



Standard Test Method for Film Permeability Determination Using Static Permeability Cells¹

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1. Scope

1.1 This test method covers the measurement of the transmission of a gas through plastic membranes, sheeting, films, and fabric materials using a static sealed diffusion chamber. The test method monitors gas diffusion across a film membrane and provides measurements of (1) gas concentrations on each side of the film membrane and (2) estimates of the mass transfer coefficient (MTC) for the tested gas and film material. The MTC represents the film permeability and is independent of the concentration gradient used during testing, which simplifies some aspects of the experimental design.

1.2 This test method permits the loading of mixed vapors and simultaneous determination of the permeability of one film to various gases.

1.3 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this 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

D618 Practice for Conditioning Plastics for Testing

D1898 Practice for Sampling of Plastics (Withdrawn 1998)³

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

¹ This test method is under the jurisdiction of ASTM Committee E35 on Pesticides, Antimicrobials, and Alternative Control Agents and is the direct responsibility of Subcommittee E35.22 on Pesticide Formulations and Delivery Systems.

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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.

³ The last approved version of this historical standard is referenced on www.astm.org.

3. Terminology

3.1 *Definitions*:

3.1.1 *concentration, C, n*—chemical mass divided by the chamber volume.

3.1.1.1 *Discussion*— C_o is the initial ($t = 0$) concentration in the source chamber. The SI unit of concentration is $\mu\text{g}/\text{cm}^3$.

3.1.2 *concentration gradient, n*—difference in the concentration of gases across the film membrane divided by the transport distance between the source and collection chambers (for example, usually considered to be the film thickness).

3.1.2.1 *Discussion*—The SI unit of the concentration gradient is $\mu\text{g}/\text{cm}^3\text{-cm}$.

3.1.3 *mass transfer coefficient, MTC, n*—gas diffusion rate constant that relates the mass transfer rate, distance, and concentration gradient as the driving force through a film membrane under the test conditions.

3.1.3.1 *Discussion*—The SI unit of the MTC is cm/hour . The MTC expresses the ease of transmission of a gas through a membrane under test conditions. The test conditions shall be stated, which include the ambient temperature, relative humidity, film conditioning, sampling, and handling.

3.1.4 *mass transfer rate, J, n*—mass transfer rate, or flux density, of a gas diffusing through a film membrane is the mass of gas passing through a unit area (for example, 1 cm^2) of film membrane per unit time interval (for example, 1 h). The SI unit of J is $\mu\text{g}/\text{cm}^2\text{ hour}$.

4. Summary of Test Method

4.1 This test method uses a static sealed apparatus consisting of two chambers separated by the test-film membrane. The test chemical in the vapor phase is added to the chamber on one side of the film and the apparatus is incubated at constant temperature during which the chemical diffuses through the test membrane. This test method requires determination of the relative chemical concentrations on both sides of the membrane at several time points during the incubation. Concentrations are monitored until equilibrium is reached or some other practical stoppage time. For permeable films, more frequent sampling is necessary because equilibrium may be reached within minutes or hours. For films with very low permeability, longer incubation times (weeks) may be necessary to reach