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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4998B

Issued 15 MAR 1977
Revised 1 JAN 1993

Superseding AMS 4998A

Submitted for recognition as an American National Standard

TITANIUM ALLOY POWDER
6A1 - 4V

UNS R56400

1. SCOPE:

1.1 Form:

This specification covers a titanium alloy in the form of prealloyed powder.

1.2 Application:

This powder has been used typically for compaction into net or near net shapes and into forgings stock in the form of billets or preforms, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2249 Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2635 Radiographic Inspection

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B.214 Sieve Analysis for Granular Metal Powders
ASTM B 215 Sampling Finished Lots of Metal Powders
ASTM B 311 Density of Cemented Carbides
ASTM B 527 Tap Density of Powders of Refractory Metals and Compounds by Tap Pak Volumeter
ASTM E 120 Chemical Analysis of Titanium and Titanium Alloys

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods acceptable to purchaser, except that oxygen shall be determined on the panels of 3.4.3 by a vacuum or inert fusion method.

TABLE I - Composition

Element	min	max
Aluminum	5.50	6.75
Vanadium	3.50	4.50
Oxygen	0.13	0.18
Iron	--	0.30
Carbon	--	0.10
Tin (3.1.1)	--	0.10
Molybdenum (3.1.1)	--	0.10
Copper (3.1.1)	--	0.10
Manganese (3.1.1)	--	0.10
Zirconium	--	0.10
Nitrogen	--	0.04 (400 ppm)
Hydrogen	--	0.012 (120 ppm)
Residual Elements, total (3.1.2)	--	0.20
Titanium	remainder	

3.1.1 Tin plus molybdenum plus copper plus manganese shall not exceed 0.20%.

3.1.2 Determination not required for routine acceptance.

3.1.3 Check Analysis: Composition variations shall meet the requirements of (R) AMS 2249.

3.2 Powder Production:

Powder shall be produced in lots by a suitable process in an appropriate noncontaminating atmosphere. A lot shall be all powder produced from common feed material (an ingot, billet, or cast electrode from a common ingot) in one production run of the equipment. When approved by purchaser, a lot may be the powder produced from common feed material in a series of consecutive runs in the same equipment under essentially the same fixed parameters; the powder from all such runs shall be thoroughly blended. The total weight of powder blended in one lot shall not exceed 10,000 pounds (4536 kg).

3.2.1 Ingot from which powder is made shall be produced by triple melting using consumable electrode practice; at least one of the melting cycles shall be under vacuum. The final melting may be performed during powder production when a fusion method is used to produce powder.

3.3 Condition:

As manufactured.

3.4 Properties:

The powder shall conform to the following requirements:

3.4.1 Particle Size: The particles shall pass through a No. 35 (500.um) sieve, with not more than 5% by weight passing through a No. 325 (45.um) sieve, determined in accordance with ASTM B 214 or other method acceptable to purchaser.

3.4.2 Powder Tap Density: When specified, shall be not less than 60% of the density value obtained in 3.4.3, determined in accordance with ASTM B 527 or other procedure acceptable to purchaser.

3.4.3 Powder Compaction and Evaluation: A sample, weighing not less than 0.75 pound (340 grams), from each powder lot shall be hot compacted using a method which will not contaminate the powder particles during compaction. Each compacted sample shall have a density, determined in accordance with ASTM B 311, not less than 0.1594 pounds per cubic inch (4.412 Mg/m^3) and shall be divided into panels or discs totalling not less than 18 square inches (116 cm^2) in area with thickness of 0.200 inch +0.015, -0.025 (5.08 mm, +0.38, -0.64). Panels shall be free of any deleterious high- or low-density inclusions, except as provided by standards agreed upon by purchaser and vendor, determined by radiographic examination in accordance with AMS 2635.

3.5 Quality:

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The powder, as received by purchaser, shall be uniform in color and quality, dry, free from agglomerated masses, and free from foreign materials and from imperfections detrimental to its performance during compaction or in resultant preforms or forgings.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

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

4.2 Classification of Tests:

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Tests for all technical requirements are acceptance tests and preproduction tests and shall be performed prior to or on the initial shipment of powder to a purchaser, on each lot, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:

(R) Shall be in accordance with ASTM B 215; sufficient powder shall be taken from each lot to perform all required tests in duplicate.

4.4 Approval:

4.4.1 The processes and control procedures, a preproduction sample, or both, whichever is specified, shall be approved by the cognizant engineering organization before powder for production parts is supplied.

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4.4.2 The supplier shall make no significant changes to ingredients, processes, or controls from those on which the approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the powder.

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4.5 Reports:

The vendor of powder shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the oxygen content and particle size distribution of each lot and stating that the powder conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 4998B, vendor's product designation, feed material, and quantity.

4.6 Resampling and Retesting:

(R) If any specimen used in the above tests fails to meet the specified requirements, disposition of the powder 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 powder represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 Powder shall be packaged in containers of a type and size acceptable to purchaser. A lot may be packaged in small quantities and delivered separately under the basic lot approval provided lot identity is maintained. Each container shall be thoroughly cleaned and dried immediately prior to filling, and shall be sealed immediately after filling to protect the contents from contamination during shipment and under normal dry storage conditions. Seals used on the containers shall be so designed that they must be destroyed in order for the container to be opened.