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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3709B

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Superseding AMS 3709A

SYNTACTIC FOAM TILES

1. SCOPE:

1.1 Form: This specification covers dielectrically-loaded syntactic foam tiles having a polyimide resin matrix.

1.2 Application: Primarily as a controlled-dielectric core material for applications requiring long-term heat resistance up to 315°C (600°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
AMS 3619 - Resin, Polyimide, Laminating, High Temperature Resistant, 315°C (600°F)
AMS 3751 - Microspheres, Hollow Glass

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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 D2520 - Complex Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials at Microwave Frequencies and Temperatures to 1650°C
ASTM D2841 - Sampling Hollow Microspheres

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

2.3.1 Federal Specifications:

O-A-51 - Acetone, Technical

2.3.2 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Tiles shall be composed of the following materials in the proportions specified:

Component	Parts by Weight
Hollow Glass Microspheres, AMS 3751, Class 15	100
Polyimide Resin Solution, AMS 3619	140
Glass Fibers, 0.25 in. (6 mm) (See 8.3)	7.2
Aluminum Powder (See 8.3)	15-16
Acetone, Technical, O-A-51	85

3.2 Fabrication: Tiles shall be fabricated as follows; drying, curing, and post-curing temperatures and vacuum readings shall be continuously monitored and recorded. All equipment and thermocouples used shall be calibrated at regular intervals.

3.2.1 Mold Preparation: The foam tile mold surfaces shall be coated with a fluorocarbon mold-release material.

3.2.2 Foam Mixing: Each component of the foam formulation in 3.1 shall be weighed to the nearest gram. The resin and acetone shall be combined in a slow-speed, low-shear mixer and mixed thoroughly. While mixing, the other components shall be sprinkled slowly into the resin-acetone solution in the following order; the glass fibers, the aluminum powder, and the microspheres (taken in accordance with ASTM D2841), with thorough mixing after each addition. Mixing shall be continued for not less than 5 min. after adding the final component.

3.2.3 Mold Packing: The foam mixture shall be evenly packed into the release-coated moldes to the specified depth for the applicable tile design.

3.2.4 Material Drying: A thermocouple shall be located at the mold surface at least 1 in. (25 mm) from the mold edge, in the thickest available mold area. The packed mold shall be placed, uncovered, into a preheated 80°C (175°F), forced-draft, explosion-proof oven, set for high air-flow. The mold shall be held in the 80°C + 3 (175°F + 5) oven for 30 min. + 1 after the mold-surface thermocouple has reached 70°C + 3 (160°F + 5) or for 150 min. + 5, whichever occurs first. The mold shall then be removed from the oven and cooled to ambient temperature.

3.2.5 Tile Bagging: The surface of the dried foam in the mold shall be covered, in order, with one ply of silicone release fabric, one ply of glass cloth (181-type fabric), and one ply of glass cloth (184-type fabric). The mold assembly shall then be vacuum-bagged and a vacuum of not less than 22 in. (550 mm) of mercury applied.

3.2.6 Tile Curing: The bagged assembly shall be placed in an ambient temperature oven under full vacuum of not less than 22 in. (550 mm) Hg. The oven temperature shall be raised to 120°C + 3 (250°F + 5) at the rate of 1 C (2 F) deg per min., and held at 120°C + 3 (250°F + 5) for 45 min. + 5. The oven temperature shall then be raised to 175°C + 3 (345°F + 5) at the rate of 1 C (2 F) deg per minute. After the mold-surface thermocouple reaches 175°C (345°F), the assembly shall be maintained at 175°C + 5 (345°F + 10) for 120 min. + 10. The assembly shall then be cooled under vacuum to below 65°C (150°F) and removed from the bag.

3.2.7 Tile Post-Curing: The tile shall be placed in a suitable holding fixture designed to maintain the part contour throughout the post-curing cycle. The assembly shall be placed in an ambient temperature oven and the temperature raised to 315°C + 5 (600°F + 10) in not less than 4 hr with a rate of rise not greater than 1 C (2 F) deg per minute. The assembly shall then be held at 315°C + 5 (600°F + 10 for 120 min. + 10. The assembly shall then be cooled to below 65°C (150°F) under restraint before removal from the post-curing fixture.

3.3 Properties: Tiles shall conform to the following requirements; tests shall be performed on the tiles supplied and in accordance with specified ASTM methods, insofar as practicable:

3.3.1 Density: Shall be 19.0 lb per cu ft + 1.5 (305 kg/m^3 + 25), determined in accordance with ASTM C271.

3.3.2 Dielectric Constant: Shall be 3.1 + 0.1 at 9.375 GHz (X-band), determined in accordance with ASTM D2520.

3.3.3 Cracks: Hairline cracks shall not exceed 0.005 in. (0.12 mm) in width, measured with a dimensionally-indexed magnifying glass or microscope.

3.4 Quality: Tiles, as received by purchaser, shall be uniform in quality and condition, smooth, and free from foreign materials and from imperfections detrimental to usage of the tiles.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of tiles 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 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tiles conform to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed prior to or on the initial shipment of tiles to a purchaser, on each lot, when a change in material, processing, or both requires approval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1 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: Sufficient tiles shall be taken at random from each lot to perform all required tests. The minimum sample size shall be 0.7 in. (20 mm) thick x 8 in. (200 mm) square. 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 all tiles produced in a single production run from the same batches of raw materials under the same fixed conditions and presented for vendor's inspection at one time. A lot shall not exceed 50 lb (25 kg) of tiles and may be packaged and delivered in smaller quantities under the basic lot approval provided lot identification is maintained.

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 4.5.1 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 tiles shall be approved by purchaser before tiles for production use are supplied, unless such approval be waived by purchaser. Results of tests on production tiles 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 tiles which are essentially the same as those used on the approved sample tiles. 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 tiles. Production tiles made by the revised procedures shall not be shipped prior to receipt of reapproval.