



AEROSPACE MATERIAL SPECIFICATION

AMS 3709

Society of Automotive Engineers, Inc.

TWO PENNSYLVANIA PLAZA, NEW YORK, N. Y. 10001

Issued March 1, 1974

Revised

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 (599° F).

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
- AMS 3619 - Resin, Polyimide, Laminating, High Temperature Resistant, 315° C (599° F)
- AMS 3751 - Microspheres, Hollow Glass

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

2.3.1 Federal Specifications:

- O-A-51 - Acetone, Technical

3. TECHNICAL REQUIREMENTS:

- 3.1 Material: The product 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. (6.4 mm) (See 8.2)	7.2
Aluminum powder (See 8.2)	15 - 16
Acetone, Technical, 0-A-51	85

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- 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 molds 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 (176° F), forced-draft, explosion-proof oven, set for high air-flow. The mold shall be held in the 80° C \pm 3 (176° F \pm 5.4) oven for 30 min. \pm 1 after the mold-surface thermocouple has reached 70° C \pm 3 (158° F \pm 5) or for 150 min. \pm 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 (style 181 fabric), and one ply of glass cloth (style 184 fabric). The mold assembly shall then be vacuum-bagged and a vacuum of not less than 22 in. (559 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. (559 mm) Hg. The oven temperature shall be raised to 120° C \pm 3 (248° F \pm 5.4) at the rate of 1.0 C (1.8 F) deg per min., and held at 120° C \pm 3 (248° F \pm 5.4) for 45 min. \pm 5. The oven temperature shall then be raised to 175° C \pm 3 (347° F \pm 5.4) at the rate of 1.0 C (1.8 F) deg per minute. After the mold-surface thermocouple reaches 175° C (347° F), the assembly shall be maintained at 175° C \pm 5 (347° F \pm 9) for 120 min. \pm 10. The assembly shall then be cooled under vacuum to below 65° C (149° 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 \pm 5 (599° F \pm 9) in not less than 4 hr with a rate of rise not greater than 1 C (1.8 F) deg per minute. The assembly shall be held at 315° C \pm 5 (599° F \pm 9) for 120 min. \pm 10. The assembly shall then be cooled to below 65° C (149° F) under restraint before removal from the post-curing fixture.
- 3.3 Properties: The product shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified ASTM methods, insofar as practicable.
- 3.3.1 Density: Shall be 19.0 lb/ft³ \pm 1.5 (304 kg/m³ \pm 24), determined in accordance with ASTM C271.
- 3.3.2 Dielectric Constant: Shall be 3.1 \pm 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. (0.13 mm) in width, measured with a dimensionally-indexed magnifying glass or microscope.
- 3.4 Quality: The product shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from imperfections detrimental to fabrication, appearance, or performance of parts.

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 4.5. 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: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.
- 4.3 Sampling:
- 4.3.1 Sample Size: Each lot of tiles shall be sampled at random. The minimum test sample size shall be 0.7 in. (18 mm) thick x 8 in. (203 mm) square for each lot.
- 4.3.2 Lot: A lot shall be all tiles produced in a single production run from the same batch of raw materials under the same fixed conditions and submitted for inspection at one time.
- 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. 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 tiles which are essentially the same as those used on the approved sample tiles. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures which could affect quality or properties of the tiles, 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 tiles made by the revised procedure shall be shipped prior to receipt of approval of such procedure.
- 4.5 Reports:
- 4.5.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests made on the product to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, material specification number, vendor's material designation, lot number, date of manufacture, and quantity.
- 4.5.2 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.
- 4.6 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 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.