Standard Test Method for
Porosity of Paint Film[1]

1. Scope

1.1 This test method is applicable to air-dry architectural coatings of any type, both solvent and water-borne, and of any color, dark as well as light. It cannot be used with films that are dissolved or excessively softened by mineral oil, but practical examples of such films will be encountered rarely, if ever.

1.2 *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 1475 Test Method for the Density of Liquid Coatings, Inks, and Related Products[2]
D 2369 Test Method for Volatile Content of Coatings[2]
D 3258 Test Method for Porosity of Paint Films[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *porosity, n*—presence of numerous minute voids in a cured material; that is, the fraction of air by volume in the dry film.

4. Summary of Test Method

4.1 The test paint is applied to a preweighed nonporous panel, air dried, then reweighed to obtain the weight of the film.

4.2 Mineral oil is applied to the surface of the paint film, allowed to absorb for a fixed period of time, and the excess removed in a specified manner. The test panel is then reweighed to determine the amount of mineral oil absorbed.

4.3 Porosity is calculated from the weight ratio of absorbed oil to dry paint film and from previously determined values of non-volatile and density for the whole paint.

5. Significance and Use

5.1 The porosity of a paint film is closely related to the important practical characteristics of stain resistance, abrasion resistance, durability, and the hold-out of any paint subsequently applied.

5.2 This test provides a precise means for evaluating and comparing the quality of paint films, insofar as it pertains to porosity as determined on a coating applied to a nonporous substrate. Porosity measured using this test method may *not* be an accurate predictor of coating porosity when the coating is applied to substrate of higher absorption characteristics.

5.3 Unlike current Test Method D 3258 Porosity of Paint Films, which is effective only with light colored paints, this test method is equally effective with paints of any color, both dark and light. Also unlike Test Method D 3258, its results are not influenced by the hiding characteristics of the paint film.

6. Apparatus and Materials

6.1 *Bird Type Film Applicator*, 150-mm wide with a clearance of 150 μm.

6.2 *Bird Type Film Applicator*, 150-mm wide with a clearance of 100 μm.

6.3 *Vacuum Drawdown Plate.*

6.4 *Test Panel.*[4]

6.5 *Mineral Oil*, specific gravity 0.8200 to 0.8350; viscosity 6.5 to 7.8 cSt at 40°C.

6.6 *Absorbent Wipers.*

7. Procedure

7.1 Weigh each test panel to the nearest milligram. Record as W_p.

7.2 Place the test panel on the vacuum plate and apply the paint under test with the 150-μm clearance drawdown blade. Remove the test panel from the vacuum plate and air dry as 48 h under standard conditions of 73 ± 3.5°F (23 ± 2°C) and 50 ± 5 % relative humidity.

7.3 Weigh the coated test panel to the nearest milligram. Record this weight as W_{p+f}.

7.4 Place the coated test panel on the vacuum plate and apply the mineral oil with the 100-μm clearance drawdown blade making sure the entire surface of the coating is covered by the oil.

7.5 After 3 min, wipe off excess mineral oil with the absorbent wipers. Hold the test panel at an angle to a light source to ascertain from its sheen if all mineral oil is removed from the test panel. Repeat wiping, if necessary, until the film has no sheen. Failure to remove this excess will produce erroneous results. Results are invalid if paint film is removed during this process.

7.6 Weigh the test panel from 7.5 to the nearest milligram and record as W_o.

7.7 Determine the density D of the paint in g/mL and the density d of the saturant in g/mL, in accordance with Test Method D 1475.

7.8 Determine the nonvolatile by weight N of the paint, in accordance with Test Method D 2369.

8. Calculation

8.1 *Weight of Applied Paint Film*:

8.1.1 Calculate the weight of the applied paint film as follows:

$$W_f = W_{p+f} - W_p \quad (1)$$

where:
W_f = paint film, g,
W_{p+f} = test panel and paint film, g, and
W_p = test panel, g.

8.2 *Weight of Mineral Oil Absorbed*:

8.2.1 Calculate the weight of the mineral oil m absorbed by the paint film as follows:

$$W_m = W_o - W_{p+f} \quad (2)$$

where:
W_m = mineral oil absorbed by the paint film, g,
W_o = oiled test paint, g, and
W_{p+f} = test panel and paint film, g.

8.3 *Weight Ratio of absorbed Oil to Dry Paint Film*:

8.3.1 Calculate the ratio of absorbed oil to dry paint film R as follows:

$$R = W_m / W_f \quad (3)$$

where:
R = weight ratio of absorbed oil to dry paint film,
W_m = mineral oil absorbed by the paint film, g, and
W_f = paint film, g.

8.4 *Porosity*:

8.4.1 Calculate porosity P as follows:

$$P = \frac{CRND}{CRND + d(C + ND - D)} \times 100 \quad (4)$$

where:
C = constant of:
1.00 for water-based systems, and
0.78 for solvent-based systems.

NOTE 1—the constant C is to adjust the calculation for the difference in density of the solvent (water in water-based systems and a generic solvent in solvent-based systems).

P = porosity of paint film, expressed as a percentage,
R = ratio by weight of absorbed oil to dry paint film,
N = nonvolatile by weight of the whole paint,
D = density of the whole paint, g/mL, and
d = density of the saturant, g/mL.

9. Report

9.1 Report the porosity of the paint film as determined in 8.4.1 to 1 decimal place.

10. Precision and Bias

10.1 *Precision*—The precision of this test method for measuring porosity is being determined.

10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure in this test method for measuring porosity, no statement on bias is being made.

11. Keywords

11.1 film porosity; porosity; resistance–penetration (into paint films)