



Designation: D 1653 – 93 (Reapproved 1999)^{€1}

Standard Test Methods for Water Vapor Transmission of Organic Coating Films¹

This standard is issued under the fixed designation D 1653; 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.

This standard has been approved for use by agencies of the Department of Defense.

^{€1} NOTE—Editorially changes made throughout in December 1999.

1. Scope

1.1 These test methods cover the determination of the rate at which water vapor passes through films of paint, varnish, lacquer, and other organic coatings. The films may be free films or they may be applied to porous substrates.

1.2 Two test methods are covered as follows:

1.2.1 *Test Method A*—Dry Cup Method, and

1.2.2 *Test Method B*—Wet Cup Method.

1.2.3 Agreement should not be expected between results obtained by different methods or test conditions. The method that most closely approaches the conditions of use should be selected.

1.3 The values stated in inch-pound units are to be designated as the standard. Factors for conversion are stated in 13.2.1.2 and 13.2.2.2.

1.4 *This standard does not purport to address 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:*

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels²

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers²

D 1193 Specification for Reagent Water³

D 4708 Practice for Preparation of Free Films of Organic Coatings²

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions⁴

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

¹ These test methods are under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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² *Annual Book of ASTM Standards*, Vol 06.01.

³ *Annual Book of ASTM Standards*, Vol 11.01.

⁴ *Annual Book of ASTM Standards*, Vol 11.03.

3.1.1 *water vapor transmission rate, WVT*—the steady water vapor flow in unit time through unit area of a body, between two specific parallel surfaces, under specific conditions of temperature and humidity at each surface. Accepted inch-pound unit is grains per square foot per hour. Accepted SI unit is grams per square metre per 24 h.

3.1.2 *water vapor permeance, WVP*—the steady water vapor flow in unit time through unit area of a body (WVT) induced by unit vapor pressure difference (Δp) between the two surfaces of a coating. Therefore, $WVP = WVT/\Delta p$. Accepted inch-pound unit is grains per square foot per hour per inch of mercury (called a perm). Accepted SI unit is grams per square metre per 24 h per millimetre of mercury (called a metric perm).

4. Summary of Test Methods

4.1 In Test Method A (Dry Cup Method), the test specimen is sealed to the open mouth of a cup or dish containing desiccant, and the assembly placed in a test chamber with a controlled atmosphere. Two sets of exposure conditions are acceptable for this test method.

4.1.1 *Condition A*, consisting of 50 % relative humidity at 73°F (23°C), and

4.1.2 *Condition B*, consisting of 90 % relative humidity at 100°F (38°C).

4.2 In Test Method B (Wet Cup Method), the test specimen is sealed to the open mouth of a cup or dish containing water, and the assembly placed in a test chamber with a controlled atmosphere. Two sets of exposure conditions are acceptable for this test method:

4.2.1 *Condition A*, consisting of 50 % relative humidity at 73°F (23°C), and

4.2.2 *Condition C*, consisting of very low (near zero) relative humidity at 73°F (23°C).

4.3 In both methods, periodic weighings of the cup or dish are made to determine the rate of water vapor movement through the specimen.

5. Significance and Use

5.1 One of the factors affecting the performance provided by an organic coating is its capability of resisting or aiding the passage of water vapor. In some services, for example, exterior