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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2368

Issued APR 1995

Sampling and Testing of Wrought Titanium Raw Material Except Forgings and Forging Stock

1. SCOPE:

1.1 Purpose:

This specification provides a standard set of procedures for sampling and testing to meet the requirements of material specifications for wrought titanium and titanium alloy products except forgings and forging stock. It is applicable to the extent specified in a material specification.

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 2631	Ultrasonic Inspection, Titanium and Titanium Alloy Bar and Billet
AMS 2632	Ultrasonic Inspection of Thin Materials, 0.5 inch (13 mm) and Thinner
AMS 2634	Ultrasonic Inspection, Thin-Wall Metal Tubing
AMS 2801	Heat Treatment, Titanium Alloy Parts

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7121 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications:

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

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 21	Elevated Temperature Tension Tests for Metallic Materials
ASTM E 112	Determining the Average Grain Size
ASTM E 120	Chemical Analysis of Titanium and Titanium Alloys
ASTM E 139	Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E 290	Semi-Guided Bend Test for Ductility of Metallic Materials
ASTM E 292	Conducting Time-for-Rupture Notch Tension Tests of Materials
ASTM E 338	Sharp-Notch Tension Testing of High-Strength Sheet Materials
ASTM E 384	Microhardness of Materials
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials
ASTM E 1304	Plain-Strain (Chevron Notch) Fracture Toughness of Metallic Materials
ASTM E 1409	Determination of Oxygen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method

3. TECHNICAL REQUIREMENTS:

3.1 General:

3.1.1 Conformance: The vendor shall be responsible for furnishing products which conform to all requirements of the material specification. Sampling and testing for any requirements not covered herein or in the material specification shall be optional, unless otherwise specified by purchaser.

3.1.2 Lot: A lot shall be all product of the same nominal size and shape, from the same ingot (heat), processed in the same manner, and presented for vendor's inspection at one time. When processing includes heat treatment, product shall have been heat treated in one or more furnaces in the same load or sequentially heat treated in a series of furnaces (See 8.1) or a continuous furnace over not more than 48 hours providing there is no interruption in operations or change in furnace temperature setting(s), charge rate, or racking pattern.

3.1.3 Sampling and Testing: Shall be as follows:

3.1.3.1 Composition: Sampling and testing shall conform to 3.2.3.

3.1.3.2 Other Properties: Except as otherwise specified below, at least one test of each type shall be performed on specimens, located and oriented in accordance with 3.1.3.2.1 and 3.1.3.2.2, from a random sample from each lot.

3.1.3.2.1 Location of Specimens: When practical, tests shall be performed on full thickness specimens. When the product is too thick for testing its full thickness, the center of the specimen shall be located at the center of the thickness of the product. Short transverse specimens shall be located at the middle of the width of the product. Specimens from flash welded rings shall not include the weld or heat affected zone.

3.1.3.2.2 Orientation of Specimens: Shall be circumferential for flash welded rings and longitudinal for other products except that orientation may be transverse for product more than 1 inch (25 mm) thick and more than 8 inches (203 mm) wide.

3.2 Tests (In alphabetical order):

3.2.1 Bending:

3.2.1.1 Bend tests shall be performed using the V-block, U-channel, or free bend procedure in accordance with ASTM E 290. In case of dispute, the V-block procedure shall govern.

3.2.1.2 The axis of bend shall be parallel to the direction of rolling.

3.2.1.3 Width of specimens shall be 10 times the nominal thickness of the product or 1 inch (25 mm), whichever is greater, except that for free bend tests the width need not be greater than 1 inch (25 mm).

3.2.2 Coiling: Tests shall be performed on two samples from each lot.

3.2.3 Composition: Shall be as follows:

3.2.3.1 Consumable Melted Ingots: Composition, except for hydrogen, shall be determined at the top and bottom of each ingot in accordance with ASTM E 1409 for oxygen, and other elements by wet chemical methods in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods acceptable to purchaser. Each analysis shall meet the composition requirements; the reported composition shall be the average of the analyses. Hydrogen content shall be determined, in accordance with ASTM E 1447 or other method acceptable to purchaser, on a random sample from each lot after completion of all thermal and chemical processing.

3.2.3.1.1 For hydrogen analysis, conducted in accordance with ASTM E 1447, sample size may be as large as 0.35 gram.

3.2.3.2 Nonconsumable Melted Ingots: Composition shall be determined as specified in 3.2.3.1; it shall also be determined at three additional ingot locations; the middle, midway between the middle and the bottom, and midway between the middle and the top.

3.2.3.3 Check Analysis: Composition variations shall meet the requirements of AMS 2249.

3.2.4 Creep: Tests shall conform to ASTM E 139.

3.2.5 Fracture Toughness: Shall be determined on specimens from two locations oriented in the T-L direction. Procedure for product under 0.5 inch (12.7 mm) thick shall conform to ASTM E 338; procedure for thicker product shall conform to ASTM E 399 or, when permitted by purchaser, ASTM E 1304.

3.2.6 Average Grain Size: Shall be determined by comparison of a polished and etched transverse specimen in accordance with the chart in ASTM E 112.

3.2.7 Hardness: Shall be determined in accordance with ASTM E 18.

3.2.8 Heat Treatment Response: Heat treatment of samples, to confirm that product will develop required properties, shall conform to AMS 2801.

3.2.9 Microstructure: Shall be determined by examination of a polished and etched transverse specimen at 200X to 300X magnification. Round bar may be examined immediately prior to grinding or turning to final size.

3.2.10 Stress Rupture, Notched: Tests shall conform to ASTM E 292.

3.2.11 Surface Contamination: Freedom from surface contamination, such as alpha case, shall be determined by bending in accordance with 3.2.5 or by microscopic examination at 200X magnification or by microhardness testing, using a 200 gram load, in accordance with ASTM E 384. Round bar may be examined immediately prior to grinding or turning to final size.

3.2.12 Tensile Tests: Shall be as follows:

3.2.12.1 Room Temperature: Tests shall be performed in accordance with ASTM E 8 or ASTM E 8M with the rate of strain maintained at 0.003 to 0.007 inch per inch per minute (0.003 to 0.007 mm/mm/minute) through the yield strength. In case of dispute over yield strength, tensile tests shall be performed with a strain rate pacer at a strain rate of 0.005 inch per inch per minute (0.005 mm/mm/minute) through the yield strength.

3.2.12.2 Elevated Temperature: Tests shall be performed at the designated temperature in accordance with ASTM E 21.

3.2.12.3 Low Temperature: Tests shall be performed at -423 °F (-253 °C) in accordance with ASTM E 8 or ASTM E 8M.

3.2.13 Ultrasonic Inspection: Shall be performed on all pieces in a lot in accordance with AMS 2631, AMS 2632, or AMS 2634.

3.2.14 Wrapping: Tests shall be performed on two samples per lot.