



Standard Test Method for Oxygen Transmission Rate Through Dry Packages Using a Coulometric Sensor¹

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1. Scope

1.1 This test method covers a procedure for the determination of the steady-state rate of transmission of oxygen gas into packages. More specifically, the method is applicable to packages that in normal use will enclose a dry environment.

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

1.3 *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

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

D1898 Practice for Sampling of Plastics (Withdrawn 1998)³

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

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *oxygen gas transmission rate (O_2 GTR)—as applied to a package*, is the quantity of oxygen gas passing through the surface of the package (PKG) per unit of time.

3.1.1.1 *Discussion*—The SI unit of transmission rate is the

mol/s. The test conditions, including temperature, oxygen partial pressure and humidity on both sides of the package, must be stated. A commonly used unit of O_2 GTR is the $\text{cm}^3(\text{STP})/(\text{PKG}\cdot\text{d})$, where 1 cm^3 at Standard Temperature and Pressure (STP = 273.15K; $1.013 \times 10^5\text{ Pa}$) is $44.62 \times 10^{-6}\text{ mol}$ and one day is 86 400 s.

3.1.2 *oxygen permeability coefficient ($P'O_2$)*—the product of the permeance and thickness of the barrier.

3.1.2.1 *Discussion*—The permeability is meaningful only for homogenous 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 in tests using several thicknesses of the material. The SI unit of permeability is the $\text{mol}/(\text{m}\cdot\text{s}\cdot\text{Pa})$. The test conditions must be stated.

3.1.3 *oxygen permeance (PO_2)*—the ratio of the O_2 GTR to the difference between the partial pressure of O_2 on the two sides of the package wall.

3.1.3.1 *Discussion*—The SI unit of permeance is the $\text{mol}/(\text{s}\cdot\text{Pa})$. The test conditions (see 4.2) must be stated.

4. Summary of Test Method

4.1 This test method employs a coulometric oxygen sensor and associated equipment in an arrangement similar to that described in Test Method D3985. Oxygen gas transmission rate (O_2 GTR) is determined after the package has been mounted on a test fixture and has equilibrated in the test environment.

4.2 The package is mounted in such a way as to provide that the inside of the package is slowly purged by a stream of nitrogen while the outside of the package is exposed to a known concentration of oxygen. The package may be exposed in ambient room air which contains 20.8 % oxygen, or immersed in an atmosphere of 100 % oxygen. As oxygen permeates through the package walls into the nitrogen carrier gas, it is transported to the coulometric detector where it produces an electrical current, the magnitude of which is proportional to the amount of oxygen flowing into the detector per unit of time.

5. Significance and Use

5.1 Oxygen gas transmission rate is an important determinant of the protection afforded by barrier materials. It is not, however, the sole determinant, and additional tests, based on

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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.