



Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting¹

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1. Scope

1.1 This test method covers the estimation of the steady-state rate of transmission of a gas through plastics in the form of film, sheeting, laminates, and plastic-coated papers or fabrics. This test method provides for the determination of (1) gas transmission rate (GTR), (2) permeance, and, in the case of homogeneous materials, (3) permeability.

1.2 Two procedures are provided:

1.2.1 *Procedure M*—Manometric.

1.2.2 *Procedure V*—Volumetric.

1.3 The values stated in SI units are to be regarded as the standard.

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:*²

D 618 Practice for Conditioning Plastics for Testing

D 1898 Practice for Sampling of Plastics

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *gas transmission rate, GTR*—the quantity of a given gas passing through a unit of the parallel surfaces of a plastic film in unit time under the conditions of test. The SI unit of GTR is 1 mol/(m²·s). The test conditions, including temperature and partial pressure of the gas on both sides of the film, must be stated. Other factors, such as relative humidity and hydrostatic pressure, that influence the transport of the gas must also be stated. The inch-pound unit of GTR, a commonly

used unit of GTR, is 1 mL (STP)/(m²·d) at a pressure differential of one atmosphere.

3.1.2 *permeance, P*—the ratio of the gas transmission rate to the difference in partial pressure of the gas on the two sides of the film. The SI unit of permeance is 1 mol/(m²·s·Pa). The test conditions (see 5.1) must be stated.

3.1.3 *permeability, P*—the product of the permeance and the thickness of a film. The permeability is meaningful only for homogeneous materials, in which it is a property characteristic of the bulk material. This quantity should not be used unless the constancy of the permeability has been verified using several different thicknesses of the material. The SI unit of *P* is 1 mol/(m·s·Pa). The test conditions (see 3.1) must be stated.

NOTE 1—One millilitre (STP) is 44.62 μmol, one atmosphere is 0.1013 MPa, and one day is 86.4 × 10³ s. GTR in SI units is obtained by multiplying the value in inch-pound units by 5.160 × 10⁻¹⁰. Additional units and conversions are shown in Appendix X1.

3.1.4 *steady state*—the state attained when the amount of gas absorbed in the film is in equilibrium with the flux of gas through the film. For Method V this is obtained when the GTR is constant.

4. Summary of Test Method

4.1 The sample is mounted in a gas transmission cell so as to form a sealed semibarrier between two chambers. One chamber contains the test gas at a specific high pressure, and the other chamber, at a lower pressure, receives the permeating gas. Either of the following procedures is used:

4.1.1 *Procedure M*—In Procedure M the lower pressure chamber is initially evacuated and the transmission of the gas through the test specimen is indicated by an increase in pressure.

4.1.2 *Procedure V*—In Procedure V the lower pressure chamber is maintained near atmospheric pressure and the transmission of the gas through the test specimen is indicated by a change in volume.

5. Significance and Use

5.1 These measurements give semiquantitative estimates for the gas transmission of single pure gases through film and sheeting. Correlation of measured values with any given use, such as packaged contents protection, must be determined by

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.