

AERONAUTICAL MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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PLASTIC FILM - TRANSPARENT, MOISTURE-VAPOR RESISTANT

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1. **ACKNOWLEDGMENT:** Vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. **MATERIAL:** This material shall be transparent, flexible moisture-resistant film. The finished plastic film may consist of two or more laminated sheets of the same material as necessary to meet the requirements specified herein. Its use is intended for envelopes or bags for enclosing aircraft engines, accessories and/or spare parts when dehydrated for shipment or storage.
3. **REQUIREMENTS:**
 - (a) **Moisture Vapor Transmission Rate.**- The moisture vapor transmission rate of the film shall not exceed .32 grams of water per 100 square inches per 24 hours when tested as directed in Paragraph 4(a).
 - (b) **Heat Sealability and Seal Strength.**- Material shall be capable of being heat sealed at 325-375°F (162.8-190.6°C) to form a seal as resistant to moisture vapor transmission as material having no seam. The seal shall be capable of withstanding static load of not less than 4 pounds per inch length of seam when tested in accordance with Paragraph 4(b). Separation shall occur only between the sealed surfaces.
 - (c) **Flammability.**- If ignited the film shall burn out within an area not exceeding 5 square inches when subjected to the test specified in Paragraph 4(c).
 - (d) **Hydrolysis.**- The material shall show no acid development in 24 hours when subjected to the hydrolysis test specified in Paragraph 4(h).
 - (e) **Shock Resistance.**- The shock resistance of the film shall be such that no rupture occurs at less than a 25-inch drop when tested as directed in Paragraph 4(d).
 - (f) **Resistance to Petroleum Derivatives.**- A sample of the film immersed in unleaded aviation gasoline for 24 hours shall not show a change greater than five per cent of its original weight when tested as directed in Paragraph 4(e).
 - (g) **Resistance to Blocking.**- The adhesion between two plies of film, when tested as directed in Paragraph 4(f) shall not be sufficient to adversely affect the Moisture Diffusion Rate and Shock Resistance of the material.
 - (h) **Transparency.**- The film (laminated if necessary to meet requirements specified herein) shall be of such transparency that ten-point type (letters 0.138 inches high) held at 18 inches and at any angle up to 60 degrees behind the film shall be clearly legible.
 - (i) **Tear Strength.**- The tear strength of the film in each principal direction shall be 55 grams minimum when tested as directed in Paragraph 4(g).

3. REQUIREMENTS: (cont'd)

(j) Construction.- The effectiveness of the film construction shall not be impaired by handling operations, such as converting, folding, creasing, laminating and heat sealing.

4. TEST PROCEDURES: (a) Moisture Vapor Transmission Rate.-

- (1) Humidity Cabinet.- The humidity cabinet for this test shall be the General Foods Moisture Vapor Transmission Cabinet or the equivalent. The cabinet shall provide a relative humidity of 90-95 per cent at a temperature of $100^{\circ}\text{F} \pm 0.5^{\circ}$ ($37.8^{\circ}\text{C} \pm 0.3^{\circ}$), 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.
- (2) Desiccator.- The desiccator shall be of such size as to permit 12 dishes to be racked vertically with a large dish of anhydrous calcium chloride on the top shelf. Sufficient space shall be provided between the shelves and sides to allow ample opportunity for air circulation.
- (3) Test Dishes and Brass Templates.- The test dish, preferably of glass, and brass template shall be made as shown in Figure I, or be the equivalent.
- (4) Procedure.- A representative sample of the film about 6 inches square shall be selected. Four equidistant parallel folds shall be placed in the 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 sample shall be creased by placing it between two 6 by 10-inch flat rigid plates and applying a total weight of 36 pounds (6 pounds per inch length of fold) for one minute on the sample. The center of gravity of the weight shall be over the center of the sample. The sample shall then be opened and the folding and creasing-under-weight process repeated making the second series of four folds perpendicular to the original folds. A circular sample shall then be cut from the center of the creased square.

A 50-ml beaker shall be filled with 8-mesh anhydrous calcium chloride (min. 96 per cent as CaCl_2) and then emptied into a test dish which has been cleaned with solvent to remove all traces of wax, dirt, etc. The calcium chloride shall be spread evenly over the bottom surface of the dish and the sample placed over the calcium chloride concentric with the rim of the dish. The brass template shall be carefully placed over the film, care being taken to have the template centralized with respect to the dish top before allowing it to come into contact with the material being tested.

A wax mixture consisting of 60-per cent amorphous wax and 40-per cent paraffin wax shall be heated in a porcelain crucible to at least 212°F (100°C). It shall then be poured through a 20-mesh screen to remove any large pieces of foreign matter that may be in the wax. The wax mixture shall be poured into the annular space between the template and the rim of the test dish, filling up this space to approximately flush with the top of the template. The dish shall then be placed in a refrigerator or maintained at a low temperature for about 5 minutes in order to harden the wax sufficiently so that the template can be removed. Care shall be taken to prevent the wax from becoming hard and brittle by exposure to a low temperature for too long a period. The template shall be removed by inserting a screw-driver under an ear of the

4. TEST PROCEDURES: (a) (cont'd)

(4) (cont'd)

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 the 3 ears of the template. Any difficulty experienced in removing the template from the dish can be overcome by first rubbing the edge of the template with vaseline before pouring the wax.

After the template has been removed, the dish and sample assembly shall be inspected for loose pieces of wax, etc., and examined for flaws in the seal. To prevent condensation the test dish and sample shall be placed in an oven at room temperature, the oven turned on and set at 100°F. When the oven is up to temperature, the test dish and samples shall then be placed in the humidity cabinet under the conditions specified in paragraph 4a(1) for a period of 16-24 hours. Afterwards it shall be dried in a desiccator for four hours and weighed on an analytical balance. The dish shall then be returned to the humidity cabinet for a period of 68 hours, dried in the desiccator for four hours, and reweighed.

The moisture vapor transmission rate shall be calculated as follows:

$$1.73 (B-A) = \text{grams of water/100 sq. in./24 hours}$$

where

A = Weight of dish before 68-hour humidity test

B = Weight of dish after 68-hour humidity test
and 4 hours in the desiccator

Two samples of each piece of film to be tested shall be used and the results from the two dishes then averaged for the final result. In case of a variance of more than 10 per cent a duplicate set of tests shall be run to determine whether this difference is due to an error in the procedure or to determine whether the film is of a non-uniform variety.

(b) Seal Strength.- Each specimen shall be prepared by heat sealing two 1 inch wide strips with a lap of approximately 1 inch, the seal being across width of specimen and in a plane perpendicular to the plane of remainder of specimen. Specimens shall be allowed to rest, after formation of heat seals, for not less than 24 hours at room temperature before being tested. 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, without separation of more than 1/4 inch occurring at seam line, a load of 4 pounds for one hour at 77°F ± 5° (25°C ± 2.8°). Failure of one or more of six specimens to withstand such loading shall be cause for rejection of material.

(c) Flammability.- A sample of film in the form of a circle having a 7-inch 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 inches above the supporting plane in a location free from draughts. Upon the center of the film shall be placed a piece of cotton weighing one-half gram, rolled into a ball approximately 1/2 inch in diameter, and wetted with one cubic centimeter of grain 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 samples.

4. TEST PROCEDURES: (cont'd)

(d) Shock Resistance.-

- (1) Preparation of Film Sample.- A film sample shall be tautly clamped in a horizontal position not less than 3 inches above the supporting plane by means of two concentric rings, with edges well rounded, the inside diameter of the inner ring being not less than 3 inches. A steel ball 1 inch in diameter and weighing approximately 67 grams shall be suspended above the film over the center of the inner ring at the specified height. The test shall be conducted at a temperature of $80^{\circ}\text{F} \pm 3^{\circ}$ ($26.7^{\circ}\text{C} \pm 1.7^{\circ}$).
- (2) Procedure: The ball shall be dropped on the film and inspection made to determine if rupture has occurred. A fresh portion of the film shall be used for each drop regardless of the effect of the previous drop. The film shall successfully pass drops on each of three successive samples or on four samples from a lot of five.

(e) Resistance to Petroleum Derivatives.- A sample sheet of film weighing approximately one gram shall be accurately weighed and immersed in unleaded aviation grade gasoline for a period of 24 hours. At the expiration of the specified time, the film shall be removed, dried and weighed immediately.

(f) Resistance to Blocking.- Two specimens of the material shall be placed on a smooth, hard, plane surface, and on top of these plies shall be placed a resilient pad pressed down with such a weight as to produce a pressure of three pounds per square inch. If a heat sealing medium is applied to one of the surfaces of the material, these heat sealable surfaces shall face each other during this test. This assembly shall be stored in an oven maintained at a constant temperature of $150^{\circ}\text{F} \pm 3^{\circ}$ ($65.6^{\circ}\text{C} \pm 1.7^{\circ}$), and shall be removed at the end of 24 hours and allowed to cool to room temperature. The weight and pad shall then be removed and an attempt made to separate the two plies. In case the two plies separate readily, no further test is necessary. If there is visual evidence of damage to the surface of either or both films, moisture vapor transmission rate and bursting strength tests shall be made on specimens subjected to blocking test.

(g) Tear Strength.- Tear strength shall be determined in accordance with ASTM D689-42T at $77^{\circ}\text{F} \pm 5^{\circ}$ ($25^{\circ}\text{C} \pm 2.8^{\circ}$). Average of values of 6 tests each in machine direction and cross direction shall be not less than the specified minimum.

(h) Hydrolysis Test.- A sample of the film shall be placed in a suitable glass tube. The tube containing the sample shall then be connected to a source of air having a relative humidity of 85-95 per cent, and an air-flow rate established sufficient to provide complete change of air within the tube 5-10 times per hour. The tube containing the sample shall be immersed in a constant-temperature bath maintained at $150^{\circ}\text{F} \pm 3^{\circ}$ ($65.6^{\circ}\text{C} \pm 1.7^{\circ}$). Outgoing air from the tube shall be passed through distilled water containing methyl-orange as an indicator. A color change of the indicator after 24 hours of test shows acid development.