses over 0.100 in. (2.50 mm). Specimens may have as-cut edges or may be hand polished with emery cloth. Specimens shall not be electropolished.

4.3.5 Specific Gravity, Microstructure, and Recrystallization: One specimen from each lot.

4.1 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition of each lot and the results of tests on each lot to determine conformance to the other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 7898B, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 7898B, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification and shall include in the report either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as follows:

5.1.1 Sheet, Strip, and Plate: Each sheet, strip, and plate shall be marked on one face, in the respective location indicated below, with AMS 7898B, lot number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be removable in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious-effect on the product or its performance and shall be sufficently stable to withstand normal handling.