SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7725D

Issued 1957-01
Revised 2007-10

Superseding AMS 7725C

Tungsten Heavy Alloy Shapes, Sintered, High Density

RATIONALE

AMS 7725D results from a Five-Year Review and update of this specification to include the alloys in AMS-T-21014.

1. SCOPE

1.1 Form

This specification covers four classes of tungsten heavy metal in the form of sintered shapes.

1.2 Application

This material has been used for parts, such as counterbalance weights or projectiles, for which mechanical properties are tested from the sintered shapes and that require high weight per unit volume, but usage is not limited to such applications.

1.3 Classification

Products covered by this specification are classified as follows:

Class	Tungsten, Nominal %
1	90
2	92.5
3	95
4	97

Type 1 - tungsten with nickel and copper (non-magnetic)
Type 2 - tungsten with iron and nickel (magnetic)

1.3.1 If no Class is specified Class 1 shall be supplied. Unless a specific Type is ordered, either Type may be supplied.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM B 311	Density of Cemented Carbides
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

3. TECHNICAL REQUIREMENTS

3.1 Composition, Density and Hardness

Composition, density and hardness shall be as specified in Table 1.

TABLE 1 - COMPOSITION, DENSITY AND HARDNESS PROPERTIES

Class	Weight percent Tungsten, nominal	Density g/cc	Hardness HRC maximum
1	90	16.85 - 17.25	32
2	92.5	17.15 - 17.85	33
3	95	17.75 - 18.35	34
4	97	18.25 - 18.85	35

3.1.1 Type 1

Shall have a nominal tungsten percentage corresponding to the Class specified with the balance being primarily an alloy of nickel and copper.

3.1.2 Type 2

Shall have a nominal tungsten percentage corresponding to the Class specified with the balance being primarily an alloy of nickel, iron, and other elements as required.

3.2 Condition

Product shall be supplied either as-sintered, or sintered and annealed. If no condition is specified, either condition may be supplied.

3.3 Properties

The product shall conform to the following requirements:

3.3.1 Tensile Properties

Specimens cut from shapes 2 inches (50 mm) and under in section thickness shall conform to the requirements of Table 2 (See 8.2) determined in accordance with ASTM E 8. Specimens cut from thicker shapes shall have mechanical properties as agreed upon between the supplier and the cognizant engineering authority:

TABLE 2 - MINIMUM TENSILE PROPERTIES

Class	Type	Ultimate Tensile Strength ksi	Ultimate Tensile Strength MPa	Yield Strength at 0.2% Offset ksi	Yield Strength at 0.2% Offset MPa	Elongation[A] percent
1	1	94	648	75	517	2
1	2	110	758	75	517	5
2	1	94	648	75	517	2
2	2	110	758	75	517	5
3	1	94	648	75	517	1
3	2	105	724	75	517	3
4	1	100	689	75	517	2
4	2	100	689	75	517	2

[A] Determine with a Class B2 or better extensometer.

3.3.1.1 In those cases where shapes and/or sizes are inadequate to extract tensile specimens, such specimens may be extracted from a bar or shape with the nominal thickness being the maximum thickness of the part and produced from the same powder lot and processed along with the shapes.

3.3.2 Hardness

Hardness as specified in Table 1 shall be determined in accordance with ASTM E 18.

3.3.3 Density

Density as specified in Table 1 shall be determined in accordance with ASTM B 311.

3.3.4 Microstructure

Shall be a uniform and homogeneous distribution of tungsten particles in a metallic matrix, when examined at 200X magnification minimum.

3.3.5 Annealing (See 8.7.1)

Parts shall be subjected to post sintering heat treatment in accordance with the following:

Vacuum or inert gas heat treat
Vacuum level shall be 10^{-4} Torr or lower.
Ramp 10 °F (6 °C) per minute to 2020 °F ± 25 (1100 °C ± 6)
Hold at temperature for 6.5 ± 0.5 hours.
Forced fan cool using nitrogen*, helium, or argon gas.
Parts shall be cooled to 930 °F (500 °C) within 15 minutes maximum.
Parts to be processed on ceramic racks/boats. Contact with carbon based fixture or rack is not permitted.
Pyrometry per AMS 2750

*NOTE: CRACKED AMMONIA IS NOT PERMITTED AS SOURCE OF NITROGEN.

3.3.5.1 Alternate heat-treat processes are permissible when approved by the cognizant engineering organization.

3.3.6 Composition shall meet the requirements in Table 1, 3.1.1 and 3.1.2 and shall be performed by any method agreed upon by the supplier and the purchaser.

3.4 Quality

Shapes, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from cracks, loose particles, and other imperfections detrimental to usage of the shapes.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of shapes shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Tensile properties (3.3.1), hardness (3.3.2), density (3.3.3), microstructure (3.3.4), and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Composition (3.1) is a periodic test.

4.3 Sampling

Shall be in accordance with the following. A lot shall be all sintered shapes formed from one blend of powder and thermally processed in a single batch or a single continuous sinter run.

4.3.1 Tensile properties, hardness, density and microstructure shall be taken from one part per lot. Where the part is of such a size or shape as to prevent extraction of a tensile specimen, a test block with a nominal thickness of the maximum section thickness of the actual production part, formed from the same blend of powder and thermally processed with the lot may be used and the tensile specimen shall be extracted from that block.

4.3.2 Composition shall be determined from a suitable sized sample of the blended powder used to manufacture the lot of sintered parts.

4.4 Approval

4.4.1 Sample sintered shapes from new or reworked master patterns shall be approved by purchaser before shapes for production use are supplied, unless such approval be waived by purchaser.

4.4.2 Vendor shall use ingredients, processing techniques, and methods of inspection on production sintered shapes which are essentially the same as those used on the approved sample shapes. If necessary to make any change in ingredients, processing techniques, or methods of inspection, vendor shall submit for reapproval a statement of the proposed changes in materials, processing, or both and, when requested, sample shapes. Production shapes made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.4.3 For material procured in off-the-shelf bar or briquette forms, approval is not required.

4.5 Reports

The vendor of shapes shall furnish with each shipment a report showing the results of tests on each lot in the shipment to determine conformance to the acceptance test requirements and stating that the material conforms to the other technical requirements. This report shall include the purchase order number, AMS 7725D, lot number, Class, Type (1 or 2), form, size or part number, and quantity.