



Standard Test Method for Oxygen Gas Transmission Rate through Plastic Film and Sheeting using a Dynamic Accumulation Method¹

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1. Scope

1.1 This test method covers a procedure for determination of the transmission rate of oxygen gas through plastics in the form of film, sheeting, laminates, coextrusions, coated or uncoated papers or fabrics.

1.2 This test method is not the only method for measurement of the oxygen transmission rate (OTR). There are 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. Commonly used metric units used to report Oxygen Transmission Rate are included in Terminology, Procedure, Precision and Bias sections and in the Calculation section of the Appendix.

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

D3985 Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using a Coulometric Sensor

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

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

F2622 Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using Various Sensors

F2714 Test Method for Oxygen Headspace Analysis of

Packages Using Fluorescent Decay

3. Terminology

3.1 Definitions:

3.1.1 *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/(m²·s). The test conditions including temperature, relative humidity and oxygen partial pressure on both sides of the film must be stated in the report.

3.1.1.1 *Discussion*—A commonly used unit of OTR is the cm³ (STP)/(m²·day) at one atmosphere pressure difference where 1 cm³ (STP) is 44.62 μ mol, 1 atmosphere 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 commonly used units by 5.160 $\times 10^{-10}$.

4. Summary of Test Method

4.1 The specimen is mounted as a sealed semi-barrier between two chambers, which together make up the permeation apparatus. The sensing well which contains the oxygen sensor is slowly purged by a stream of pure nitrogen or other oxygen deficient gas mixture until the oxygen concentration represents that of the purge gas. A commercial grade of compressed nitrogen containing less than 0.05% oxygen is recommended. A gas of known oxygen concentration, typically air or pure oxygen, is directed into the opposite chamber, the driving well. Oxygen concentration in the sensing well containing the oxygen sensor is measured periodically and the accumulating oxygen concentration recorded. The Oxygen Transmission Rate (OTR) parameter is determined from the slope of the logarithm of accumulated oxygen concentration in the sensing well versus time as described in 14.2.

5. Significance and Use

5.1 The Oxygen Transmission Rate is an important determinant of packaging functionality afforded by packaging materials for a wide variety of packaged products including food, pharmaceuticals and medical devices. In some applications, sufficient oxygen must be allowed to permeate into the package. In others, the oxygen ingress must be minimized to maintain product quality.

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.