



AEROSPACE MATERIAL SPECIFICATION

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

AMS 3711A

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CORE, HONEYCOMB, FIBROUS ARAMID BASE, PHENOLIC COATED

1. SCOPE:

1.1 Form: This specification covers expanded honeycomb core made of fibrous aramid 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 -67° to $+180^{\circ}$ F (-55° to $+82^{\circ}$ 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 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, PA 19120.

2.3.1 Military Specifications:

MIL-R-9299 - Resin, Phenolic, Laminating

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Synthetic Sheet: The synthetic paper sheet shall be made from aramid fiber.

SAE Technical Board rules provide that: "All technical reports, including standards, app and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE 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 liability for infringement of patents."

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 3.3.

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

- a. Material
- b. Cell Size (fraction of an in.) (mm)
- c. Density (lb per cu ft) (kg/m^3)

Example: Core, Fibrous Aramid Phenolic Coated - 1/4 - 2.0 (in U.S. Conventional Units)
Core, Fibrous Aramid Phenolic Coated - 6.4 - 32 (in S.I. Units)

Means: Core, fibrous aramid phenolic coated, 1/4 in. (6.4 mm) cell size, density of 2.0 lb per cu ft ($32 \text{ kg}/\text{m}^3$).

3.1.4 Cell Configuration: Core shall consist of specified aramid 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 dimension measured along the direction of a ribbon

W = Transverse dimension perpendicular to the ribbon direction

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 $\pm 10\%$ of the nominal density specified in Table I, determined in accordance with ASTM C271.

3.3.3 Flatness: Expanded core shall make total facing contact with a flat surface under a uniform pressure of not more than 2 psi or 14 kPa without resulting in any damage that would cause core rejection.

3.3.4 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.

3.3.5 Node Bond Strength: Shall be not less than 16 lb (71 N) at $75^\circ\text{F} \pm 5$ ($23.9^\circ\text{C} \pm 2.8$) and not less than 8 lb (36 N) at $350^\circ\text{F} \pm 5$ ($176.7^\circ\text{C} \pm 2.8$), determined in accordance with ASTM C363.

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

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 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. or 300 mm in the "W" direction, as shown in Fig. 2.

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: ± 1.0 in. (± 25 mm), -0.00 .

3.5.3 Cell Pitch: 1.733 times the nominal cell size, $\pm 20\%$, -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 $\pm 10\%$ 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° (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. or 300 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 core 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 core 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), core density (3.3.2), quality (3.4), and tolerance (3.5), requirements are classified as acceptance tests.

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

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.

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 core shall be approved by purchaser before core for production use is supplied, unless such approval be waived. 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 core. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material and processing and, when requested, sample core. Production core made by the revised procedures shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

- 4.5.1 Compressive Strength: Shall be determined in accordance with ASTM C365 at $77^{\circ}\text{F} \pm 5$ ($25^{\circ}\text{C} \pm 2.8$) and $180^{\circ}\text{F} \pm 5$ ($82.2^{\circ}\text{C} \pm 2.8$) on core specimens. Specimens for wet testing shall be immersed in water at $77^{\circ}\text{F} \pm 5$ ($25^{\circ}\text{C} \pm 2.8$) for not less than 24 hr and tested immediately after removal.
- 4.5.2 Core Shear Strength and Shear Modulus: Shall be determined in two directions, using a plate shear test in accordance with ASTM C273 at $77^{\circ}\text{F} \pm 5$ ($25^{\circ}\text{C} \pm 2.8$) and $180^{\circ}\text{F} \pm 5$ ($82.2^{\circ}\text{C} \pm 2.8$). The test specimen shall be $0.500\text{ in.} \pm 0.010$ ($12.70\text{ mm} \pm 0.25$) thick with 0.06 lb per sq ft (0.30 kg/m^2) adhesive to bond plates to core.
- 4.5.3 Flatwise Tensile Strength: Shall be determined in accordance with ASTM C297 at $77^{\circ}\text{F} \pm 5$ ($25^{\circ}\text{C} \pm 2.8$).

4.6 Reports:

- 4.6.1 The vendor of core shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, core 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 and its revision letter, contractor or other direct supplier of core, supplier's material designation, part number, and quantity. When core for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of core to determine conformance to the requirements of this specification, and shall include in the report a statement that the core 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 core 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 core 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 physical damage during shipment and handling and shall be shipped flat unless contoured or formed shapes, requiring special support, are ordered.

- 5.1.2 Each piece of core and each interior and exterior package shall be marked to show not less than 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:

Ø CORE, HONEYCOMB, FIBROUS ARAMD BASE, PHENOLIC COATED
AMS 3711A
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 and in compliance with applicable regulations pertaining to handling of this product. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

- 5.1.4 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.3 will be acceptable if it meets the requirements of Level C.

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

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

8. NOTES:

- 8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

- 8.2 For direct U.S. Military procurement, purchase documents should specify the following:

Title, number, and date of this specification
Nominal cell size and density required
Length, width, and thickness of blocks or slices required
Quantity of core desired
Applicable level of packaging (See 5.1.4).

TABLE I

Nominal Core Dimensions		Test Temp ° F	Core Shear Strength		Core Shear Modulus		Flatwise Tensile Strength psi, min	Compressive Strength psi, min		
Cell Size Inch	Density lb per cu ft		psi, min		psi, min avg			Unstabilized		Stabilized Dry
			L	W	L	W		Dry	Wet	
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
Ø 1/8	5.0	RT	235	120	8500	4500	480	600	420	660
		180	210	110	7600	4000		540		595
Ø 1/8	6.0	RT	260	135	10000	4700	480	800	500	825
		180	235	120	9000	4200		720		740
Ø 1/8	8.0	RT	355	190	13000	6500	480	1100	750	1250
		180	320	170	11500	5900		1000		1125
Ø 1/8	9.0	RT	370	240	14500	8000	480	1400	1000	1600
		180	330	215	13000	7200		1250		1440
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
Ø 3/16	4.5	RT	225	110	7500	3000	550	320	225	400
		180	200	100	6700	2700		290		360
Ø 3/16	6.0	RT	330	150	11600	4500	550	580	405	650
		180	295	135	10500	4000		520		585
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
Ø 1/4	3.1	RT	135	60	5600	2100	325	180	125	240
		180	120	55	5000	1900		160		215
Ø 1/4	4.0	RT	200	95	6500	2800	325	310	215	360
		180	180	85	5800	2500		280		325
Ø 1/4	4.8	RT	255	140	7300	4000	325	400	320	450
		180	230	125	6500	3600		360		405
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
Ø 3/8	3.0	RT	110	55	3900	2500	225	175	130	210
		180	100	50	3500	2200		155		190