

AERONAUTICAL MATERIAL SPECIFICATION

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BARRIER MATERIAL, WATER VAPOR RESISTANT, FLEXIBLE, TRANSPARENT

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. MATERIAL: The material shall be a transparent, flexible, moisture resistant, sheet consisting of one or more plies.
3. APPLICATION: Primarily for envelopes or bags for enclosing aircraft engines, accessories, and spare parts when desiccated for shipment or storage.
4. TECHNICAL REQUIREMENTS:
 - 4.1 Water Vapor Transmission Rate: The water vapor transmission rate of the sheet shall not exceed 0.32 gram of water per 100 square inches per 24 hours, when determined in accordance with 5.1.
 - 4.2 Heat Sealability and Seal Strength: The material shall be capable of being heat sealed by commercially available sealing equipment to form a seal whose water vapor transmission rate is not greater than that specified in 4.1. The seal shall be capable of withstanding static load of not less than 2 pounds per inch length of seam, when tested in accordance with 5.2.
 - 4.3 Corrosion: There shall be no evidence of corrosion on steel and aluminum panels when tested in accordance with 5.3.
 - 4.4 Resistance to Blocking: The material shall not block at a temperature of 150 F + 2, when tested in accordance with 5.4.
 - 4.5 Impact Resistance: The impact resistance of the sheet shall be such that no rupture occurs at less than a 25-inch drop at 77 F + 5 and 5-inch drop at 0 F + 3, when tested in accordance with 5.5.
 - 4.6 Tear Strength: The tear strength of the sheet in each principal direction shall be not less than 55 grams, when determined in accordance with 5.6.
 - 4.7 Flammability: If ignited, the sheet shall burn out within an area not exceeding 5 square inches when tested in accordance with 5.7.
 - 4.8 Oil Resistance: After having been immersed in aircraft engine lubricating oil, Grade 1100 or 1120, for 24 hours at 150 F + 2, the material shall have a water vapor transmission rate not higher than that specified in 4.1. This exposure shall not appreciably lower the physical properties of the material.

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4.9 Transparency: The finished sheet (laminated if necessary to meet requirements specified herein) shall be of such transparency that ten-point type (letters 0.138-in. high) held at 18 inches and at any angle up to 60 degrees behind the film shall be clearly legible.

5. TEST PROCEDURES:

5.1 Water Vapor Transmission Rate:

5.1.1 Humidity Cabinet: The humidity cabinet for this test shall be the General Foods Water Vapor Transmission Cabinet or the equivalent. The cabinet shall provide a relative humidity of $90\% + 2$ at $100\text{ F} + 0.5$, with no condensation on the test dishes or in the space in which the dishes are placed. Circulation over the test dishes shall be negligible.

5.1.2 Test Dishes and Brass Template: The test dishes and brass template shall be made as shown in Figure 1, or be the equivalent.

5.1.3 Specimens As Received: Two representative samples of the film, each 6 in. square shall be selected. Four equidistant parallel folds shall be placed in each square by alternating the direction of folding on each successive fold so that the apex of each successive fold is facing an opposite side of the sheet, in accordion style. The folded square shall then be creased by placing it between two 6 x 10 in. flat, rigid plates and applying a total weight of 36 lb (6 lb per in. of length of fold) for one minute. The center of gravity of the weight shall be over the center of the sample. The squares shall be opened and the folding and creasing under weight repeated, making the second series of four folds perpendicular to the original folds. A circular specimen shall then be cut from the center of the creased square.

5.1.3.1 Heat Sealed Specimens: Four representative samples of the film, each 4 x 6 in. shall be selected. Two samples are then heat sealed along the 6 in. length in a fin type seal approximately 1 in. wide, made in accordance with good commercial practice and otherwise meeting the requirements of 4.2. Two such samples are prepared and allowed to rest, after formation of the seals for not less than 24 hours at room temperature, before testing. A circular specimen shall be cut from each sample so that the joint of the seal falls on a diameter of the specimen. These specimens are tested with the fin on the external surface of the test dish assembly.

5.1.3.2 Specimens After Oil Resistance Test: Two samples after treatment as directed in 4.5 shall be wiped clean of oil and a circular specimen cut from each.

5.1.4 Procedure:

5.1.4.1 A 50-ml beaker shall be filled with 8-mesh anhydrous calcium chloride (minimum 96% as CaCl_2) and then emptied into a thoroughly cleaned test dish. The calcium chloride shall be spread evenly over the bottom surface of the dish and the test specimens placed over the calcium chloride, concentric with the rim of the dish. The brass template (Figure 1) shall be carefully placed over the specimen, taking care to have the template centralized with respect to the dish top, before allowing it to come into contact with the specimen.

- 5.1.4.2 A wax mixture consisting of 60% amorphous wax and 40% paraffin wax shall be heated in a porcelain casserole to at least 212 F. It shall then be poured through a 20-mesh screen to remove any large pieces of foreign matter that may be in the wax.
- 5.1.4.3 The wax mixture shall be poured into the annular space between the template and the rim of the test dish, filling this space approximately flush with the top of the template. The dish shall then be cooled to harden the wax sufficiently so that the template can be removed. Care shall be taken not to cool the dish so long as to make the wax hard and brittle. The template shall be removed by inserting a screw driver under an ear of the template and giving a slight twist, tending to press the wax against the dish and at the same time raising the template. This shall be done on three ears of the template. Any difficulty experienced in extracting the template from the dish can be overcome by first rubbing the edge of the template with vaseline before pouring the wax.
- 5.1.4.4 After the template has been removed, the assembly shall be inspected for loose pieces of wax, etc., and examined for flaws in the seal. It shall then be conditioned in the humidity cabinet as follows, according to the construction of the material being tested, any surface coating 0.001 in. or more in thickness being considered a ply, but no laminate being considered a ply: material of one or two plies, 24 hours; material of three or more plies, 48 hours. Assemblies shall then be removed from the humidity cabinet, cooled to room temperature in a suitable desiccator containing anhydrous calcium chloride or its equivalent, and weighed on an analytical balance. The assembly shall then be replaced in the humidity cabinet for a period of 68 hours, removed, cooled as before and reweighed. The cycle of exposure in the humidity cabinet, cooling and weighing shall be repeated at intervals of 24 hours thereafter until two consecutive weighings indicate that a practically constant rate of moisture transmission has been attained.
- 5.1.4.5 The unit of moisture transmission shall be grams of moisture per 100 square inches of area per 24 hours, and shall be calculated as follows:

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$$\text{Transmission rate} = \frac{(W_2 - W_1) \times 2400}{T \times A}$$

Where:

- W₁ = weight (in grams) before exposure period
- W₂ = weight (in grams) after exposure period
- T = exposure period (in hours)
- A = area (in square inches) of opening

- 5.1.4.6 Test results on the three types of specimens shall be averaged separately. In case of a variance greater than 20% in either sealed, folded, or oil immersed specimens, a duplicate set of tests shall be run to determine whether this difference is due to an error in the procedure or to non-uniformity of sheet.
- 5.2 Seal Strength: Each specimen shall be prepared by heat sealing two 1-in. wide strips, with a lap of approximately 1 in., the seal being across the width of the specimen and in a plane perpendicular to the plane of the remainder of the specimen. Specimens shall be allowed to rest, after formation of the seals, for not less than 24 hours at room temperature before testing. Specimens shall be clamped in the jaws of testing apparatus, with seal midway between jaws and line of seal perpendicular to direction of load. Each seal shall withstand a load of 2 lb for one hour at $77\text{ F} + 5$, without separation of more than 1/4-in. occurring at seam line. Failure of any of six specimens to withstand such loading shall be cause for rejection of material.
- 5.3 Corrosion Test: Polished aluminum and low carbon steel panels each 1/16 x 2 x 4 in., shall be packaged individually using a closely fitting envelope fabricated of the barrier material. After insertion of the panels, the excess air shall be removed from each envelope and the envelopes closed by heat sealing. The resulting containers shall be placed horizontally in an oven on a flat surface to give maximum contact area between the material and the panel. After heating for 48 hours at $150\text{ F} + 2$, the panels shall be examined for corrosion and staining. Failure is defined as any corrosion or staining in excess of that which can be rubbed off with a clean cotton cloth.
- 5.4 Resistance to Blocking: Two 4 x 4-in. specimens of the material shall be placed face to face on a smooth, hard, flat surface. A 2 x 2-in. resilient pad of 1/8-in. cork board shall be centered on top of the specimens and a flat bottom 12-lb weight, having a 2 x 2-in. base, shall be placed on the pad. The assembly shall be placed in an oven maintained at $150\text{ F} + 2$. After 24 hours the weight shall be removed and the specimens allowed to cool for 4 hours at room temperature. Failure is defined as any visual evidence of mechanical damage to the surfaces after separation.
- 5.5 Impact Resistance: A specimen of the sheet shall be tautly and uniformly clamped in a horizontal position not less than 3 in. above the supporting plane by means of two concentric rings having well rounded edges, the inside diameter of the inner ring being not less than 3-in. A steel ball 1-in. in diameter and weighing approximately 67 grams shall be suspended above the specimen over the center of the inner ring at the specified height. The ball shall be dropped on the specimen and inspection made to determine if rupture has occurred. A fresh portion of the sheet shall be used for each drop regardless of the effect of the previous drop. The material shall successfully pass drops on each of three successive samples, or on four samples from a lot of five. This test shall be conducted at $77\text{ F} + 5$. The test conducted at $0\text{ F} + 3$ shall be made as directed above, except that the entire apparatus, including steel ball and dropping arrangement, shall be held at this temperature.
- 5.6 Tear Strength: Tear strength shall be determined at $77\text{ F} + 5$ in accordance with ASTM D689-44. Averages of values of six tests each in machine direction and cross direction shall be not less than the specified minimum.

5.7 Flammability: A specimen of sheet in the form of a circle having a 7-in. diameter, or square of equivalent area, shall be tautly fastened to a circular or square frame and supported in a horizontal position not less than 6-in. above the supporting plane, in a location free from draughts. Upon the center of the specimen shall be placed a piece of cotton weighing 0.5 gram, rolled into a ball approximately 1/2-in. in diameter, and wetted with 1-ml of ethyl alcohol delivered by a pipette. The alcohol-wetted ball shall be ignited immediately thereafter. When all fire is out, the area of the hole, in square inches, shall be determined in any convenient manner. The average burned-out area shall be determined from not less than six specimens.

6. QUALITY: Material shall be uniform in quality and condition, clean, and free from foreign materials and from defects detrimental to fabrication or to performance of parts.

7. REPORTS:

7.1 Unless otherwise specified, the vendor of material shall furnish with each shipment three copies of a notarized report stating that the material meets the requirements of this specification. The report shall include the purchase order number, material specification number, vendor's identification, size, quantity, and date of manufacture.

7.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a notarized report showing the purchase order number, material specification number, contractor or other direct supplier of material, 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 the specification, and shall include in the report a certification that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

8. PACKAGING: Unless otherwise specified, the material shall be supplied on rolls of the specified width. When specified as flat cut stock, it shall be wrapped completely in clean paper. All rolls and flat stock shall be packed in exterior container of suitable strength and rigidity to prevent damage to edges of the material.

9. IDENTIFICATION: The following marking shall appear on the top and on one end or side of each shipping container:

BARRIER MATERIAL, WATER VAPOR RESISTANT, FLEXIBLE, TRANSPARENT
 AMS 3610B
 HEAT SEALING TEMPERATURE RANGE _____
 WIDTH _____
 LENGTH (IF FLAT SHEETS ARE FURNISHED) _____
 GROSS WEIGHT _____
 PURCHASE ORDER NUMBER _____
 DATE OF MANUFACTURE _____
 MANUFACTURER'S IDENTIFICATION _____

10. APPROVAL: A vendor shall not supply material until samples have been approved by the purchaser. After such approval, materials and methods of manufacture shall not be changed without purchaser's permission. Results of tests on incoming shipments shall be essentially equal to those on the approved samples.