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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-T-21014

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Submitted for recognition as an American National Standard

Tungsten Base Metal, High Density

NOTICE

This document has been taken directly from U.S. Military Specification MIL-T-21014D, Amendment 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-T-21014D, Amendment 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualifications requirements and associated qualified products lists are mandatory to DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

1. SCOPE:

1.1 Scope:

This specification covers the requirements for four classes of machinable, high density tungsten base metal produced by consolidation of metal powder mixtures whose composition is mainly tungsten. This material may be used for uncoated parts or parts that may be coated with other materials for protection against corrosion and abrasion such as, electrodeposited and vacuum deposited cadmium and electrodeposited chromium. Detailed requirements for coatings should be covered in the applicable part drawing, when required.

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1.2 Classification:

The tungsten base metal shall be of the following classes (see Tables I and II), as specified (see 6.2.1).

Class	Nominal Density (g/cc)
1	17
2	17.5
3	18
4	18.5

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 311	Density of Cemented Carbides
ASTM D 3951	Commercial Packaging
ASTM E 3	Metallographic Specimens, Preparation of
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 407	Microetching Metals and Alloys
ASTM A 600	Tool Steel, High Speed

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Property
MIL-STD-2073/1	DoD Material, Procedures for Development and Application of Packaging Requirements

3. REQUIREMENTS:

3.1 Materials:

The raw materials shall be a mixture of loose metal powders consisting mainly of tungsten and a metallic powder binder such as copper, nickel or iron, which will produce, by sintering, materials meeting the requirements of this specification.

3.2 Composition, physical and mechanical properties:

The sintered material shall have properties conforming to Tables I and II as determined on standard test bars.

3.3 Microstructure:

The microstructure of each sample part selected shall be a uniform distribution of tungsten particles in a binder metal matrix when viewed at a magnification of 200 times. The location may be specified (see 4.2.3.4).

3.4 Machinability:

When specified (see 6.2.1), the machinability of the basic parts or of a suitable test specimen shall be such it shall pass the test specified in 4.2.4.

3.5 Identification:

Each lot and associated test bars shall be clearly marked with a lot serial number in accordance with MIL-STD-130.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items must meet all the requirements of sections 3 and 5. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Quality conformance inspection:

4.2.1 Inspection lot: An inspection lot shall consist of a uniform blend from one batch of powder, and submitted for inspection at one time. If a shipment is made from more than one lot, the acquiring activity may choose to consider that shipment as a single inspection lot or may choose to separate the shipment into several inspection lots for acceptance purposes.

4.2.2 Sampling: Unless otherwise specified, a minimum of two sintered test bars and one chemical analysis sample shall be made from each powder lot.

4.2.2.1 Hardness tests: Each test bar shall be tested for conformance with the hardness requirements of Table I (see 4.2.3.1).

4.2.2.2 Density: Each test bar shall be tested for conformance with the density requirements of Table I (see 4.2.3.2).

4.2.2.3 Tension tests: Each test bar shall be tested for conformance with Table II (see 4.2.3.3).

4.2.2.4 Examination of microstructure: This test shall be accomplished on one of the test bars (4.2.3.4).

4.2.3 Methods for test and examinations:

4.2.3.1 Hardness: Samples shall be tested in accordance with ASTM E 18.

4.2.3.2 Density: The equal water displacement method performed in accordance with ASTM B 311 shall be used.

4.2.3.3 Mechanical properties: Samples shall be tested in accordance with ASTM E 8.

4.2.3.4 Microstructure: A test bar shall be sectioned and a specimen shall be prepared for examination in accordance with ASTM E 3. The specimen may be etched in accordance with ASTM E 407. It shall be examined at 200 magnifications for conformance with 3.3.

4.2.4 Machinability: Unless otherwise specified, this test shall be made on a representative sample. Holes, 0.1695 inches in diameter and a minimum of 0.343 inches deep, shall be drilled and tapped with a No. 10-32 high speed steel tap to a minimum full thread of 0.312 inches deep. The tap shall be of high speed steel, conforming to ASTM A 600, Type M1, heat treated to a hardness of 62-63 HRC. Machinability will be considered acceptable in each class if each of the number of holes indicated in Table III is satisfactorily threaded to a minimum of 60 percent without destruction to the tap.

4.3 Rejection:

Failure to conform with any of the requirements of this specification shall be cause for rejection of the lot.

4.4 Examination for preservation, packing and marking:

An examination for preservation, packing and marking shall be conducted to determine conformance with Section 5.

5. PACKAGING:

5.1 Preservation and packing:

Preservation and packing shall be in accordance with MIL-STD-2073/1 or ASTM D 3951, as specified (see 6.2.1). The levels of preservation and packing shall be as specified (see 6.2.1).

5.2 Marking:

In addition to any special markings (see 6.2.1), each shipment shall be marked in accordance with MIL-STD-129.

6. NOTES:

6.1 Intended use:

Parts are intended for use such as weights or counter balances in static or dynamic balancing, high speed rotating members, radiation shielding, and vibration damping applications.

6.2 Ordering data:

6.2.1 Acquisition requirements: Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Class, when required (see 1.2).
c. Machinability requirements, if any (see 3.4).
d. Quantity.
e. Levels of preservation and packing (see 5.1).
f. Special markings, if required (see 5.2).
g. Method of hardness testing, if different from Rockwell “C” (see Table I).
h. Freedom of parts from magnetic response, if required (see 6.3).

6.3 Special applications:

For particular applications, properties or requirements other than those specified in Section 3 of this specification may be important. These alloys may contain elements which make them magnetic. Where freedom from magnetic response is required, this should be specified in the acquisition document (see 6.2.1). Class 4 is not available in a non-magnetic grade. For purposes of this specification, non-magnetic characteristics are defined as material having a maximum magnetic permeability of 1.05. Also for special applications involving large sections, methods for determining internal quality, such as mechanical tests on specimens from these larger sections or suitable nondestructive tests may be applied. If required, these additional tests shall be specified in the acquisition document (see 6.2.1).

6.4 Specification sheets:

The three specification sheets associated with the previous revision to this document have been cancelled without replacement.

6.5 Subject term (keyword) listing:

Metal
Tungsten

TABLE I. Composition, density and hardness properties

Class	Nominal Tungsten (weight percent)3/	Density (g/cc)	Hardness1/ 2/ Rockwell "C" (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

1/ When specified by the acquiring activity, other hardness testing methods may be employed.
2/ For mechanically worked or aged material, the hardness can be as high as R_c46.
3/ Tests for composition are not required for acceptance nor are results of this testing basis for rejection of the lot.