

Titanium Alloy Bars and Rods
3Al - 8V - 6Cr - 4Mo - 4Zr
Consumable Electrode Melted
Solution Heat Treated and Centerless Ground or Peeled and Polished
(Composition similar to UNS R58640)

RATIONALE

AMS4958D results from a Five Year Review and update of this specification that removed the coiling requirement.

1. SCOPE

1.1 Form

This specification covers a titanium alloy in the form of bars and rods 1.00 inch (25.4 mm) and under in nominal diameter.

1.2 Application

These products have been used typically for coil springs requiring low solid height, high tensile strength, and corrosion resistance, but usage is not limited to such applications.

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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2249	Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS2368	Sampling and Testing of Wrought Titanium Raw Material Except Forgings and Forging Stock
AMS2750	Pyrometry
AMS2809	Identification, Titanium and Titanium Alloy Wrought Products

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2013 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: <http://www.sae.org>

**SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/AMS4958D>**

2.2 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 E 8 / E 8M	Tension Testing of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 1409	Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1417	Liquid Penetrant Testing
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method
ASTM E 1941	Determination of Carbon in Refractory and Reactive Metals and Their Alloys
ASTM E 2371	Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

2.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1; carbon shall be determined in accordance with ASTM E 1941, hydrogen in accordance with ASTM E 1447, oxygen and nitrogen in accordance with ASTM E 1409, and other elements in accordance with ASTM E 2371. Other analytical methods may be used if acceptable to the purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Aluminum	3.00	4.00
Vanadium	7.50	8.50
Chromium	5.50	6.50
Molybdenum	3.50	4.50
Zirconium	3.50	4.50
Iron	--	0.30
Oxygen	--	0.12
Carbon	--	0.05
Nitrogen	--	0.03
Hydrogen (3.1.2)	--	0.030 (300 ppm)
Yttrium (3.1.1)	--	0.005 (50 ppm)
Other Elements, each (3.1.1)	--	0.15
Other Elements, total (3.1.1)	--	0.40
Titanium	remainder	

3.1.1 Determination not required for routine acceptance.

3.1.2 Sample size when using ASTM E 1447 for hydrogen determination may be as large as 0.35 gram.

3.1.3 Check Analysis

Composition variations shall meet the applicable requirements of AMS2249.

3.2 Melting Practice

3.2.1 Alloy shall be multiple melted. The first melt shall be made by consumable electrode, nonconsumable electrode, electron beam cold hearth, or plasma arc cold hearth melting practice. The subsequent melt or melts shall be made under vacuum using vacuum arc remelting (VAR) practice. Alloy additions are not permitted in the final VAR melt.

3.2.1.1 The atmosphere for nonconsumable electrode melting shall be vacuum or shall be argon and/or helium at an absolute pressure not higher than 1000 mm of mercury.

3.2.1.2 The electrode tip for nonconsumable electrode melting shall be water-cooled copper.

3.3 Condition

Hot rolled, solution heat treated and centerless ground or peeled and polished to size with surface removal sufficient to remove all surface defects and alpha case. In addition acid pickle with not less than 0.0005 inch (12.7 μm) overall stock removal may be used. The solution heat treated product may be cold worked, not exceeding 5% total reduction, for sizing purposes prior to centerless grinding or peeling and polishing and surface removal. It shall have a surface texture not greater than Ra 63, determined in accordance with ASME B46.1. Bar shall not be cut from plate.

3.4 Heat Treatment

Product shall be solution heat treated by heating to a temperature within the range 1450 to 1600 °F (788 to 871 °C), holding at the selected temperature within ± 25 °F (± 14 °C) for sufficient time for solution heat treatment, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

Product shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Average Grain Size

Shall be as follows, determined in accordance with ASTM E 112:

3.5.1.1.1 Product 0.625 Inch (15.88 mm) and Under in Nominal Diameter

ASTM 5 or finer.

3.5.1.1.2 Product Over 0.625 to 1.00 Inch (15.88 to 25.4 mm), Inclusive in Nominal Diameter

ASTM 3 or finer.

3.5.2 After Aging

Product shall have the following properties after being aged by heating to a temperature within the range 850 to 1050 °F (454 to 566 °C), holding at the selected temperature within ± 10 °F (± 6 °C) for 6 to 30 hours, and cooling in air.

3.5.2.1 Tensile Properties

Shall be as shown in Table 3, determined in accordance with ASTM E 8 / E 8M with the rate of strain set at 0.005 inch/inch/minute (0.005 mm/mm/minute) and maintained within a tolerance of ± 0.002 inch/inch/minute (0.002 mm/mm/minute) through the 0.2% offset yield strain.

TABLE 3 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	180 ksi (1241 MPa)
Elongation in 4D	8%
Reduction of Area	20%

3.6 Quality

Product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6.1 Product shall have a smooth finish free from pits and abrasions, shall be cylindrical, clean, even uniform cast, and free from kinks, twists, scrapes, splits, and other imperfections.

3.6.2 Bars and rods shall be nondestructively inspected by fluorescent penetrant inspection in accordance with ASTM E 1417 or by electromagnetic (eddy current) inspection (See 8.4). Cracks, seams and other surface defects are not acceptable.

3.7 Tolerances

Shall conform to 3.7.1 and 3.7.2.

3.7.1 Diameter

Shall be as shown in Table 4.

TABLE 4A - TOLERANCES, INCH-POUND UNITS

Nominal Diameter Inch	Tolerance, Inch Plus and Minus
Up to 0.032, incl	0.0005
Over 0.032 to 0.042, incl	0.00075
Over 0.042 to 0.312, incl	0.001
Over 0.312 to 1.000, incl	0.0015

TABLE 4B - TOLERANCES, SI UNITS

Nominal Diameter Millimeters	Tolerance, Millimeter Plus and Minus
Up to 0.81, incl	0.013
Over 0.81 to 1.07, incl	0.019
Over 1.07 to 7.92, incl	0.025
Over 7.92 to 25.40, incl	0.038

3.7.2 Length Tolerance

Straight lengths shall vary not more than +2.0 inches (+51 mm), -0 inches (-0 mm).