



Designation: D 737 – 96

Standard Test Method for Air Permeability of Textile Fabrics¹

This standard is issued under the fixed designation D 737; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method covers the measurement of the air permeability of textile fabrics.

1.2 This test method applies to most fabrics including woven fabrics, nonwoven fabrics, air bag fabrics, blankets, napped fabrics, knitted fabrics, layered fabrics, and pile fabrics. The fabrics may be untreated, heavily sized, coated, resin-treated, or otherwise treated.

1.3 The values stated in SI units are to be regarded as the standard. The values stated in inch-pound units may be approximate.

1.4 *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.*

2. Referenced Documents

2.1 ASTM Standards:

D 123 Terminology Relating to Textiles²

D 1776 Practice for Conditioning Textiles for Testing²

D 2904 Practice for Interlaboratory Testing of a Textile Test Method That Produces Normally Distributed Data²

D 2906 Practice for Statements on Precision and Bias for Textiles²

F 778 Methods for Gas Flow Resistance Testing of Filtration Media³

2.2 ASTM Adjuncts:

TEX-PAC⁴

NOTE 1—TEX-PAC is a group of programs on floppy disks available through ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

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

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ A PC program on floppy disk for Analyzing Committee D-13 interlaboratory data are available from ASTM Headquarters. For a 3½-in. disk, request PCN:12-429040-18. For a 5¼-in. disk, request PCN:12-429041-18.

3. Terminology

3.1 *Definitions*—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 *air permeability, n*—the rate of air flow passing perpendicularly through a known area under a prescribed air pressure differential between the two surfaces of a material.

3.2.1.1 *Discussion*—Air permeability of fabric at a stated pressure differential between two surfaces of the fabric is generally expressed in SI units as $\text{cm}^3/\text{s}/\text{cm}^2$ and in inch-pound units as $\text{ft}^3/\text{min}/\text{ft}^2$ calculated at operating conditions.

3.2.2 *cross-machine direction, CD, n*—the direction in the plane of the fabric perpendicular to the direction of manufacture.

3.2.2.1 *Discussion*—This term is used to refer to the direction analogous to coursewise or filling direction in knitted or woven fabrics, respectively.

3.2.3 *fabric, in textiles, n*—a planar structure consisting of yarns or fibers.

3.2.4 *machine direction, MD, n*—the direction in the plane of the fabric parallel to the direction of manufacture.

3.2.4.1 *Discussion*—This term is used to refer to the direction analogous to warpwise or warp direction in knitted or woven fabrics, respectively.

4. Summary of Test Method

4.1 The rate of air flow passing perpendicularly through a known area of fabric is adjusted to obtain a prescribed air pressure differential between the two fabric surfaces. From this rate of air flow, the air permeability of the fabric is determined.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments since current estimates of between-laboratory precision are acceptable, and this test method is used extensively in the trade for acceptance testing.

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. Test specimens then should be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using the appropriate statistical analysis and an acceptable probability level chosen by the two parties before 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 of the known bias.

5.2 Air permeability is an important factor in the performance of such textile materials as gas filters, fabrics for air bags, clothing, mosquito netting, parachutes, sails, tentage, and vacuum cleaners. In filtration, for example, efficiency is directly related to air permeability. Air permeability also can be used to provide an indication of the breathability of weather-resistant and rainproof fabrics, or of coated fabrics in general, and to detect changes during the manufacturing process.

5.3 Performance specifications, both industrial and military, have been prepared on the basis of air permeability and are used in the purchase of fabrics where permeability is of interest.

5.4 Construction factors and finishing techniques can have an appreciable effect upon air permeability by causing a change in the length of airflow paths through a fabric. Hot calendaring can be used to flatten fabric components, thus reducing air permeability. Fabrics with different surface textures on either side can have a different air permeability depending upon the direction of air flow.

5.4.1 For woven fabric, yarn twist also is important. As twist increases, the circularity and density of the yarn increases, thus reducing the yarn diameter and the cover factor and increasing the air permeability. Yarn crimp and weave influence the shape and area of the interstices between yarns and may permit yarns to extend easily. Such yarn extension would open up the fabric, increase the free area, and increase the air permeability.

5.4.2 Increasing yarn twist also may allow the more circular, high-density yarns to be packed closely together in a tightly woven structure with reduced air permeability. For example, a worsted gabardine fabric may have lower air permeability than a woolen hopsacking fabric.

6. Apparatus

6.1 *Air Permeability Testing Apparatus*⁵ consisting of the following:

6.1.1 *Test Head* that provides a circular test area of 38.3 cm² (5.93 in.²) ± 0.3 %.

NOTE 2—Alternate test areas may be used, such as 5 cm² (0.75 in.²), 6.45 cm² (1.0 in.²), and 100 cm² (15.5 in.²).

6.1.2 *Clamping System to Secure Test Specimens*, of different thicknesses under a force of at least 50 ± 5 N (11 ± 1 lbf) to the test head without distortion and minimal edge leakage underneath the test specimen.

6.1.2.1 A suitable means to minimize edge leakage is to use a 55 Type A durometer hardness polychloroprene (neoprene)

clamping ring 20 mm (0.75 in.) wide and 3 mm (0.125 in.) thick around the test area above and underneath the test specimen.

NOTE 3—Since air leakage may affect test results, precautions must be taken, especially with very heavy or lofty fabrics, to prevent leakage. The use of a weighted ring and rubber gaskets on the clamp surfaces has been found to be helpful. Test Method F 778 describes a series of usable clamping adaptations to eliminate edge leakage. Gaskets should be used with caution because in some cases, and with repeated-use gaskets may deform resulting in a small change in test area. A weighted ring can be used with fabrics, such as knits or those that readily conform to the test head. The weighted ring is not recommended for lofty or stiff fabric.

6.1.3 Means for drawing a steady flow of air perpendicularly through the test area and for adjusting the airflow rate that preferably provides pressure differentials of between 100 and 2500 Pa (10 and 250 mm or 0.4 and 10 in. of water) between the two surfaces of the fabric being tested. At a minimum, the test apparatus must provide a pressure drop of 125 Pa (12.7 mm or 0.5 in. of water) across the specimen.

6.1.4 *Pressure Gage or Manometer*, connected to the test head underneath the test specimen to measure the pressure drop across the test specimen in pascals (millimetres or inches) of water with an accuracy of ± 2 %.

6.1.5 *Flowmeter*, volumetric counter or measuring aperture to measure air velocity through the test area in cm³/s/cm² (ft³/min/ft²) with an accuracy of ± 2 %.

6.1.6 *Calibration Plate*, or other means, with a known air permeability at the prescribed test pressure differential to verify the apparatus.

6.1.7 Means of calculating and displaying the required results, such as scales, digital display, and computer-driven systems.

6.2 *Cutting Dies or Templates*, to cut specimens having dimensions at least equal to the area of the clamping surfaces of the test apparatus (optional).

7. Sampling and Test Specimens

7.1 *Lot Sample*—As a lot sample for acceptance testing, randomly select the number of rolls or pieces of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider the rolls or pieces of fabric to be the primary sampling units. In the absence of such an agreement, take the number of fabric rolls or pieces specified in Table 1.

NOTE 4—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls or pieces of fabric and between specimens from a swatch from a roll or piece of fabric to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

TABLE 1 Number of Rolls or Pieces of Fabric in the Lot Sample

Number of Rolls or Pieces in Lot, Inclusive	Number of Rolls or Pieces in Lot Sample
1 to 3	all
4 to 24	4
25 to 50	5
over 50	10 % to a maximum of 10 rolls or pieces

⁵ Suitable apparatus is commercially available.