



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

**AMS 3710A**  
Superseding AMS 3710

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## SANDWICH STRUCTURES, GLASS FABRIC-RESIN Low Pressure Molded, Heat Resistant

### 1. SCOPE:

1.1 Form: This specification covers flat or contoured sandwich structures.

1.2 Application: Primarily for structural and electrical parts requiring low weight, strength, and good electrical resistance up to 300°F (150°C).

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 2350 - Standards and Test Methods

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

ASTM C271 - Density of Core Materials for Structural Sandwich Constructions  
ASTM C273 - Shear Test in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores  
ASTM C297 - Tension Test of Flat Sandwich Constructions in Flatwise Plane  
ASTM C364 - Edgewise Compressive Strength of Flat Sandwich Constructions  
ASTM C365 - Flatwise Compressive Strength of Sandwich Cores  
ASTM C393 - Flexure Test of Flat Sandwich Constructions  
ASTM D1781 - Climbing Drum Peel Test for Adhesives

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

#### 2.3.1 Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes  
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

### 3. TECHNICAL REQUIREMENTS:

3.1 Material and Fabrication: Shall consist of a resin-impregnated, glass-fabric honeycomb core covered with resin-impregnated, glass-fabric faces.

#### 3.1.1 Core:

3.1.1.1 Glass Fabric Reinforcement: Unless otherwise specified, the glass fabric reinforcement, prior to being coated, shall be heat cleaned followed by application of a water-resistant finish compatible with the impregnating resin.

SAE Technical rules provide that: "All technical reports, including standards approved and practiced by governmental agencies is entirely voluntary. There is no agreement to adhere to an E standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against infringement of patents."

- 3.1.1.2 Style of Weave: Unless otherwise specified, each ply of glass fabric used for the honeycomb core shall not exceed 0.004 in. (0.10 mm) in thickness and 2 oz per sq yd (68 g/m<sup>2</sup>) in weight. Breaking strength shall be not less than 88 lb per in. (15.4 kN/m) edgewise and 86 lb per in. (15.1 kN/m) pickwise.
- 3.1.2 Impregnating Resin: Shall be a heat-resistant, thermosetting resin.
- 3.1.3 Core Layup: Unless otherwise specified, honeycomb core material shall be a random layup but symmetrically positioned at diametrically opposite locations. Adjacent blocks of honeycomb whose joints are parallel to the ribbon direction shall be intermeshed (See 3.1.3.1) or butted. All other joints shall be intermeshed. The honeycomb shall not be gored.
- 3.1.3.1 Intermesh is defined as the positioning of adjacent blocks of honeycomb such that the outermost edge of one block shall fall within the outermost edge of the adjacent block. This shall be accomplished without crushing or damaging the honeycomb core material.
- 3.1.4 Faces: The thickness of faces and their tolerances shall be as specified by purchaser. The faces shall be premolded or laminated prior to bonding to the core, unless otherwise specified. If required, a peel-ply-wet-ply bonding technique may be used. Unless otherwise specified, sandwich faces shall be essentially void-free.
- 3.1.4.1 Glass Fabric Reinforcement: Unless otherwise specified, each ply of glass fabric used for the outer faces shall not exceed 0.016 in. (0.41 mm) in thickness and 10 oz per sq yd (340 g/m<sup>2</sup>) in weight.
- 3.1.4.2 Impregnation Resin: Shall be a heat-resistant, thermosetting resin.
- 3.1.5 Core-To-Face Bonding Resin: Unless otherwise specified, the resin or adhesive used for bonding the sandwich faces to the honeycomb core shall be a supported or unsupported, heat-resistant epoxy compound.
- 3.1.6 Edge Band Sealant and Local Reinforcements: Unless otherwise specified, the product shall be furnished free of edge band sealant and locally embedded reinforcements.
- 3.1.7 Core-To-Face Bond: The sandwich faces shall be uniformly and firmly bonded to the core material over the entire area of the sandwich structure. There shall be a substantial fillet of resin where the honeycomb contacts the face material. Excessive resin deposits, which affect electrical transmission efficiency, are not permitted. No unbonded areas between the outer face and the core are allowed.
- 3.1.8 Sandwich Panels: The thickness and thickness tolerance of panels shall be as specified by purchaser.
- 3.2 Condition: Unless otherwise specified, the bonded construction shall be furnished cured to meet the requirements of 3.3 and in the unpainted condition.
- 3.3 Properties: Sandwich constructions having nominal cell size (distance between parallel sides of a cell measured perpendicular to the ribbon direction) of the core of 3/16 in. (4.8 mm) shall conform to the following requirements; properties of constructions having nominal core cell size other than 3/16 in. (4.8 mm) shall be as agreed upon by purchaser and vendor; tests shall be performed in accordance with specified test methods, insofar as practicable:
- 3.3.1 Honeycomb Core:

3.3.1.1	<u>Density:</u>	8.0 - 10.0 lb per cu ft (128 - 160 kg/m <sup>3</sup> )	ASTM C271
3.3.1.2	Dielectric Constant at 9375 MHz	1.28	4.5.1
3.3.1.3	Dissipation Factor at 9375 MHz, max	0.004	4.5.1
3.3.1.4	Compressive Strength, 1/2 in. (13 mm) thick specimens, min	1500 psi (10.3 MPa)	ASTM C365
3.3.2	Sandwich Panels: Flat sandwich panels, 0.500 in. $\pm$ 0.015 (12.70 mm $\pm$ 0.38) total thickness, having 0.040 in. $\pm$ 0.005 (1.02 mm $\pm$ 0.13) thick faces and 3/16 in. (4.8 mm) cells, representative of the construction supplied, shall conform to the following requirements; tests shall be performed in accordance with the listed ASTM Methods, insofar as practicable:		
3.3.2.1	Compressive Strength, min At 70°F $\pm$ 2 (21°C $\pm$ 1) At 300°F $\pm$ 5 (150°C $\pm$ 2) after 192 hr at 300°F $\pm$ 5 (150°C $\pm$ 2)	1,500 psi (10.3 MPa) 1,500 psi (10.3 MPa)	ASTM C364
3.3.2.2	Shear Strength, min At 70°F $\pm$ 2 (21°C $\pm$ 1) At 300°F $\pm$ 5 (150°C $\pm$ 2) after 30 min $\pm$ 5 at 300°F $\pm$ 5 (150°C $\pm$ 2)	800 psi (5.52 MPa) 600 psi (4.14 MPa)	ASTM C273
3.3.2.3	Shear Modulus At 70°F $\pm$ 2 (21°C $\pm$ 1) At 300°F $\pm$ 5 (150°C $\pm$ 2) after 30 min $\pm$ 5 at 300°F $\pm$ 5 (150°C $\pm$ 2)	40,000 psi (276 MPa) 30,000 psi (207 MPa)	ASTM C273
3.3.2.4	Flatwise Tensile Strength, min At 70°F $\pm$ 2 (21°C $\pm$ 1)	600 psi (4.14 MPa)	ASTM C297
3.3.2.5	Shear Strength, (sandwich structure flat only), min Parallel to ribbon Perpendicular to ribbon	400 psi (2.76 MPa) 400 psi (2.76 MPa)	ASTM C273
3.3.2.6	Flexural Strength, (sandwich structure flat only), min Parallel to ribbon Perpendicular to ribbon	290 psi (2 MPa) 170 psi (1.17 MPa)	ASTM C393
3.3.2.7	<u>Power Transmission Efficiency:</u> Unless other wise specified, the power transmission efficiency of the sandwich structure at 9375 MHz $\pm$ 10 when oriented at a 20 deg angle of incidence using parallel and perpendicular polarization shall be not less than 95% when tested at 50% $\pm$ 5 relative humidity. The sandwich transmission efficiency shall be not less than 90% after exposure to 25 cycles of heating to equilibrium at + 158°F (+ 70°C) and cooling to equilibrium at -37°C) followed by 50 cycles of simulated altitude exposure within the range 8,000 to 50,000 ft (2440 to 15240 m) with condensation on the panel surfaces.		
3.3.2.8	<u>Weathering:</u> When specified, the product shall have weather resistance acceptable to the purchaser, determined by a procedure agreed upon by purchaser and vendor.		
3.3.2.9	<u>Corrosion:</u> The product shall not have a corrosive effect on other materials when exposed to conditions normally encountered in service. Discoloration of metals shall not be considered objectionable.		

- 3.4 Quality: The product shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from imperfections detrimental to fabrication, appearance, or performance of parts.
- 3.4.1 Surface Condition: The surfaces of the sandwich structure shall be free of adhesion-inhibiting materials.
- 3.4.2 Imperfections: Molded sandwich structures shall not have imperfections which exceed the maximum allowable limits of 3.4.2.1 through 3.4.2.4.
- 3.4.2.1 Gaps: Not more than 20% of the total amount of honeycomb jointed lengths may have gaps up to 1/2 cell diameter in dimension for a maximum total gap length of 8 in. (200 mm) including all adjacent pieces. Not more than 5% of the total amount of honeycomb jointed lengths may have gaps up to 1 cell diameter in dimension for a maximum total gap length of 5 in. (125 mm) between adjacent pieces.
- 3.4.2.2 Unbonded Areas: Unbonded areas not larger than 1 sq in. (6.5 cm<sup>2</sup>) shall be allowed between the inner skin of the sandwich and the core if the total area of these unbonded areas is less than 1/2% of the total face-to-core area. Unbonded areas shall also be limited to not more than 1 per each 3-ft (900-mm) square and they shall be no closer than 6 in. (150 mm) from each other.
- 3.4.2.3 Resin Pools: A resin pool not larger than 1 sq in. (6.5 cm<sup>2</sup>) in area is permitted on the inner skin of the sandwich if the total area of such a resin pool is less than 1% of the total face-to-core area. Resin pools also shall be limited to not more than 1 per each 3-ft (900-mm) square and they shall be not closer than 6 in. (150 mm) from each other.
- 3.4.2.4 Other small surface imperfections, such as reduction of void-freeness (excluding contaminants) on the inner skin of the sandwich, not exceeding 1 sq in. (6.5 cm<sup>2</sup>) in area, are allowed. The total area of these imperfections shall be less than 5% of the total face-to-core area. Such imperfections shall be limited to not more than 1 per each 3-ft (900-mm) square and they shall be not closer than 6 in. (150 mm) from each other.

#### 4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of sandwich panels 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 4.6. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the panels conform to the requirements of this specification.
- 4.2 Classification of Tests:
- 4.2.1 Acceptance Tests: Tests to determine conformance to requirements for material and fabrication (3.1), flatwise tensile strength (3.3.2.4), flexural strength (3.3.2.6), quality (3.4), and tolerances are classified as acceptance tests and shall be performed on each lot.
- 4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification tests and shall be performed on the initial shipment of panels to a purchaser, when a change in material or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.
- 4.2.2.1 For direct U.S. Military procurement, substantiating test data and when requested, qualification test material shall be submitted to the cognizant qualification agency as directed by the procuring activity, the contracting officer, or the request for procurement.