Designation: ~~D4585 – 07~~ D4585/D4585M – 13

Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation[1]

This standard is issued under the fixed designation ~~D4585;~~D4585/D4585M; 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 practice covers basic principles and operating procedures for testing water resistance of coatings using controlled condensation. Condensation is produced by exposing one surface of a coated specimen to a heated, saturated mixture of air and water vapor, while the reverse side of the specimen is exposed to the cooling effect of room temperature air. This practice is derived from research of the Cleveland Society for Coatings Technology.[2]

1.2 This practice is limited to the methods of obtaining, measuring, and controlling conditions and procedures of controlled condensation tests. It does not specify specimen preparation, specific test conditions, or evaluation of results.

NOTE 1—Alternative practices for testing water resistance of coatings include Practices D870, D1735, and D2247.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as ~~the~~ standard. The values ~~given in parentheses are for information only.~~stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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:*[3]

D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
D714 Test Method for Evaluating Degree of Blistering of Paints
D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
D870 Practice for Testing Water Resistance of Coatings Using Water Immersion
D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
D1735 Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
D2247 Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
D2616 Test Method for Evaluation of Visual Color Difference With a Gray Scale
D3359 Test Methods for Measuring Adhesion by Tape Test
D3363 Test Method for Film Hardness by Pencil Test
D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.27 on Accelerated Testing.

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[2] Foecking, N. J., "Cleveland Condensing Type Humidity Cabinet," *Official Digest*, December 1963, Vol 35, No. 467, pp. 1318–1327; and Higgins, W. A., "Cleveland Condensing Type Humidity Cabinet: II," *Official Digest*, November 1965, Vol 37, No. 490, pp. 1392–1404.

[3] 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.

***A Summary of Changes section appears at the end of this standard**

3. Summary of Practice

3.1 Water vapor is generated by heating a pan of water at the bottom of the test chamber. The specimens form the roof or walls of the test chamber so that the back sides of the specimens are exposed to the cooling effects of room temperature air. The resulting heat transfer causes vapor to condense on the test specimens as liquid water saturated with air.

3.2 The temperature and amount of condensate forming on the specimens is controlled by the test temperature and the room temperature. The test specimens are inclined so that condensate runs off the test surface by gravity and is replaced by fresh condensate in a continuous process during the condensate cycle.

3.3 Exposure conditions are varied by selecting: (*a*) the temperature of the test, (*b*) the duration of the test, and (*c*) periodic drying of the specimens. Testing may be conducted at temperatures from 38 to 82°C ~~(100~~[100 to ~~180°F).~~180°F]. Any effects such as color change, blistering, loss of adhesion, softening, or embrittlement are observed and reported.

4. Significance and Use

4.1 Water can cause degradation of coatings, so knowledge of how a coating resists water is helpful in predicting its service life. Failure in a condensation test may be caused by a number of factors including a deficiency in the coating itself, contamination of the substrate, or inadequate surface preparation. The test is therefore useful for evaluating coatings alone or complete coating systems.

4.2 Condensation tests of coatings are used for specification acceptance, quality control, and research and development of coatings and substrate treatments. These tests usually result in a pass or fail determination but the degree of failure also may be measured. A coating system is considered to pass if there is no evidence of water-related failure after a specified period of time.

4.3 Results obtained from the use of condensation tests in accordance with this practice should not be represented as being equivalent to a period of exposure to water in the natural environment, until the degree of quantitative correlation has been established for the coating or coating system.

4.4 The test is usually conducted on metal, plastics, or wood specimens with the coating facing the inside of the chamber. However, it is possible to test the blister resistance of house paints on wood specimens by mounting the uncoated wood surface facing the inside of the chamber.

4.5 This practice can be used for corrosion tests particularly if the specimens are periodically dried. While corrosion products will drain into the water bath, they are not carried into the vapor that condenses on the test specimens.

5. Apparatus

5.1 *Test Chamber* (see Fig. 1 and Fig. 2), consisting of insulated side walls mounted on a base, test specimen racks attached to the side walls, a heated water pan, and provisions for controlling and indicating the vapor temperature within the chamber. Vents, approximately 3 to 5 mm ~~(0.10~~[0.10 to 0.20 ~~in.)~~in.] wide, shall be provided to admit room air at the bottom of the test chamber. Locate the chamber away from air vents and direct drafts.

NOTE 2—The apparatus described in Practice G154 may be used if the ultraviolet lamps specified in Practice G154 are turned off.

5.2 Specimens shall form the roof of the test chamber. If the specimens cannot completely fill all the openings, blank panels shall be used. Certain substrates may deform from the heat and moisture. The specimens ~~should~~shall be mounted to ~~avoid~~eliminate gaps between specimens that allow heat and moisture to escape. Various types of tape can be used to seal the gaps that develop when the specimen deforms. Specimens shall be inclined from 15 to 75° from the horizontal and arranged so that condensate is returned to the water pan without dripping on other specimens.

5.3 *Water Supply,* with water level control. ~~The water quality should be agreed upon between the customer and the supplier for running this test.~~

5.4 *Water Heater,* preferably located under the water pan, controlled by a thermostat with the sensing element located in the water.

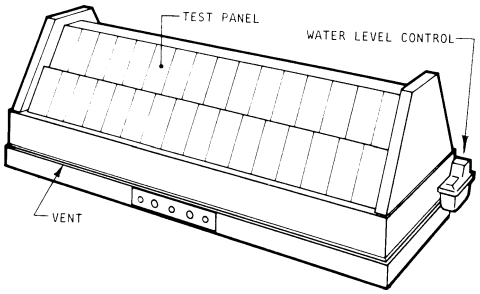

FIG. 1 Controlled Condensation Apparatus