Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 3711

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Revised

CORE, HONEYCOMB, FIBROUS NYLON BASE, PHENOLIC COATED

1. SCOPE:

1.1 Form: This specification covers expanded honeycomb core made of fibrous nylon sheets and supplied in the form of blocks, slices, and ordered shapes.

1.2 Application: Primarily for bonded sandwich structures requiring high strength and corrosion resistance in the temperature range of -67° to +180° F (-55° to +82° 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., Two Pennsylvania Plaza, New York, New York 10001.

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, Pennsylvania 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 C363 - Delamination Strength of Honeycomb Type Core Material
ASTM C365 - Flatwise Compressive Strength of Sandwich Cores

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

2.3.1 Military Specifications:

MIL-R-9299 - Resin, Phenolic, Laminating

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Synthetic Sheet: The snythetic sheet base material shall be made from modified nylon fiber capable of meeting the requirements of this specification when fabricated into core.

3.1.2 Resin: The resin used for impregnating the paper and for any additional dip coatings shall conform to MIL-R-9299, Type II, Class 1. The resin or adhesive used to bond the adjacent cells shall be sufficiently strong to meet the requirements of this specification.

Printed in U.S.A.

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 (lb per cu ft) (kg/m^3)

Example: Core, fibrous nylon, phenolic coated, 1/4 in. (6.4 mm) cell size, density of 2.0 lb per cu ft (32 kg/m^3).

Fibrous Modified, Phenolic Coated - 1/4 - 2.0 in U. S. Conventional Units
Fibrous Modified, Phenolic Coated - 6.4 - 32 in S. I. Units

3.1.4 Cell Configuration: Core shall consist of specified paper sheets, bonded together so that cells approximately hexagonal in shape are formed when fully expanded (See Fig. 1).

3.1.5 Core Dimensions: Shall be as specified in Fig. 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

3.1.6 Visual Imperfections: The following maximum requirements apply for imperfections observed in any randomly selected 12 in. (305 mm) diameter circle.

	Maximum Number for Cell Size, Inch (mm) Shown				
Type of Imperfection	1/8(3.2)	5/32(4.0)	3/16(4.8)	1/4(6.4)	3/8(9.5)
Split Cell Walls	0	0	0	0	0
Buckled Cell Walls	0	0	0	0	0

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

3.3 Properties:

3.3.1 Core Properties: The compressive strength, core shear strength, core shear modulus, and flatwise tensile strength shall be as specified in Table I, determined in accordance with 4.5.1, 4.5.2, and 4.5.3, respectively. Specimens shall be tested after exposure for not less than 30 min. at the test temperature.

3.3.2 Density: The core density shall be within ± 10% of the nominal density specified, determined in accordance with ASTM C271.

3.3.3 Flatness: Expanded core shall be capable of 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.

3.3.4 Double Layer: Expanded core slices 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 in. (305 mm) in the "W" direction, as shown in Fig. 2.

3.3.5 Node Bond Breaks: No more than 3 node-bond breaks or separations per 12 in. (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 not less than 16 lb (71 N) at 75° F ± 5 (23.9° C ± 2.8) and not less than 8 lb (36 N) at 350° F ± 5 (176.7° C ± 2.8), determined in accordance with ASTM C363.

3.4 Quality: The core shall be uniform in quality and condition, clean, sound, and free from foreign materials and from imperfections detrimental to fabrication, appearance, or performance of parts.

3.5 Tolerances: Unless otherwise specified, the following tolerances shall apply:

3.5.1 Core Thickness: ± 0.008 in. (± 0.20 mm) for machined slices up to 4 in. (102 mm) thick, ± 0.062 in. (±1.57 mm) for machined slices over 4 in. (102 mm) thick; and + 0.25 in. (+6.4 mm), -0.00 for raw block.

3.5.2 Length and Width: +1.00 in. (+25.4 mm), -0.00.

3.5.3 Cell Pitch: 1.733 times the nominal cell size, +20%, -10%, measured by taking the average distance between nodes along a ribbon as determined on six different ribbons.

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 Fig. 1).

3.5.5 Ribbon Direction: All ribbons shall be parallel to each other within 10 deg (0.175 rad). The ribbon direction shall be determined by measuring the angle between one line through two nodes on the same ribbon ("L" direction) 12 in. (305 mm) apart, and another line in the principal ribbon direction (See Fig. 1).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product 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 assure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to core compressive strength (3.3.1) and core density (3.3.2) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification or periodic control tests and may be the basis for approval of the product (See 4.4.1).

4.3 Sampling: Each block or 2% of the slices from each lot. A lot shall be all slices cut from a single block.

4.4 Approval:

4.4.1 Sample material shall be approved by purchaser before material for production use is supplied, unless such approval be waived. Results of tests on production material 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 material which are essentially the same as those used on the approved sample material. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit samples for reapproval unless purchaser grants written approval after review of a detailed statement of materials and processing used on the approved sample and those proposed. No production material made by the revised procedure shall be shipped prior to receipt of approval of such procedure.

4.5 Test Methods:

4.5.1 Compressive Strength: Shall be determined in accordance with ASTM C365 at 77° F ± 5 (25° C ± 2.8) on stabilized core specimens. Specimens for wet testing shall be immersed in water at 77° F ± 5 (25° C ± 2.8) for not less than 24 hr and tested immediately after removal.

4.5.2 Plate Shear Strength and Shear Modulus of Core: Shall be determined in two directions by using a plate shear test. The test specimen shall be 0.500 in. (12.70 mm) thick with 0.06 lb per sq ft (0.29 kg/m^2) adhesive to bond plates to core. The specimens shall be tested in accordance with ASTM C273 at 77° F ± 5 (25° C ± 2.8).

4.5.3 Flatwise Tensile Strength: Shall be determined in accordance with ASTM C297 at 77° F ± 5 (25° C ± 2.8).

4.6 Reports:

4.6.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests to determine conformance to the acceptance test requirements and a statement that the product conforms to all other technical requirements of this specification. This report shall include the purchase order number, material specification number, product designation, quantity, and block or lot number.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, supplier's material designation, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens, cut from the same block, for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 The core shall be packaged to prevent any physical damage during shipment and handling and shall be shipped flat unless contoured or formed shapes require special support.

5.1.2 Each piece of core and each interior and exterior package shall be identified with the following information applied to a durable tag, using characters of such size as to be clearly legible and which will not be obliterated by normal handling:

CORE, HONEYCOMB, FIBROUS NYLON BASE, PHENOLIC COATED
AMS 3711
CORE CLASSIFICATION _____
T x L x W _____
MANUFACTURER'S NAME OR TRADE MARK _____
BLOCK OR LOT NUMBER _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____

5.1.3 Packages shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.

8. NOTES: None.

TABLE I

Nominal Core Dimensions			Core Shear Strength, psi, min		Core Shear Modulus, psi, min, avg		Flatwise Tensile Strength	Compressive Strength, psi, min		
								Unstabilized		Stabilized
Cell Size Inch	Density lb per cu ft	Test Temp °F	L	W	L	W	psi, min	Dry	Wet	Dry
1/8	1.8	RT	65	36	2000	1300	160	70	50	80
		180	58	25	1900	1170		50		72
1/8	3.0	RT	162	85	5200	2500	300	180	165	270
		180	145	76	4300	2250	-	145		243
1/8	4.0	RT	225	112	7000	3600	300	330	256	470
		180	200	100	6300	3240		297		423
3/16	2.0	RT	72	40	2500	1400	180	90	81	105
		180	64	36	2100	1260		81		94
3/16	3.0	RT	135	67	4500	2400	250	180	167	270
		180	122	60	4050	2160		167		243
3/16	4.0	RT	225	112	7000	3800	325	320	256	470
		180	200	100	6300	3420		256		423
1/4	1.5	RT	45	23	1800	1000	125	45	40	55
		180	40	20	1600	900		40		50
1/4	2.0	RT	72	36	2200	1300	190	80	72	105
		180	64	32	1980	1170		72		94
3/8	1.5	RT	45	23	1800	1000	110	45	40	55
		180	40	20	1600	900		40		50
3/8	2.0	RT	72	36	2200	1300	160	80	72	105
		180	64	32	1980	1170		72		94