Designation: D 6490 – 99

Standard Test Method for Water Vapor Transmission of NonFilm Forming Treatments Used on Cementitious Panels[1]

This standard is issued under the fixed designation D 6490; 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.

1. Scope

1.1 This test method covers the determination of the rate at which water vapor passes through non film forming treatments, such as silanes, siloxanes and blends of silanes/siloxanes applied to cementitious substrates.

1.2 This test method covers the use of the wet cup technique, which most closely approaches the exterior conditions for use for these materials. Other conditions can be used if agreed upon between purchaser and supplier. Agreement should not be expected between results obtained by different methods or test conditions.

1.3 The values stated in SI units of measurement are designated as the standard. Factors for conversion to inch-pound units are given in 9.2.1.1 and 9.2.2.1.

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:*

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[2]

D 1193 Specification for Reagent Water[3]

D 1734 Practice for Making Cementitious Panels for Testing Coatings[4]

D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials[2]

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions[5]

3. Summary of Test Method

3.1 The treated cementitious substrate is sealed to the open mouth of an assembly containing water with the treated side facing the water, and the assembly placed in a test chamber with a controlled atmosphere maintained at 50 ± 5 % relative humidity at 23 ± 2°C (73.5 ± 3.5°F). Periodic weighings of the assembly are made to determine the rate of water vapor movement through the specimen.

4. Significance and Use

4.1 One of the factors affecting the performance provided by a cementitious treatment is how readily water vapor passes through it. Hence, the water vapor transmission characteristics of treatments are important in assessing their performance in practical use.

4.2 The purpose of this test method is to obtain values of water vapor transfer through treatments that range in permeability from high to low. These values are for use in design, manufacture, and marketing.

4.3 Water vapor transmission is not a linear function of film thickness, temperature or relative humidity.

4.4 Values of water vapor transmission rate (*WVT*) and water vapor permeance (*WVP*) can be used in the relative rating of treatments only if the treatments are tested under the same closely controlled conditions of temperature and relative humidity.

5. Apparatus

5.1 *Assembly*, consisting of a container, typically with an opening of approximately 75 mm (3 in.) by 150 mm (6 in.). The depth of the dish is such that there is a 20 ± 5 mm (0.8 ± 0.2 in.) distance between the water surface and the surface of the under surface of the test specimen, with a water depth of at least 5 mm (0.2 in.). The assembly should be made of a noncorroding material, impermeable to water or water vapor in order to be found acceptable. The treated cementitious substrate can be sealed with wax or sealant to the assembly. If the assembly is made of aluminum, it must be anodized or given a protective clear coating to prevent corrosion.

5.2 *Test Chamber*, with a controlled temperature and relative humidity as specified in Section 3. Air shall be circulated throughout the chamber to maintain uniform conditions at all test locations.

NOTE 1—For maintaining constant relative humidities other than those specified in 3.1, by means of aqueous solutions, refer to procedures outlined in Practice E 104.

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[1] These test methods are under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials and Applications, and is the direct responsibility of Subcommittee D01.47 on Masonry Treatments.

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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 06.02.

[5] *Annual Book of ASTM Standards*, Vol 11.03.

5.3 *Analytical Balance*, having an adequate capacity for the weight of the test assemblies and a sensitivity of 10 mg (0.0002 lb).

6. Reagents and Materials

6.1 *Purity of Water*, unless otherwise indicated, reference to water shall be understood to mean reagent water conforming to Type IV of Specification D 1193.

6.2 *Sealant*, such as wax for attaching the coated panel to the top of the test assembly. It must be highly resistant to the passage of water vapor. It must not lose weight to, nor gain weight from the atmosphere in an amount, over the required period of time, that would affect the test results by more than 2 %. It must not affect the vapor pressure in a water-filled assembly.

NOTE 2—Among acceptable sealants are (*1*) a 60:40 mixture of microcrystalline wax and refined crystalline parafin wax, (*2*) tissue embedding wax, and (*3*) a 50:50 mixture of beeswax and rosin.

7. Test Specimen

7.1 Suggested cementitious substrates to be used should be 75 by 150 by 15 mm (3 by 6 by 9⁄16 in.) as outlined in Practice D 1734. Before use, the substrates should be removed from storage in water, dried at 80 ± 5°C (176 ± 9°F) until a constant weight has been reached. A constant weight shall be assumed when the specimen weighed to the nearest 0.1 g loses not more than 0.1 % in any 4-h period. Allow specimens to cool and store at standard conditions as outlined in Specification D 3924 before use.

7.2 Apply treatment to one face of the test substrates using one of the methods described in Practices D 823 or by brush following manufacturer's application instructions. The amount of material (spreading rate) applied to the substrate must then be calculated and reported.

7.3 Air-dry the treated substrate in a horizontal position for 7 days in a room preferably maintained at 23± 2°C (73.5 ± 3.5°F) and 50 ± 5 % relative humidity as outlined in Specification D 3924. The drying schedule may be modified as recommended by manufacturer.

8. Procedure

8.1 Prepare at least three test assemblies for each test material as follows:

8.1.1 Fill the assembly with water to within 20 ± 5 mm (0.8 ± 0.2 in.) of the treated substrate.

8.1.2 Seal the treated substrate to the top edge of the assembly with wax or sealant with the treated face placed facing the water.

8.2 Weigh the test assemblies to 0.1 g. and place them in the test chamber. Record time, temperature, and relative humidity. Unless other conditions are agreed upon between the purchaser and the seller, perform the test(s) in a chamber maintained at 23 ± 2°C (73 ± 3.5°F) and 50 ± 5 % relative humidity.

8.2.1 In general, the test assemblies should be weighed every 24 h for a period of time until the weight change per 24 h has become consistent. The time that weighings are taken should be recorded to the precision of approximately 1 % of the time span between weighings. Thus, if weighings are made every day, a time to the nearest 15 min would be allowed.

8.2.2 Treatments expected to have high WVT ratings, over 6.7 metric perms (10 perms), may require weighings more frequently than once a day.

8.3 Return the test assemblies to the test chamber immediately after weighings.

9. Calculation

9.1 For each material tested, plot the weight changes against elapsed time. When a straight line adequately fits the plot of at least four properly spaced points, a nominal steady state exists and the slope of the straight line is the rate of water vapor transmission.

9.2 Calculate one or more of the following, depending of the water vapor transmission characteristics to be determined:

9.2.1 Calculate the water vapor transmission rate, *WVT:*

9.2.1.1 In inch-pound units as follows:

$$WVT = (G/t)/A = \text{grains per square foot per 1 h} \quad (1)$$

where:

G = weight change, grains (from the straight line),
t = time during which G occurred, h,
A = test area, square foot, and
1 g = 15.43 grains.

9.2.1.2 In metric units as follows:

$$WVT = (G/t)/A = \text{grams per square metre per 24 h} \quad (2)$$

where:

G = weight change, grams (from the straight line),
t = time during which G occurred, h, and
A = test area, square metre.

9.2.2 Calculate the permeance, *WVP:*

9.2.2.1 In inch-pound units as follows:

$$WVP = WVT/\text{p} = \text{grains per ft}^2 \text{ per 1 h per inch of mercury (perms)} \quad (3)$$

where:

p = S ($R_1 - R_2$),
S = inches of mercury (saturation vapor pressure at test temperature) see Table 1,
R_1 = relative humidity at vapor source, and
R_2 = relative humidity at vapor sink.

9.2.2.2 In metric units as follows:

$$WVP = WVT/p = \text{grams per square metre per 24 h per millimetre of mercury, (metric perms)} \quad (4)$$

where:

p = S ($R_1 - R_2$),
S = millimetres of mercury (saturation vapor pressure at test temperature) see Table 1,
R_1 = relative humidity at vapor source, and
R_2 = relative humidity at vapor sink.

10. Report

10.1 Report the following information:

10.1.1 Method of application and curing procedure used.

10.1.2 Spreading rate applied or mean film thickness of the test specimens for each material.

10.1.3 Substrate, if different than specified in Specification D 1734.

TABLE 1 Saturation Vapor Pressure

Temperature		Pressure	
°F	°C	in. Hg	mm Hg
72.3	22.4	0.800	20.316
72.5	22.5	0.805	20.440
72.7	22.6	0.810	20.565
72.9	22.7	0.816	20.690
73.1	22.8	0.819	20.815
73.3	22.9	0.824	20.941
73.4	23.0	0.829	21.068
73.6	23.1	0.834	21.196
73.8	23.2	0.840	21.324
74.0	23.3	0.845	21.453
74.2	23.4	0.850	21.583
74.4	23.5	0.855	21.714
74.5	23.6	0.860	21.845
99.3	37.4	1.894	48.102
99.5	37.5	1.904	48.364
99.7	37.6	1.914	48.627
99.9	37.7	1.925	48.891
100.1	37.8	1.935	49.157
100.2	37.9	1.946	49.424
100.4	38.0	1.956	49.692
100.6	38.1	1.967	49.961
100.8	38.2	1.978	50.231
101.0	38.3	1.988	50.502
101.1	38.4	1.999	50.774
101.3	38.5	2.010	51.048
101.5	38.6	2.021	51.323

10.1.4 Test temperature and relative humidity in the test chamber.

10.1.5 Computed rate of water vapor transmission (*WVT*), either in inch-pound or in metric units.

10.1.6 The computed permeance in terms of both perms and metric units.

11. Precision and Bias

11.1 Precision is being developed in Subcommittee D01.47.

11.2 Bias is not applicable to this test method.

12. Keywords

12.1 permeability; permeance; perms; water vapor permeance; water vapor transmission