SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4997B

Issued SEP 1977
Revised JAN 2003

Superseding AMS 4997A

Titanium Alloy Powder
5Al - 2Sn - 2Zr - 4Cr - 4Mo - 0.100
Premium Quality

(Composition similar to UNS R58650)

CANCELLATION NOTICE

This specification has been declared “CANCELLED” by the Aerospace Materials Division, SAE, as of January 2003. By this action, this document will remain listed in the numerical section of the Index of Aerospace Materials Specifications.

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1. SCOPE:

1.1 Form:

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

1.2 Application:

This product has been used typically for compaction into net or near net shapes and into forging stock in the form of billets or preforms for use in highly-stressed parts such as rotating parts of gas turbine engines.

2. APPLICABLE DOCUMENTS:

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

2.1 SAE Publications:

Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2249 Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2350 Standards and Test Methods
AMS 2635 Radiographic Inspection

2.2 ASTM Publications:

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

ASTM B214 Sieve Analysis for Granular Metal Powders
ASTM B215 Sampling Finished Lots of Metal Powders
ASTM B311 Density of Cemented Carbides
ASTM B527 Tap Density of Refractory Metals and Compounds by Tap-Pak Volumeter
ASTM E120 Chemical Analysis of Titanium and Titanium-Base Alloys

2.3 Government Publications:

Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-2073-1 Standard Practice for Military Packaging

3. TECHNICAL REQUIREMENTS:

3.1 Composition:
Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E120, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser, except that oxygen and hydrogen shall be determined on the panels of 3.4.3 by a vacuum or inert fusion method:

	min		max	
Aluminum	4.50	-	5.50	
Zirconium	1.50	-	2.50	
Tin	1.50	-	2.50	
Molybdenum	3.50	-	4.50	
Chromium	3.50	-	4.50	
Oxygen	0.08	-	0.12	
Iron	--		0.30	
Copper	--		0.10	
Manganese	--		0.10	
Carbon	--		0.05	
Nitrogen	--		0.04	(400 ppm)
Hydrogen	--		0.0125	(125 ppm)
Yttrium	--		0.0050	(50 ppm)
Residual Elements, each (3.1.1)	--		0.10	
Residual Elements, total (3.1.1)	--		0.30	
Titanium	remainder			

3.1.1 Determination not required for routine acceptance.

3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2249; no variation over maximum for yttrium will be permitted, unless otherwise agreed upon by purchaser and vendor.

3.2 Condition:

As manufactured.

3.3 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 lb (4540 kg).

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 µm) sieve, with not more than 5% by weight passing through a No. 325 (45 µm) sieve, or as agreed upon by purchaser and vendor, determined in accordance with ASTM B214 or other method approved by 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 B527 or other procedure agreed upon by purchaser and vendor.

3.4.3 Powder Compaction and Evaluation: A sample, weighing not less than 0.75 lb (340 g), 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 B311, not less than 0.163 lb per cu in. (4.51 Mg/m^3) and shall be divided into panels or discs totalling not less than 18 sq in. (116 cm^2) in area with thickness of 0.200 in., +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 permitted by standards agreed upon by purchaser and vendor, determined by radiographic examination in accordance with AMS 2635 or as otherwise agreed upon by purchaser and vendor.

3.5 Quality:

3.5.1 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.

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

3.5.3 The powder shall be free from nonmetallic inclusions of size and frequency exceeding standards agreed upon by purchaser and vendor, determined by a procedure agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of powder shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the powder conforms to the requirements of this specification.

4.2 Classification of Tests:

Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests.

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, the contracting officer, or the request for procurement.

4.3 Sampling:

Shall be in accordance with ASTM B215; sufficient powder shall be taken from each lot to perform all required tests in duplicate.

4.4 Approval:

4.4.1 Sample powder shall be approved by purchaser before powder for production use is supplied, unless such approval be waived. Results of tests on production powder shall be essentially equivalent to those on the approved sample.

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

4.5 Reports:

4.5.1 The vendor of powder shall furnish with each shipment three copies of 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 of this specification. This report shall include the purchase order number, material specification number, vendor's product designation, feed material, lot number, and quantity.

4.5.2 When parts requiring use of this powder are supplied, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, this specification number, lot number, contractor or other direct supplier or powder, part number, and quantity. When powder for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of powder to determine conformance to the requirements of this specification, and shall include in the report a statement that the powder conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting:

If any sample 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 samples for each original nonconforming sample. Failure of any retest sample to meet the specified requirements shall be cause for rejection of the powder represented and no additional testing shall be permitted. 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 the size ordered. A lot may be packaged in smaller quantities and delivered separately under the basic lot approval as long as 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.

5.1.2 Each individual container shall be identified with not less than the following information, using characters of such size as to be clearly legible and which will not be obliterated by normal handling.

TITANIUM ALLOY POWDER, 5Al - 2Sn - 2Zr - 4Cr - 4Mo - 0.100,
PREMIUM QUALITY
AMS 4997B
MANUFACTURER'S IDENTIFICATION _____
PURCHASE ORDER NUMBER _____
QUANTITY _____
LOT NUMBER _____