Designation: D3985 – 05 (Reapproved 2010)$^{\varepsilon 1}$

# Standard Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using a Coulometric Sensor[1]

This standard is issued under the fixed designation D3985; 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.

$\varepsilon^1$ NOTE—Editorial changes were made throughout in November 2010.

## 1. Scope

1.1 This test method covers a procedure for determination of the steady-state rate of transmission of oxygen gas through plastics in the form of film, sheeting, laminates, coextrusions, or plastic-coated papers or fabrics. It provides for the determination of (*1*) oxygen gas transmission rate (OTR), (*2*) the permeance of the film to oxygen gas ($PO_2$), and (*3*) oxygen permeability coefficient ($P'O_2$) in the case of homogeneous materials.

1.2 This test method does not purport to be the only method for measurement of OTR. There may be other methods of OTR determination that use other oxygen sensors and procedures.

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

1.4 *This standard does not purport to address all of the safety problems, 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]

D1434 Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting

D1898 Practice for Sampling of Plastics (Withdrawn 1998)[3]

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

F1927 Test Method for Determination of Oxygen Gas Transmission Rate, Permeability and Permeance at Controlled Relative Humidity Through Barrier Materials Using a Coulometric Detector

## 3. Terminology

3.1 *Definitions:*

3.1.1 *oxygen permeability coefficient* ($P'O_2$)—the product of the permeance and the thickness of film. The permeability is meaningful only for homogeneous materials, in which case it is a property characteristic of the bulk material. This quantity should not be used, unless the relationship between thickness and permeance has been verified on tests using several different thicknesses of the material. The SI unit of oxygen permeability is the mol/(m·s·Pa). The test conditions (see 3.1.3) must be stated.

3.1.2 *oxygen permeance* ($PO_2$)—the ratio of the OTR to the difference between the partial pressure of $O_2$ on the two sides of the film. The SI unit of permeance is the mol/($m^2$·s·Pa). The test conditions (see 5.1) must be stated.

3.1.3 *oxygen transmission rate* (OTR)—the quantity of oxygen gas passing through a unit area of the parallel surfaces of a plastic film per unit time under the conditions of test. The SI unit of transmission rate is the mol/($m^2$·s). The test conditions, including temperature and oxygen partial pressure on both sides of the film must be stated.

3.1.3.1 A commonly used unit of OTR is the $cm^3$ (STP)/($m^2$·d) at one atmosphere pressure difference where 1 $cm^3$ (STP) is 44.62 µmol, 1 atm is 0.1013 MPa, and one day is $86.4 \times 10^3$s. The OTR in SI units is obtained by multiplying the value in inch-pound units by $5.160 \times 10^{-10}$.

## 4. Summary of Test Method

4.1 The oxygen gas transmission rate is determined after the sample has equilibrated in a dry test environment. In this context, a "dry" environment is considered to be one in which the relative humidity is less than 1 %.

4.2 The specimen is mounted as a sealed semi-barrier between two chambers at ambient atmospheric pressure. One chamber is slowly purged by a stream of nitrogen and the other chamber contains oxygen. As oxygen gas permeates through

[1] This test method is under the jurisdiction of ASTM Committee F02 on Flexible Barrier Packaging and is the direct responsibility of Subcommittee F02.10 on Permeation.

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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.

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