SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4013E

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Superseding AMS 4013D

Aluminum Sheet, Laminated Surface Bonded

1. SCOPE:

1.1 Form:

This specification covers aluminum and aluminum alloy foil in the form of laminated sheet.

1.2 Application:

This product has been used typically for shims in which thickness is to be adjusted by removal of laminations as required, 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 4016	Aluminum Alloy Sheet and Plate, 2.5Mg - 0.25Cr (5052-H32), Strain Hardened, Quarter-Hard, and Stabilized
AMS 4017	Aluminum Alloy Sheet and Plate, 2.5Mg - 0.25Cr (5052-H34), Strain Hardened, Half-Hard, and Stabilized
AMS 4041	Aluminum Alloy Sheet and Plate, Alclad, 4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024 and 1-1/2% Alclad 2024, -T3 Flat Sheet; 1-1/2% Alclad 2024-T351 Plate)

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

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

3.1.1 Laminations: Shall be AA1100, AA1145, AA3003, or AA5052 aluminum alloy foil. The choice of alloy shall be at the discretion of the producer unless a specific alloy is specified by purchaser.

3.1.2 Solid Base: Shall be AMS 4041 aluminum alloy sheet, except that when laminations are AA5052 aluminum alloy foil the base shall be AMS 4016 or AMS 4017 aluminum alloy sheet.

3.1.3 Adhesive: Shall be a composition which will meet the fabrication and quality requirements of 3.2, 3.3, and 3.4.

3.2 Fabrication:

Laminated shim stock shall be fabricated from hard or extra hard laminations, in combination with a solid base, when required. Laminations shall be 0.0030 inch ± 0.0003 (0.076 mm ± 0.008) thick unless thickness of 0.0020 inch + 0.0002 (0.051 mm + 0.005) is specified. The thickness of each layer of adhesive shall not exceed 0.0003 inch (0.008 mm).

3.2.1 Laminations and solid base when applicable, shall be bonded together throughout the surface area in a manner which will permit peeling of laminations for adjustment of shim thickness without the aid of mechanical devices and without separation of the remaining laminations and solid part. Laminations shall be bonded together so that any shape can be cut from the material using suitable tools, without separation. Material shall remain intact without separation during normal handling. Requirements shall be applicable to laminations not less than eight hours after completion of bonding.

3.2.2 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.

3.2.3 Water Resistance: Sheet shall withstand immersion in tap water at 120 °F ±5 (49 °C ±3) for not less than 3 hours without separation of laminations or any evidence of corrosion.

3.3 Sizes:

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

TABLE 1 - Lamination Thickness/Combinations

Nominal Thickness of Shim Stock		All Laminated, 0.002 inch (0.05 mm)	All Laminated, 0.003 inch (0.08 mm)	Half Solid, Half Laminated, 0.002 inch (0.05 mm)	Half Solid, Half Laminated, 0.003 inch (0.08 mm)	Three-Quarters Solid, One Quarter Laminated, 0.002 inch (0.05 mm)	Three-Quarters Solid, One Quarter Laminated, 0.003 inch (0.08 mm)
Inch	mm						
0.006	0.15	X					
0.008	0.20	X					
0.010	0.25	X					
0.012	0.30	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	2.36	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

3.4 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 Tolerances:

Shall be as specified in Table 2.

TABLE 2A - Tolerances, Inch/Pound Units

Nominal Thickness Inches					Tolerance, Inch Plus	Tolerance, Inch Minus
	Up	to	0.008,	incl	0.001	0.005
Over	0.008	to	0.010,	incl	0.0015	0.005
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 - Tolerances, SI Units

Nominal Thickness Millimeters					Tolerance, mm Plus	Tolerance, mm 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	0.03
Over	0.41	to	0.53,	incl	0.05	0.03
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	0.17	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 specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing:

Sufficient sheet shall be selected at random from each inspection lot to perform all required tests. The number of determinations for each requirement shall be not less than two.

4.4 Reports:

The vendor of sheet shall furnish with each shipment a report showing the results of tests for composition of each alloy used and stating that the sheet conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 4013E, shim stock thickness, foil thickness, percentage of total thickness which is laminated, size, and quantity. The report shall also identify the producer and lot identity.

4.5 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, disposition of the sheet may be based on the results of testing two additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the sheet represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Laminated sheet shall be marked with not less than the nominal total thickness, thickness of each lamination, percentage of total thickness which is laminated, and AMS 4013E.

5.2 Packaging:

Product shall be prepared for shipment in accordance with ASTM B 660 and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the sheet to ensure carrier acceptance and safe delivery.