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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3712B

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Superseding AMS 3712A

Submitted for recognition as an American National Standard

CORE, HONEYCOMB, GLASS/POLYIMIDE

1. SCOPE:

1.1 Form:

This specification covers expanded honeycomb core made of glass cloth impregnated with polyimide resin and supplied in the form of blocks, slices, and ordered shapes.

1.2 Application:

This core has been used typically for bonded sandwich structures requiring high strength and corrosion resistance for long-time service up to 230 °C (446 °F) and short duration up to 370 °C (698 °F), but usage is not limited to such applications.

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 3824 Cloth, Type "E" Glass, Finished for Resin Laminates

2.2 ASTM Publications:

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

ASTM C 271 Density of Core Materials for Structural Sandwich Constructions
ASTM C 273 Shear Properties in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores
ASTM C 365 Flatwise Compressive Strength of Sandwich Cores

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Glass Cloth: Shall be suitably finished as required for impregnation with the resin system specified herein and shall meet the requirements of AMS 3824 for the style used for each core size and density.

3.1.2 Resin: The resin used for impregnating the glass cloth in the initial and final web impregnations, and also for the node bond adhesive, shall be a polyimide resin system suitable for producing core material meeting the requirements of 3.3.

3.1.3 Designation: Core shall be designated according to the following numbering system:

a. Material
b. Cell Size (fraction of an inch) (mm)
c. Density (pounds per cubic foot) (kg/m^3)

Example: Core, Glass/Polyimide - 3/16 - 4.0 (in inch/pound units)
Core, Glass/Polyimide - 4.8 - 64 (in SI units)

Means: Core, glass cloth impregnated with polyimide resin, 3/16 inch (4.8 mm) cell size, with density of 4.0 pounds per cubic foot (64 kg/m^3)

3.1.4 Cell Configuration: Core shall consist of polyimide resin impregnated glass cloth sheets, bonded together so that cells, approximately hexagonal in shape, are formed when fully expanded (See Figure 1).

3.1.5 Core Dimensions: Shall be as specified in Figure 1 where,

T = Thickness, depth, or height dimension measured parallel to the core cell axis
L = Longitudinal or ribbon direction measured along the direction of a ribbon
W = Transverse direction perpendicular to the ribbon direction.

3.2 Condition:

Core shall be supplied completely cured and in the expanded form.

3.3 Properties:

Core shall conform to the following requirements:

3.3.1 Shear Strength and Shear Modulus: Shall be as specified in Table 1, determined in accordance with ASTM C 273 at 25 °C ± 3 (77 °F ± 5) and at 230 °C ± 5 (446 °F ± 9). Specimens shall be plate shear specimens 0.500 inch ± 0.010 (12.70 mm ± 0.25) thick. Two or more plies of adhesive may be used in preparing test specimens if necessary to induce core failure (See 8.3). Specimens shall be tested after exposure for not less than 30 minutes at the test temperature. Determinations shall be made in two directions.

3.3.2 Compressive Strength and Compressive Modulus: Shall be as specified in Table 1, determined in accordance with ASTM C 365 at 25 °C ± 3 (77 °F ± 5) and at 230 °C ± 5 (446 °F ± 9) on stabilized core specimens (See 8.4). Test shall be performed after exposure of test specimens for not less than 30 minutes at the test temperature.

TABLE 1A - Shear Strength and Shear Modulus, Inch/Pound Units

Nominal Cell Size Inch	Nominal Core Density lb per cu ft	Test Temp °F	Core Shear Strength[A] psi, min L	Core Shear Strength[A] psi, min W	Core Shear Modulus[B] Msi, min L	Core Shear Modulus[B] Msi, min W	Compressive Strength[A] Stabilized psi, min	Compressive Modulus[B] Stabilized Msi, min, dry
3/16	4.0	77	140	70	13.0	5.0	300	25.0
		446	90	45	8.5	3.5	195	16.0
3/16	4.5	77	220	110	22.0	8.4	400	31.0
		446	145	70	14.0	5.5	260	20.0
3/16	5.0	77	250	125	26.0	10.0	480	42.0
		446	160	80	17.0	6.5	310	27.5
3/16	6.0	77	345	170	35.0	11.5	625	64.0
		446	225	110	22.5	7.5	405	41.5
3/16	8.0	77	500	330	48.0	17.5	1000	85.0
		446	325	215	31.0	11.5	650	55.0
1/4	4.0	77	140	80	13.0	7.0	325	25.0
		446	90	50	8.5	4.5	215	16.0
1/4	5.0	77	250	125	26.0	10.0	450	35.0
		446	160	80	17.0	6.5	300	22.5
3/8	4.0	77	195	100	23.0	8.0	325	35.0
		446	125	65	15.0	5.0	215	22.5
3/8	5.5	77	300	160	30.0	10.0	540	45.0
		446	195	105	19.5	6.5	350	29.0
3/8	7.0	77	480	280	37.0	14.0	875	75.0
		446	310	180	24.0	8.0	565	50.0

[A] Strengths are minimum individual values

[B] Moduli are minimum average values

TABLE 1B - Shear Strength and Shear Modulus, SI Units

Nominal Cell Size mm	Nominal Core Density kg/m³	Test Temp °C	Core Shear Strength[A] MPa, min		Core Shear Modulus[B] MPa, min		Compressive Strength[A] Stabilized MPa, min	Compressive Modulus[B] Stabilized MPa, min, dry
			L	W	L	W		
4.8	64	25	0.97	0.48	89.6	34.5	2.07	172.4
		230	0.62	0.31	58.6	24.1	1.34	110.3
4.8	72	25	1.52	0.76	151.7	57.9	2.76	213.7
		230	1.00	0.48	96.5	37.9	1.79	137.9
4.8	80	25	1.72	0.86	179.3	68.0	3.31	289.6
		230	1.10	0.55	117.2	44.8	2.14	189.6
4.8	96	25	2.38	1.17	241.3	79.3	4.31	441.3
		230	1.55	0.76	155.1	51.7	2.79	286.1
4.8	128	25	3.45	2.28	331.0	120.7	6.90	586.1
		230	2.24	1.48	213.7	79.3	4.48	379.2
6.4	64	25	0.97	0.55	89.6	48.3	2.24	172.4
		230	0.62	0.34	58.6	31.0	1.48	110.3
6.4	80	25	1.72	0.86	179.3	69.0	3.10	241.3
		230	1.10	0.55	117.2	44.8	2.07	155.1
9.5	64	25	1.34	0.69	158.6	55.2	2.24	241.3
		230	0.86	0.45	103.4	34.5	1.48	155.1
9.5	88	25	2.07	1.10	206.8	69.0	3.72	310.3
		230	1.34	0.72	134.5	44.8	2.41	200.0
9.5	112	25	3.31	1.93	255.1	96.5	6.03	517.1
		230	2.14	1.24	165.5	55.2	3.90	344.7

[A] Strengths are minimum individual values

[B] Moduli are minimum average values

3.3.3 Density: Shall be within ±10% of the nominal density specified in Table 1, determined in accordance with ASTM C 271.

3.3.4 Flatness: Expanded core shall exhibit total facing contact with a flat surface under a uniform pressure of not more than 2 psi (13.8 kPa) without resulting in any damage that would cause core rejection.

3.3.5 Node Bond Breaks: No more than three node bond breaks or separations per 12-inch (305-mm) diameter circle will be permitted with no two breaks being adjacent in the "L" ribbon direction.

3.3.6 Node Bond Strength: Shall be such that no rupture of node bonds will occur during machining performed in accordance with manufacturer's recommendations.

3.4 Quality:

Core, 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 core.

3.4.1 Visual Imperfections:

3.4.1.1 Cell Walls: There shall be no split or buckled cell walls.

3.4.1.2 Double Layer: Expanded core blocks or splices which have double layers (two ribbons bonded together which cause uneven expansion in the "L" direction) shall be acceptable if the double layers are not more frequent than one in 12 inches (305 mm) in the "W" direction, as shown in Figure 2.

3.5 Tolerances:

Shall be as shown in Table 2, 3.5.2, 3.5.3, 3.5.4, and 3.5.5.

3.5.1 Core Thickness:

TABLE 2A - Core Thickness Tolerances, Inch/Pound Units

Core Thickness Inches	Tolerance, Inch plus and minus
0.125 to 1.500, incl	0.006
Over 1.500 to 3.000, incl	0.010
Over 3.000	0.063

TABLE 2B - Core Thickness Tolerances, SI Units

Core Thickness Millimeters	Tolerance, Millimeters plus and minus
3.18 to 38.10, incl	0.15
Over 38.10 to 76.20, incl	0.25
Over 76.20	1.60

3.5.2 Length and Width: +1.0 inch (+25 mm), -0.0.

3.5.3 Cell Pitch: 1.733 times the nominal cell size, +20%, -10%, measured by taking the average distance between 10 nodes along a ribbon. Report the average of determinations of six different ribbons selected at random.

3.5.4 Average Cell Size: Shall not vary more than ±10% from nominal dimensions, determined by taking the average distance between node bonds along the "W" dimension for at least 60 cells selected at random in groups containing 10 adjacent cells (See Figure 1).

3.5.5 Ribbon Direction: All ribbons shall be parallel to each other within 10 degrees. This shall be determined by measuring the angle between one line through two nodes of the same ribbon ("L" direction) 12 inches (305 mm) apart, and a corresponding line through two nodes of another ribbon in the principal ribbon direction (See Figure 1).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for compressive strength (3.3.2), density (3.3.3), quality (3.4), and tolerances (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of core to a purchaser, when a change in ingredients and/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, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:
(R)

Shall be as follows:

4.3.1 For Acceptance Tests: Each block or 2% of the slices from each lot shall be sampled at random to provide sufficient core to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be a single block or all slices cut from a single block and shall not exceed 250 pounds (113 kg).

4.3.1.2 (R) When a statistical sampling plan has been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.5 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample core shall be approved by purchaser before core for production use is supplied, unless such approval be waived by purchaser. Results of tests on production core shall be essentially equivalent to those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production core which are essentially the same as those used on the approved sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample core. Production core made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Reports:

The vendor of core shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the core conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 3712B, block number, manufacturer's product designation, and quantity.