



Standard Test Method for Air Wicking of Tire Fabrics, Tire Cord Fabrics, Tire Cord, and Yarns¹

This standard is issued under the fixed designation D 2692; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of longitudinal air permeability for tire fabrics, tire cord fabrics, tire cords, or yarns embedded in cured rubber compound. This test method is designed to demonstrate the effectiveness of fabric treatments intended to prevent air permeability. This test method is applicable to fabrics made from all types of fibers with all types of rubber compound.

1.2 This test method is written in SI units. The inch pound units which are provided are not necessarily exact equivalents of the SI units. Either system of units may be used in this test method.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* See the Note in 11.1.

2. Referenced Documents

2.1 ASTM Standards:

D 123 Terminology Relating to Textiles²

D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets³

3. Terminology

3.1 Definitions:

3.1.1 *air wicking, n*—in tires, the passage of air longitudinally along or through yarns in a fabric that has been encased and cured in rubber or other elastomer, that is, air permeability in the plane of the fabric.

3.1.2 *chafer fabric, n*—a woven fabric, usually coated with unvulcanized rubber, which is laid around the bead of a tire before vulcanization.

3.1.2.1 *Discussion*—Chafer fabric is used to reinforce the outer layer of rubber on the tire bead to provide an abrasion-

resistant surface in contact with the wheel rim. In the case of tubeless tires, the chafer fabric is usually made wickproof to prevent air leaking from the inflated tire.

3.1.3 *skein, n*—a continuous strand of yarn, wound on a hand or motorized reel.

3.1.4 *tire cord, n*—a twisted or formed structure composed of one or more single or plied filaments, strands, or yarns of organic polymer or inorganic material.

3.1.4.1 *Discussion*—The direction of twist used to combine the single or plied yarn elements into a cord structure is in a direction opposite to that used in the yarn.

3.1.5 *tire cord fabric, n*—a fabric consisting of tire cord warp with widely spaced (usually 1 to 5 picks/in. or 4 to 20 picks/dm) of single yarn filling.

3.1.6 *tire fabric, n*—a textile fabric, other than tire cord fabric, which is used as a reinforcement in tires.

3.1.7 *vulcanization, n*—an irreversible process, usually accomplished through the application of heat, during which a rubber compound through a change in its chemical structure (for example, cross-linking), becomes less plastic and more resistant to swelling by organic liquids while elastic properties are conferred, improved, or extended over a greater range of temperatures.

3.1.8 *yarn, n*—a generic term for a continuous strand of textile fibers, filaments, or material in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric.

3.1.9 For definitions of other textile terms used in this test method, refer to Terminology D 123.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *test panel, n*—in air wicking tests, the composite structure of a rubber compound and fabric which is used to test the fabric for air wicking.

3.2.2 *wickproof, adj*—in tire fabric, tire cord fabric, tire cord, or yarn, a term used to describe a fabric or yarn that shows no air wicking by this prescribed test.

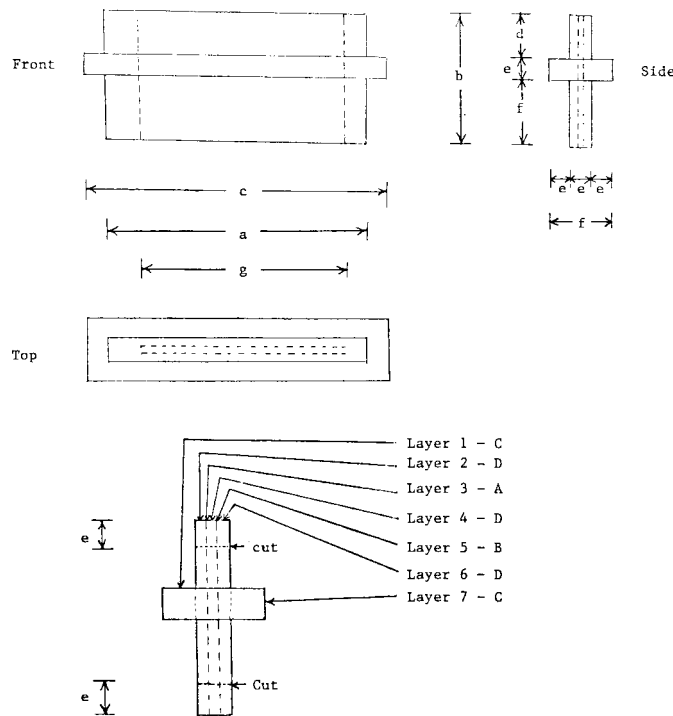
4. Summary of Test Method

4.1 Fabric specimens are embedded in a rubber compound and air pressure is applied to freshly exposed yarn ends. Detergent solution is applied to the opposite end of the yarns which have also been freshly exposed. Air wicking is indicated by continuous formation of air bubbles in the detergent solution due to air passing along the axis of a yarn.

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² *Annual Book of ASTM Standards*, Vol 07.01.

³ *Annual Book of ASTM Standards*, Vol 09.01.



DIMENSIONS

	a	b	c	d	e	f	g
Inches	3.0	1.5	3.5	0.5	0.25	0.75	2.25
Millimetres	76	38	89	12.6	6.4	19	57

NOTE 1—Lower case letters refer to dimensions. Capital letters refer to pieces prepared as outlined in 10.2.

FIG. 1 Test Panel

5. Significance and Use

5.1 This test method is considered satisfactory for the acceptance testing of commercial shipments of tire fabrics since this test method has been used extensively in the trade for acceptance testing. This test method is also considered satisfactory for quality control.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories may be compared using appropriate statistical analysis and an acceptable probability level chosen by the two parties before the testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration to the known bias.

5.2 This test method is applicable for testing the air permeability of any fabric that is embedded in a rubber compound, but is particularly useful when testing chafer fabrics to be used in a tubeless tire construction. In tubeless tires, chafer fabric

yarns that are not wick proof represent potential channels for air to pass through, and thus, this test method provides a prediction of chafer permeability.

5.3 Evaluation of air wicking in other fabric and cord components in such products as tires, rubber brake diaphragms, and pneumatic hoses, is useful.

6. Apparatus and Materials

6.1 *Test Panel Mold*—A fixed dimension mold designed to produce a test panel of dimensions and shape shown in Fig. 1.⁴

6.2 *Test Chamber*—An air chamber and test panel holder similar to the device shown in Fig. 2.⁴

6.3 *Rubber Compound*—The test compound in Table 1 shall be used as standard unless otherwise agreed upon between the purchaser and the supplier.

6.4 *Air Supply*—Compressed air, to be controlled at a test pressure agreed upon between the purchaser and the supplier. Commercially available compressed air or dry nitrogen gas is preferred since these products are clean and dry.

6.5 *Vulcanization Press*—For vulcanizing the test panel in the test panel mold. See Practice D 3182.

6.6 *Detergent Solution*—Mix 10 g of nonionic detergent with 100 g of tap water. An ethoxylated alkyl phenol, having 10

⁴ The Burlington Diffusion Tester and Test Piece Mold covered by U.S. Patent 3,034,336 has been found satisfactory. Blueprints for the fabrication of the tester and mold may be obtained from Manager of Process Technology, Highland Industries Inc., 215 Drummond Street, Kernersville, NC 27284.

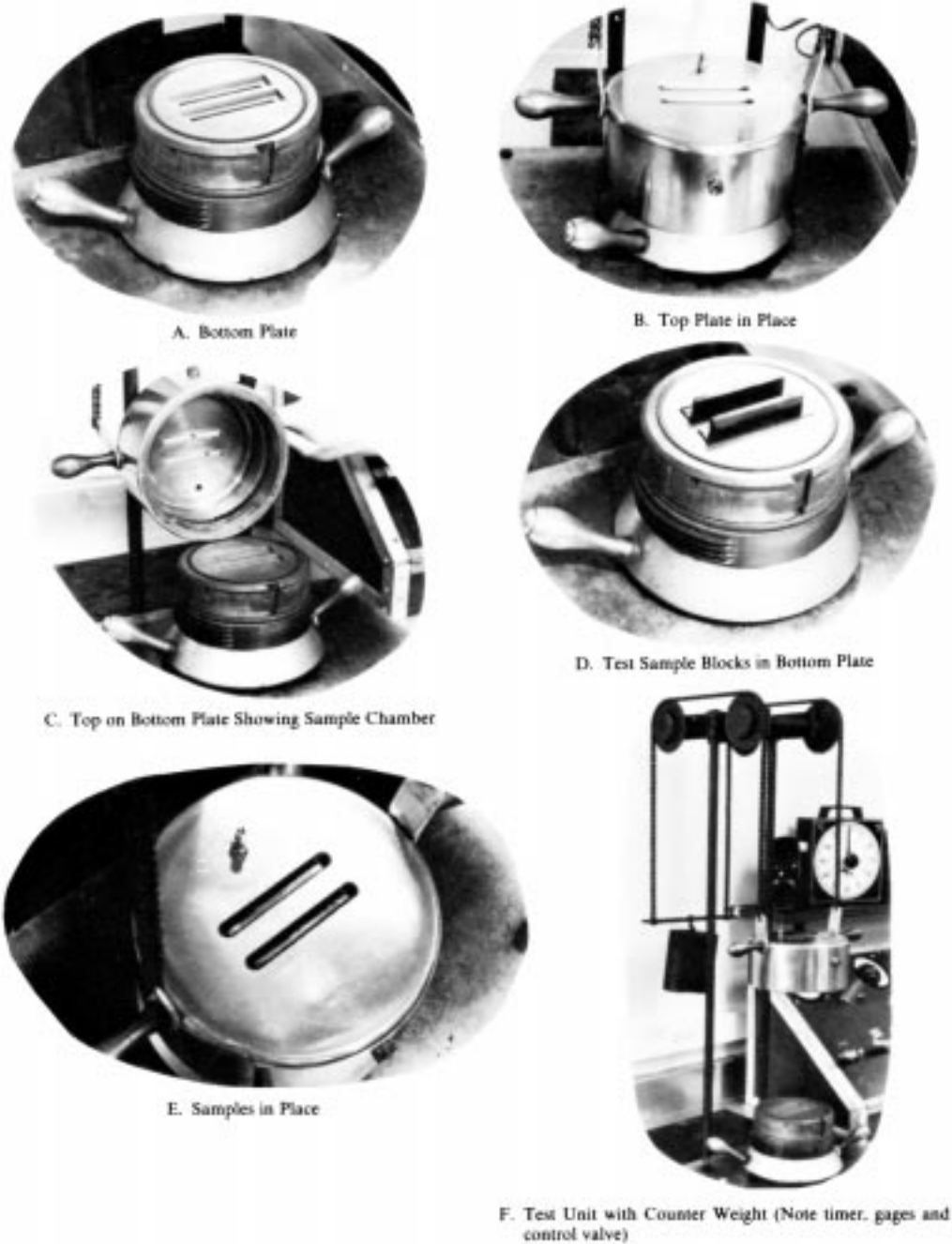


FIG. 2 Testing Chamber

to 30 mol of ethylene oxide, is the recommended nonionic detergent.⁵

7. Sampling Tire Fabric

7.1 *Lot Sample*—Tire fabrics are shipped in continuous lengths of several hundred metres each, and testing frequency

will be as agreed upon between the purchaser and the supplier. In the absence of an applicable material specification for sampling frequency, consider each roll to be a sampling unit for tire fabric.

7.2 *Laboratory Samples*—For acceptance testing, take from each roll a full-width swatch, 1 m (1 yd) long, after first discarding a minimum of 1 m of fabric from the very outside of the roll.

⁵ Common laundry detergent has been found satisfactory for this purpose.

TABLE 1 Recipe—Air Wicking Test Rubber Compound

Peptized SMR—20	60 parts by mass
SBR—1502	40
Zinc oxide	5
Stearic acid	2
6 PPD	1
Aromatic Hydrocarbon Resin	5
HA Oil	10
N-330 black	50
Precipitated silica	20
PEG	1
TBBS	1.25
TMTD	0.5
Sulfur	2
PVI	0.3

Cure: 30 ± 2 min at 145 ± 2°C (293 ± 40°F).

Compound to be stored in a cool dry area—refrigeration is preferred.

7.3 Test Specimen—Cut two fabric specimens from each laboratory sample, each being 38 by 57 mm (1.5 by 2.25 in.). Space the specimens from a laboratory sample along a diagonal line so that each specimen will contain different warp ends and filling picks. Cut one specimen with the warp ends parallel to the 38-mm side (A), and one specimen with the filling picks parallel to the 38-mm side (B). See Fig. 1.

7.3.1 When it is necessary to differentiate air wicking in the warp direction from air wicking in the filling direction, it is recommended that two specimens be cut in the warp direction, and two in the filling direction, and that a separate test panel be made for each fabric direction.

8. Sampling Tire Cord Fabric

8.1 Lot Samples—Tire cord fabrics are shipped in continuous lengths of several hundred metres each, and testing frequency will be as agreed upon between the purchaser and the supplier. In the absence of an applicable material specification for sampling frequency, consider each roll to be a sampling unit for tire fabric.

8.2 Laboratory Sample—For acceptance testing, take from each roll a full-width swatch, 1 m (1 yd) long, after first discarding a minimum of 1 m of fabric from the very outside of the roll. From the 1-m swatch, randomly remove three tire cords. Take the tire cords no nearer to the selvage than one tenth the width of the fabric.

8.3 Test Specimens—From the laboratory sample, cut six 500-mm (20-in.) lengths of tire cord. The six lengths of tire cord are one test specimen. Tire cord fabrics are tested in the warp direction only.

9. Sampling Tire Cords and Yarns

9.1 Lot Samples—Tire cords and yarns are shipped on spools in cases or on beams. Testing frequency will be as agreed upon between the purchaser and the supplier, or in the absence of an applicable material specification, consider each case or beam of tire cord or yarn to be a sampling unit.

9.2 Laboratory Samples:

9.2.1 Cases—For acceptance testing, take at random one spool from each case and take one 3-m (3-yd) sample, after first discarding a minimum of 10 m (10 yd) of tire cord or yarn

from the outside of the spool, plus any additional tire cord having a disturbed wind.

9.2.2 Beams—For acceptance testing, reel at random five skeins, 3 m (3 yd) long, from each beam.

9.3 Test Specimens:

9.3.1 Cases—From the laboratory sample, cut six 500-mm (20-in.) lengths of tire cord or yarn. The six lengths of tire cord or yarn are one test specimen. Tire cord and yarn are tested in the warp direction only.

9.3.2 Beams—From the laboratory sample, cut six 500-mm (20-in.) lengths from each of the five skeins. The six lengths of tire cord or yarn are one test specimen.

10. Preparation of Test Panels

10.1 Tire Fabric Test Panel Preparation—Embed the fabric specimens in a 38 by 76 by 6.4-mm (1.5 by 3.0 by 0.25-in.) cured rubber compound test panel which is bounded by a 6.4 by 6.4-mm (0.25 by 0.25-in.) flange, perpendicular to the 38-mm (1.5-in.) test panel dimension. The test panel is trimmed to expose yarn ends for testing. See Fig. 1.

10.1.1 Cut two pieces of rubber compound (C) 6.4 by 6.4 by 89 mm (0.25 by 0.25 by 3.5 in.).

10.1.2 Cut three sheets of rubber compound (D) 2.3 by 76 by 38 mm (0.09 by 3 by 1.5 in.). Preassemble the test panel in the following order (refer to letter designation in Fig. 1): D, A, D, B, D. Locate fabric specimens (A) and (B) to ensure the fabric is centered in the 38 by 76-mm (1.5 by 3.0-in.) test panel plane. Roll the composite with a stitching wheel or other comparable device to minimize entrapped air.

10.1.3 The mass of the test panel, including flange strips, must exceed 35 g (1.23 oz). If a rubber compound other than that given in Table 1 is used, the density of the rubber compound may differ, and the minimum mass of the test panel will also differ. If necessary, additional rubber compound can be applied to the flange strip to obtain the required mass.

10.2 Tire Cord or Yarn Test Panel Preparation (Including Cords from Tire Cord Fabrics or Yarns):

10.2.1 From one to three tire cord or yarn specimens can be placed in one test panel. If more than one specimen is placed in a test panel, then mark the specimen locations on the outside of the test panel. Place each specimen in location (A) only of the test panel, so that the yarn ends protrude equally from both sides of the test panel. Fill location (B) with a 2.3 by 76 by 38-mm (0.09 by 3 by 1.5-in.) sheet of rubber compound.

10.2.2 The mass of the test panel, including flange strips, must exceed 35 g (1.23 oz). If a rubber compound other than that given in Table 1 is used, the density of the rubber compound may differ, and the minimum mass of the test panel will also differ. If necessary, additional rubber compound can be applied to the flange strip to obtain the required mass.

10.3 Test Panel Vulcanization:

10.3.1 Preheat a cold mold and vulcanizing press to the temperature specified for the rubber compound in use.

10.3.2 Insert the two 6.4 by 6.4 by 89-mm (0.25 by 0.25 by 3.5-in.) flange strips (C) in the corresponding slots in the preheated mold. Insert the test panel into the mold and press it to the bottom of the cavity.

10.3.3 Insert the mold between press platens and adjust the pressure to at least 3.45 MPa (500 psi) with reference to the top

surface of the mold. Leave the mold in the press under pressure for 30 min or the vulcanizing time specified for the rubber compound in use. Withdraw the mold and remove test panels from the mold. Allow the test panels to cool to room temperature by exposure to air or immersion in water before proceeding to the next step.

10.4 *Post Vulcanization Setup*—Using a sharp knife or die, cut 6.4 mm (0.25 in.) from each 76-mm (3.0-in.) edge of the test panel to expose yarn ends. See Fig. 1. The test panel must be tested within 6 h of the time the yarns are exposed. If more than 6 h elapse before the panel is tested, expose fresh yarn ends by trimming away an additional 1-mm strip from the 76-mm edge.

11. Procedure

11.1 Place the test panel between the plates of the test chamber and secure the two plates. Apply detergent solution to the exposed yarn ends. Apply air pressure as specified in the purchase agreement. Maintain air pressure as specified and observe yarn ends to detect air bubbles, which indicate air passage through the test specimen. The duration of time covering the test will be agreed upon between the purchaser and the supplier and may be selected from the following:

- 11.1.1 A. Two minutes at 0.7 MPa (100 psig), + 5 %, – 0 %

- 11.1.2 B. Two minutes at 1.4 MPa (200 psig), + 5 %, – 0 %

- 11.1.3 C. One minute at 2.1 MPa (300 psig), + 5 %, – 0 %

- 11.1.4 D. One minute at 2.8 MPa (400 psig), + 5 %, – 0 %

NOTE 1—**Precaution:** Test panels should only be tested in apparatus that has safety shields to protect the operator.

12. Report

12.1 State that the tests were made as directed in Test Method D 2692. Describe the materials or products sampled and the method of sampling used.

12.2 Report the following information:

12.2.1 Air pressure used and duration of testing, and

12.2.2 Whether or not air wicking was noted in the testing.

12.2.3 If a rubber compound other than that given in Table 1 is used, this will be reported.

13. Precision and Bias

13.1 No information is presented about either the precision or the bias of this test method since the test result is nonquantitative.

14. Keywords

- 14.1 air wicking; chafer fabrics; tire fabrics

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