AEROSPACE MATERIAL SPECIFICATION

AMS3711	REV. E

Issued 1974-06
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Reaffirmed 2013-07

Superseding AMS3711D

Core, Honeycomb
Fibrous, Aramid Base, Phenolic Coated

RATIONALE

AMS3711E has been reaffirmed to comply with the SAE five-year review policy.

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:

This honeycomb core has been used typically for bonded sandwich structures requiring high strength and corrosion resistance for service in the temperature range -65 to +180 °F (-54 to +82 °C), but usage is not limited to such applications.

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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS3711E

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM C 271 Density of Sandwich Core Materials
ASTM C 273 Shear Properties or Sandwich Core Material
ASTM C 363 Delamination Strength of Honeycomb Core Material
ASTM C 365 Flatwise Compressive Properties of Sandwich Cores
ASTM F 501 Aerospace Materials Response to Flame, with Vertical Test Specimen (For Aerospace Vehicles Standard Conditions)

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 be a phenolic resin. The resin and adhesive used to bond the honeycomb cell nodes 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 to 2.0 (in Inch/Pound Units)
Core, Fibrous Aramid Phenolic Coated - 6.4 to 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 in the expanded form and cured to meet the requirements of 3.3.

3.3 Properties:

Core shall conform to the following requirements:

3.3.1 Strength and Modulus: The compressive strength, shear strength, and shear modulus shall be as specified in Table 1, 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: Shall be within ±10% of the nominal density specified in Table 1, determined in accordance with ASTM C 271.

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 Strength: Shall be not less than 16 pounds-force (71 N) at 75 °F ± 5 (24 °C ± 3) and not less than 8 pounds-force (36 N) at 350 °F ± 5 (177 °C ± 3), determined in accordance with ASTM C 363.

3.3.5 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 and condition, sound, as free from foreign materials as commercially practicable, and free 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.

3.4.1.3 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.

3.5 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), -0.0.

3.5.3 Cell Pitch: 1.733 times the nominal cell size, +20%, -10%, measured by taking the average distance between ten 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 ten 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 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 manufacturer of core shall supply all samples for required tests and shall be responsible for the performance of 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 specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Shear strength (3.3.1), density (3.3.2), visual imperfections (3.4.1), and tolerances (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of core by the manufacturer, when a change in ingredients and/or processing requires reapproval as in 4.4.1, and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

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.

4.3.1.2 A statistical sampling plan acceptable to purchaser may be used in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

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

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. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer 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 procedures shall not be shipped prior to receipt of reapproval.

4.4.2 Manufacturer 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.

4.5 Test Methods:

4.5.1 Compressive Strength: Shall be determined in accordance with ASTM C 365 at 75 °F ± 5 (24 °C ± 3) and 180 °F ± 5 (82 °C ± 3), on core specimens. Specimens for wet testing shall be immersed in water at 75 °F ± 5 (24 °C ± 3) for not less than 24 hours and tested immediately after removal.

4.5.2 Core Shear Strength and Shear Modulus: Shall be determined in the L and W directions, using a plate shear test in accordance with ASTM C 273 at 75 °F ± 5 (24 °C ± 3) and 180 °F ± 5 (82 °C ± 3). The test specimen shall be 0.500 inch ± 0.010 (12.70 mm ± 0.25) in thickness. 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 F 501, 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:

The supplier of core shall furnish with each shipment a report from the manufacturer 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, block or lot number, AMS 3711E, manufacturer's identification, size and quantity.

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. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 A core lot may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.

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

5.1.3 Each piece of core and each interior and exterior package shall be legibly marked with not less than the following information applied to a durable tag, using characters which will not be obliterated by normal handling:

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

5.1.4 Packages of core shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the core to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT:

The supplier 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 A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revisions. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 The flame resistance requirements (3.3.5) 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 Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.4 Procurement documents should specify not less than the following:

AMS 3711E
Nominal cell size and core density required
Length, width, and thickness of blocks or slices required
Quantity of core desired
Special packaging, if required.

TABLE 1A - Properties, Inch/Pound Units

Nominal Cell Size Inch	Nominal Core Density lb per cu ft	Test Temp °F	Core Shear Strength[1] psi, min L	Core Shear Strength[1] psi, min W	Core Shear Modulus[1] ksi, min L	Core Shear Modulus[1] ksi, min W	Compressive Strength[1] psi, min Unstabilized Dry	Compressive Strength[1] psi min Unstabilized Wet	Compressive Strength[1] psi min Stabilized Dry
1/8	1.8	75	65	36	2.0	1.3	70	50	80
		180	58	25	1.9	1.17	50	--	72
1/8	3.0	75	162	85	5.2	2.5	180	165	270
		180	145	76	4.3	2.25	145	--	243
1/8	4.0	75	225	112	7.0	3.6	330	256	470
		180	200	100	6.3	3.24	297	--	423
1/8	5.0	75	235	120	8.5	4.5	600	420	660
		180	210	110	7.6	4.0	540	--	595
1/8	6.0	75	260	135	10.0	4.7	800	500	825
		180	235	120	9.0	4.2	720	--	740
1/8	8.0	75	355	190	13.0	6.5	1100	750	1250
		180	320	170	11.5	5.9	1000	--	1125
1/8	9.0	75	370	240	14.5	8.0	1400	1000	1600
		180	330	215	13.0	7.2	1250	--	1440
3/16	2.0	75	72	40	2.5	1.4	90	81	105
		180	64	36	2.1	1.26	81	--	94
3/16	3.0	75	135	67	4.5	2.4	180	167	270
		180	122	60	4.05	2.16	167	--	243
3/16	4.0	75	225	112	7.0	3.8	320	256	470
		180	200	100	6.3	3.42	256	--	423
3/16	4.5	75	225	110	7.5	3.0	320	225	400
		180	200	100	6.7	2.7	290	--	360
3/16	6.0	75	330	150	11.6	4.5	580	405	650
		180	295	135	10.5	4.0	520	--	585

TABLE 1A - Properties, Inch/Pound Units (Continued)

Nominal Cell Size Inch	Nominal Core Density lb per cu ft	Test Temp °F	Core Shear Strength[1] psi, min L	Core Shear Strength[1] psi, min W	Core Shear Modulus[1] ksi, min L	Core Shear Modulus[1] ksi, min W	Compressive Strength[1] psi, min Unstabilized Dry	Compressive Strength[1] psi min Unstabilized Wet	Compressive Strength[1] psi min Stabilized Dry
1/4	1.5	75	45	23	1.8	1.0	45	40	55
		180	40	20	1.6	0.9	40	--	50
1/4	2.0	75	72	36	2.2	1.3	80	72	105
		180	64	32	2.0	1.17	72	--	94
1/4	3.1	75	135	60	5.6	2.1	180	125	240
		180	120	55	5.0	1.9	160	--	215
1/4	4.0	75	200	95	6.5	2.8	310	215	360
		180	180	85	5.8	2.5	280	--	325
1/4	4.8	75	255	140	7.3	4.0	400	320	450
		180	230	125	6.5	3.6	360	--	405
3/8	1.5	75	45	23	14.8	1.0	45	40	55
		180	40	20	1.6	0.9	40	--	50
3/8	2.0	75	72	36	2.2	1.3	80	72	105
		180	64	32	2.0	1.17	72	--	94
3/8	3.0	75	110	55	3.9	2.5	175	130	210
		180	100	50	3.5	2.2	155	--	190

[1]Strengths are minimum individual values

[2]Moduli are minimum average values