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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3711C

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Superseding AMS 3711B

CORE, HONEYCOMB, FIBROUS ARAMID BASE, PHENOLIC COATED

1. SCOPE:

1.1 Form: This specification covers expanded honeycomb core made of fibrous aramid paper 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 -55° to +82°C (-67° to +180°F).

1.3 Safety - Hazardous Materials: While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 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 C273 - Shear Test in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores
ASTM C363 - Delamination Strength of Honeycomb Type Core Material
ASTM C365 - Flatwise Compressive Strength of Sandwich Cores
ASTM F501 - Aerospace Materials Response to Flame, with Vertical Test Specimen (For Aerospace Vehicles Standard Conditions)

2.3 U.S. 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-401 - Sandwich Constructions and Core Materials; General Test Methods
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Fibrous Paper: Shall be made from aramid fiber.

3.1.2 Resin: The resin used for impregnating the paper and for any additional dip coatings shall conform to MIL-R-9299, Grade A. The resin or adhesive used to bond the adjacent cells shall be sufficiently strong to meet the requirements of 3.3.

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

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

Example: Core, Fibrous Aramid Phenolic Coated - 1/4 - 2.0 (in Inch/Pound Units)
Core, Fibrous Aramid Phenolic Coated - 6.4 - 32 (in SI Units)

Means: Core, fibrous aramid phenolic coated, 1/4 inch (6.4 mm) cell size, density of 2.0 pounds/cubic foot (32 kg/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 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 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: Core shall conform to the following requirements:

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

3.3.2 Density: The core density shall not vary more than ±10% from the nominal density specified in Table I, determined in accordance with MIL-STD-401 using a specimen at least one square foot (0.09 m^2) in area.

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 (14 kPa) without resulting in any damage that would cause core rejection.

3.3.4 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.

3.3.5 Node-Bond Strength: Shall be not less than 16 pounds force (71 N) at 25°C ± 3 (77°F ± 5) and not less than 8 pounds force (36 N) at 175°C ± 3 (347°F ± 5), determined in accordance with ASTM C363.

3.3.6 Flame Resistance: Time to extinguish, defined as the total of flame time and glow time, shall not exceed 5.0 seconds average, or 6.0 seconds individual. Burn length shall not exceed 6.0 inches (152 mm) average, or 7.2 inches (183 mm) individual. Specimens shall be tested in the vertical position with 60 seconds ± 1 flame exposure in accordance with 4.5.3.

3.4 Quality: The core, as received by purchaser, shall be uniform in quality, clean, 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 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 inches (305 mm) in the "W" direction, as shown in Figure 2.

3.5 Tolerances: Shall be as follows:

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

3.5.2 Length and Width: +1.0 inch (+25 mm), -0.00.

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. The ribbon direction shall be determined by measuring the angle between one line through two nodes on the same ribbon ("L direction) 12 inches (305 mm) apart, and another line in the principal ribbon direction (See Figure 1).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of core shall supply all samples for vendor's tests 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 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 to determine conformance to requirements for core shear strength (3.3.1), core density (3.3.2), quality (3.4), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the first-article shipment of core to a purchaser, when a change in material, processing, or both 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: 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 each block or all slices cut from a single block. A lot shall not exceed 250 lb (113 kg).

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have 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 4.6.1 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 core. 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 material, processing, or both 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 25°C ± 3 (77°F ± 5) and 82°C ± 3 (180°F ± 5) on core specimens. Specimens for wet testing shall be immersed in water at 25°C ± 3 (77°F ± 5) for not less than 24 hours and tested immediately after removal.

4.5.2 Ø Core Shear Strength and Shear Modulus: Shall be determined in two directions, using a plate shear test in accordance with ASTM C273 at 25°C ± 3 (77°F ± 5) and 82°C ± 3 (180°F ± 5). The test specimen shall be 0.500 inch ± 0.010 (12.70 mm ± 0.25) thick with 0.06 pound/square foot (0.30 kg/m^2) adhesive to bond plates to core. Two or more plies of adhesive may be used in preparing test specimens if necessary to induce core failure.

4.5.3 Flame Resistance: Shall be determined in accordance with ASTM F501, using three bare core specimens, 0.500 inch (12.70 mm) thick by 3.0 x 14.0 inch (76 x 356 mm), with the 14 inch (356 mm) dimension in either the "W" or "L" direction, and the flame applied for 60 seconds ± 1.

4.6 Reports:

4.6.1 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 of this specification. This report shall include the purchase order number, AMS 3711C, core designation, quantity, and block or lot number.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3711C, 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 either a statement that the core conforms or 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 with not less than the following information applied to a durable tag, using characters of such size as to be legible and which will not be obliterated by normal handling:

CORE, HONEYCOMB, FIBROUS ARAMID BASE, PHENOLIC COATED
AMS 3711C
CORE CLASSIFICATION _____
T x L x W _____
MANUFACTURER'S IDENTIFICATION _____
BLOCK OR LOT NUMBER _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____

5.1.3 Packages of core shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to handling, packaging, and transportation of the core to ensure carrier acceptance and safe delivery. 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 5.1.1 and 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 modifications authorized by purchaser, 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 The flame resistance requirements (3.3.6) of this specification meet the requirements of FAA FAR 25.853 (a) and Appendix F thereto. The flame resistance test is intended only for comparative evaluation of materials and is not to be construed as an indication of characteristics of the product under actual fire conditions.

8.3 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.4 For direct U.S. Military procurement, purchase documents should specify not less than 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).

8.5 Core meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 5680.

TABLE I

Nominal Core Dimensions		Test	Core Shear Strength psi, min		Core Shear Modulus psi, min avg		Compressive Strength psi, min		
Cell Size Inch	Density lb per cu ft	Temp °F	L	W	L	W	Unstabilized Dry	Unstabilized Wet	Stabilized Dry
1/8	1.8	77	65	36	2000	1300	70	50	80
		180	58	25	1900	1170	50	-	72
1/8	3.0	77	162	85	5200	2500	180	165	270
		180	145	76	4300	2250	145	-	243
1/8	4.0	77	225	112	7000	3600	330	256	470
		180	200	100	6300	3240	297	-	423
1/8	5.0	77	235	120	8500	4500	600	420	660
		180	210	110	7600	4000	540	-	595
1/8	6.0	77	260	135	10000	4700	800	500	825
		180	235	120	9000	4200	720	-	740
1/8	8.0	77	355	190	13000	6500	1100	750	1250
		180	320	170	11500	5900	1000	-	1125
1/8	9.0	77	370	240	14500	8000	1400	1000	1600
		180	330	215	13000	7200	1250	-	1440
3/16	2.0	77	72	40	2500	1400	90	81	105
		180	64	36	2100	1260	81	-	94
3/16	3.0	77	135	67	4500	2400	180	167	270
		180	122	60	4050	2160	167	-	243
3/16	4.0	77	225	112	7000	3800	320	256	470
		180	200	100	6300	3420	256	-	423
3/16	4.5	77	225	110	7500	3000	320	225	400
		180	200	100	6700	2700	290	-	360
3/16	6.0	77	330	150	11600	4500	580	405	650
		180	295	135	10500	4000	520	-	585
1/4	1.5	77	45	23	1800	1000	45	40	55
		180	40	20	1600	900	40	-	50
1/4	2.0	77	72	36	2200	1300	80	72	105
		180	64	32	1980	1170	72	-	94
1/4	3.1	77	135	60	5600	2100	180	125	240
		180	120	55	5000	1900	160	-	215

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