



Designation: D1735 – 21

# Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus<sup>1</sup>

This standard is issued under the fixed designation D1735; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

## 1. Scope\*

1.1 This practice covers the basic principles and operating procedures for testing water resistance of coatings in an apparatus similar to that used for salt spray testing.

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

NOTE 1—Alternative practices for testing the water resistance of coatings include Practices D870, D2247, and D4585.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[B117 Practice for Operating Salt Spray \(Fog\) Apparatus](#)

[D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and](#)

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 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, Coatings and Related Products on Test Panels](#)

[D870 Practice for Testing Water Resistance of Coatings Using Water Immersion](#)

[D1193 Specification for Reagent Water](#)

[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](#)

[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 Rating 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](#)

[D4585 Practice for Testing Water Resistance of Coatings Using Controlled Condensation](#)

## 3. Summary of Practice

3.1 Coated specimens are placed in an enclosed chamber to permit free settling of fog on all specimens. The temperature of the chamber is usually maintained at 38 °C (100 °F). The exposure condition is varied by selecting the duration of the test. Water permeates the coating at rates that are dependent upon the characteristics of the coating. Any effects such as color change, blisters, loss of adhesion, softening, or embrittlement are observed and reported.

## 4. Significance and Use

4.1 Water can cause the degradation of coatings, so knowledge of how a coating resists water is helpful in predicting its service life. Failure in water fog tests may be caused by a number of factors, including a deficiency in the coating itself,

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

contamination of the substrate, or inadequate surface preparation. The test is therefore useful for evaluating coatings alone or complete coating systems.

4.2 Water fog tests are used for research and development of coatings and substrate treatments, specification acceptance, and quality control in manufacturing. These tests usually result in a pass or fail determination, but the degree of failure may also 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 water fog 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 apparatus is similar to that used in Practice B117, and the conversion of the apparatus from salt spray to water fog testing is feasible. Care should be taken to remove all traces of the salt from the cabinet and reservoir when converting from salt spray to water fog testing.

## 5. Apparatus

5.1 *Descriptions for the Test Chamber, Test Specimen Supports, and Fog Collecting Devices*, are listed under Apparatus Section in Practice B117.

5.2 Unless otherwise specified, provide for continuous recording, such as a chart recorder or data logger, of the temperature within the chamber during the exposure period.

## 6. Test Specimens

6.1 This practice does not cover the preparation of test specimens. The substrate composition and surface preparation, specimen preparation, and the number of specimens should be agreed upon prior to testing.

NOTE 2—Applicable methods for the preparation of test panels and substrates are given in Practices D609 and D1730. Practices D823 cover application techniques of the production of uniform films.

6.2 It's recommended that a control specimen of a paint with known durability be included with each test. Such control specimens can provide warning of changes in test severity in a given apparatus, and can indicate variations in test severity between different apparatuses.

6.3 It's recommended that at least two replicate specimens of each different coating be used, so as to compensate for variations between specimens and variations in test conditions within the apparatus.

## 7. Procedure

7.1 Fill the reservoir with reagent water conforming to Type IV or better of Specification D1193.

7.2 Heat the water to the desired temperature with the circulating system in operation. If no temperature is specified, heat the water to  $38 \pm 2$  °C ( $100 \pm 4$  °F). Maintain the temperature throughout the test.

7.3 The specimens shall be supported or suspended with the surface of interest at an angle to permit unencumbered expo-

sure to the fog. Flat test specimens shall be exposed between 15° and 30° angle (unless otherwise specified by contractual parties) and spaced so that water from one specimen does not drip on other specimens. The orientation (angle) of the flat test specimens in the cabinet should be consistent and documented. Slotted wood or plastic supports are suitable for flat specimens. Test specimens other than flat specimens shall be spaced and placed at an angle to permit unencumbered exposure to the fog and to prevent water from dripping from one specimen onto another. The angle and orientation of the test specimen shall be documented.

NOTE 3—SAE Technical Paper SP-1770-(2003-01-1236)<sup>3</sup> concluded if the surface of the specimen is not shielded and the fog settles uniformly across the test surface, there does not appear to be a significant difference in performance based on the spacing between test specimens.

7.4 To collect fog for measurement, place two collectors within the chamber near the test specimens. Use a glass or plastic funnel with a diameter of approximately 100 mm with the stem of the funnel extending into the collection container. Locate one container within 10 cm of the fog nozzle and the other as far as possible from the nozzle. Place the collectors so that they collect only the fog from the nozzle. Collection rates are to be measured every 24 h except on weekends and holidays. Record the collection rate in mL/h. Refer to customer specification for acceptable collection rates.

7.4.1 Use at least four collectors for cabinets that have more than one fogging nozzle. Position a collector 10 cm from each nozzle. Place the other collectors at positions as far as possible from each nozzle.

7.4.2 It is recommended to map the collection rates within the exposure zone of the cabinet once a year. Place collectors throughout the exposure zone to evaluate variations within the cabinet. Areas that are out of compliance should be taped off and specimens not tested there. Refer to manufacturer's recommendations to correct the problem.

NOTE 4—Collection rate mapping of a chamber throughout the exposure zone to ensure conformance to the collection rate requirements is recommended as a means of reducing test variability.

NOTE 5—Larger cabinets that have more than one fogging nozzle, may need more than two collectors to obtain adequate collection information. Refer to manufacturers' recommendations and customers' requirements for specific requirements.

7.5 To control for variability within the apparatus, reposition the specimens on a regular basis so that all specimens spend equivalent amounts of time in the various areas of the apparatus (front, back, left, right, and center).

7.6 Adjust the atomizing air supply so that 1.0 to 3.0 mL of water/h is collected in a collector with a diameter of 100 mm based on an average run of at least 16 h. Collection rates outside the 1 mL/h to 3 mL/h range must be agreed upon between the customer and the supplier before starting the test and the alternate collection rate used must be stated in the test report.

NOTE 6—The fog rate specified in Practice B117 is only 1.0 to 2.0 mL/h

<sup>3</sup> Giles, T., Lerminez, M., and Smith, S., "Examination of the Effects of Test Piece Spacing in ASTM B117-97 Neutral Salt Spray and General Motors 9540P," SAE Technical Paper 2003-01-1236, 2003.