

AEROSPACE MATERIAL SPECIFICATION

Issued 2003-07
Reaffirmed 2008-11

Titanium, Sheet, Laminated, Surface Bonded

1. SCOPE:

1.1 Form:

This specification covers titanium in the form of laminated sheet.

1.2 Application:

This material has been used typically for shims in which thickness is adjusted by removal of laminations as required, but usage is not limited to such applications.

1.3 Classification:

Materials are classified as follows:

1.3.1 Type:

Type I - All laminations
Type II - One half laminations
Type III - Three quarters laminations

1.3.2 Class:

Class 1 - 0.002 inch (0.05 mm) thick laminations
Class 2 - 0.003 inch (0.075 mm) thick laminations

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

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 © 2008 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: 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/AMS4949>**

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 4901	Titanium, Sheet, Strip, and Plate, Commercially Pure, 70ksi (485 Mpa) Yield Strength
AMS 4907	Titanium Alloy, Sheet, Strip, and Plate, 6.0Al-4.0V, Extra Low Interstitial, Annealed
AMS 4911	Titanium Alloy, Sheet, Strip, and Plate, 6.0Al-4.0V, Annealed

2.2 American Society for Quality Publications:

Available from ASQ, 600 North Plankinton Avenue, Milwaukee, WI 53203 or www.asq.org

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

3.1.1 Laminations: Shall conform to AMS 4901 or harder condition.

3.1.2 Solid Stock: When required, shall conform to AMS 4907 or AMS 4911.

3.1.3 Adhesive: Shall be of a composition which will meet the fabrication and quality requirements of this specification.

3.2 Fabrication:

The laminated shim stock shall consist completely of laminations each 0.002 inch $\pm$ 0.0002 (0.05 mm $\pm$ 0.005) thick or 0.003 inch $\pm$ 0.0003 (0.08 mm $\pm$ 0.008) thick, or partly of such laminations combined with a single thicker lamination, as ordered, bonded together by an adhesive such that individual laminations may be peeled for adjustment of shim thickness. The thickness of each layer of adhesive shall not exceed 0.0003 inch (0.008 mm).

3.2.1 Sheet shall be of the thicknesses and combinations of laminations and solid base shown in Table 1.

TABLE 1 - Thickness Combinations Of Shim Stock

Inch	mm	Type I Class 1 All Laminated, 0.002 in. (0.05 mm) Laminations	Type I Class 2 All Laminated, 0.003 in. (0.08 mm) Laminations	Type II Class 1 Half Solid, Half Laminated 0.002 in. (0.05 mm) Laminations	Type II Class 2 Half Solid, Half Laminated 0.003 in. (0.08 mm) Laminations	Type III Class 1 Three Quarters Solid, One Quarter Laminated 0.002 in. (0.05 mm) Laminations	Type III Class 2 Three Quarters Solid, One Quarter Laminated 0.003 in. (0.08 mm) Laminations
0.006	0.15	X					
0.008	0.20	X					
0.010	0.25	X					
0.012	0.31	X					
0.015	0.38	X	X				
0.016	0.41	X	X				
0.020	0.51	X	X				
0.021	0.53	X	X				
0.032	0.81	X	X				
0.033	0.84	X	X				
0.047	1.19	X	X				
0.048	1.22	X	X				
0.062	1.58	X	X	X	X		
0.063	1.60	X	X	X	X		
0.078	1.98	X	X	X	X		
0.080	2.03	X	X	X	X		
0.093	2.37	X	X	X	X		
0.094	2.39	X	X	X	X		
0.109	2.77	X	X	X	X		
0.121	3.07	X	X	X	X	X	X
0.125	3.18	X	X	X	X	X	X

3.3 Construction:

- 3.3.1 General Requirements: Laminations and solid stock, when applicable, shall be bonded together throughout the whole surface area in a manner which will permit peeling of the laminations without the aid of mechanical devices, for adjustment of shim thickness, without separation of the remaining laminations and solid part. Laminations shall be bonded together in such a manner that any shape can be cut from the material using suitable tools, without separation. Laminations shall remain intact without separation during normal handling. Requirements shall be applicable to laminations not less than eight hours after completion of bonding.
- 3.3.2 Surface Roughness: Flat surfaces of laminations, and solid stock when applicable, shall have a maximum roughness of 63 RA (microinches) on original surfaces and on metallic surfaces after peeling.
- 3.3.3 Water Resistance: Sheet shall withstand total immersion in water at $120^{\circ}\text{F} \pm 3$ ($49^{\circ}\text{C} \pm 3$) for at least three hours without separation of laminations or any evidence of corrosion.
- 3.3.4 Peel Strength: Each individual lamination shall have a peel strength no less than 1 pound per inch of width (180 gm/cm of width) and no more than 5 pounds per inch of width (900 gm/cm of width), except at the solid/laminate bond line which may be higher.

3.4 Quality:

Sheet, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from dents, creases, and other imperfections detrimental to usage of the sheet.

3.5 Thickness Tolerances:

Shall be as specified in Table 2.

TABLE 2A - Total Thickness Tolerances, Inch-Pound Units

Nominal Total Thickness Inches			Tolerance, Inch Plus	Tolerance, Inch Minus
Up to	0.008, incl		0.001	0.0005
Over 0.008 to	0.010, incl		0.0015	0.0005
Over 0.010 to	0.016, incl		0.0015	0.001
Over 0.016 to	0.021, incl		0.002	0.001
Over 0.021 to	0.033, incl		0.003	0.002
Over 0.033 to	0.048, incl		0.005	0.002
Over 0.048 to	0.063, incl		0.006	0.002
Over 0.063 to	0.080, incl		0.007	0.002
Over 0.080 to	0.094, incl		0.009	0.003
Over 0.094 to	0.109, incl		0.010	0.003
Over 0.109 to	0.125, incl		0.012	0.003
Over 0.125 to	0.156, incl		0.015	0.003
Over 0.156 to	0.187, incl		0.018	0.003
Over 0.187 to	0.190, incl		0.018	0.005

TABLE 2B - Total Thickness Tolerances, SI Units

Nominal Total Thickness Millimeters			Tolerance, Millimeter Plus	Tolerance, Millimeter Minus
Up to	0.20, incl		0.025	0.013
Over 0.20 to	0.25, incl		0.038	0.013
Over 0.25 to	0.41, incl		0.038	0.025
Over 0.41 to	0.53, incl		0.05	0.025
Over 0.53 to	0.84, incl		0.08	0.05
Over 0.84 to	1.22, incl		0.13	0.05
Over 1.22 to	1.60, incl		0.15	0.05
Over 1.60 to	2.03, incl		0.18	0.05
Over 2.03 to	2.39, incl		0.23	0.08
Over 2.39 to	2.77, incl		0.25	0.08
Over 2.77 to	3.18, incl		0.30	0.08
Over 3.18 to	3.96, incl		0.38	0.08
Over 3.96 to	4.75, incl		0.46	0.08
Over 4.75 to	4.83, incl		0.46	0.13

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

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