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Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)[1]

This standard is issued under the fixed designation D5894; 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 practice for cyclic corrosion/UV exposure of paints on metal, using alternating periods of exposure in two different cabinets: a cycling salt fog/dry cabinet, and a fluorescent UV/condensation cabinet.

1.2 This practice is limited to the methods of obtaining, measuring, and controlling exposure conditions, and procedures. It does not specify specimen preparation nor evaluation of results.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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:*[2]

D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
D714 Test Method for Evaluating Degree of Blistering of Paints
D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D4587 Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
G85 Practice for Modified Salt Spray (Fog) Testing
G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests
G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
G152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Terminology

3.1 *Definitions*—The definitions given in Terminology G113 are applicable to this practice.

4. Summary of Practice

4.1 The test specimens are exposed to alternating periods of one week in a fluorescent UV/condensation chamber and one week in a cyclic salt fog/dry chamber. The fluorescent UV/condensation cycle is 4-h UV at 0.89 W/(m^2· nm) at 340 nm at 60°C and 4-h condensation at 50°C, using UVA-340 lamps. The fog/dry chamber runs a cycle of 1-h fog at ambient temperature and 1-h dry-off at 35°C. The fog electrolyte is a relatively dilute solution, with 0.05 % sodium chloride and 0.35 % ammonium sulfate.

NOTE 1—The irradiance target setpoint of 0.89 is based upon actual irradiance levels that have been historically widely used for coatings.

5. Significance and Use

5.1 The outdoor corrosion of painted metals is influenced by many factors, including: corrosive atmospheres, rain, condensed dew, UV light, wet/dry cycling, and temperature cycling. These factors frequently have a synergistic effect on one another. This

[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] 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.**

practice is intended to provide a more realistic simulation of the interaction of these factors than is found in traditional tests with continuous exposure to a static set of corrosive conditions.

5.2 Results obtained from this practice can be used to compare the relative durability of materials subjected to the specific test cycle used.

5.3 No single exposure test can be specified as a complete simulation of actual use conditions in outdoor environments. Results obtained from exposures conducted according to this practice can be considered as representative of actual outdoor exposures only when the degree of rank correlation has been established for the specific materials being tested. The relative durability of materials in actual outdoor service can be very different in different locations because of differences in UV radiation, time of wetness, temperature, pollutants, and other factors. Therefore, even if results from a specific artificial test condition are found to be useful for comparing the relative durability of materials exposed in a particular exterior environment, it cannot be assumed that they will be useful for determining relative durability for a different environment.

5.4 Even though it is very tempting, it is not recommended to calculate an "acceleration factor" relating *x*hours of laboratory exposure to *y* months of exterior exposure. Different materials and different formulations of the same material can have significantly different acceleration factors. The acceleration factor also varies depending on the variability in rate of degradation in the laboratory test and in actual outdoor exposure.

5.5 This practice is best used to compare the relative performance of materials tested at the same time in the same exposure device. Because of possible variability between the same type of exposure devices, it is not recommended to compare the amount of degradation in materials exposed for the same duration at separate times, or in separate devices running the same test condition. This practice should not be used to establish a "pass/fail" approval of materials after a specific period of exposure unless performance comparisons are made relative to a control material exposed simultaneously, or the variability in the test is rigorously quantified so that statistically significant pass/fail judgments can be made.

5.6 This practice has been found useful for air-dry industrial maintenance paints on steel[3, 4,5,6,7] and zinc-rich primers but its applicability has not yet been assessed for galvanized substrates.

6. Apparatus

6.1 *Fluorescent UV-Condensation Exposure Chamber*, complying with Practices G151 and G154.

6.2 *UVA-340 Fluorescent Lamps*.

6.3 *Salt Fog/Dry Cabinet*, complying with Practice G85, Dilute Electrolyte Cyclic Fog/Dry Test Annex.

NOTE 2—Committee G03 is developing information to be published in Appendices of Practices G151, G152, G154, and G155 for guidance on uniformity of conditions in the test chambers and allowed operational fluctuations of the set points.

7. Test Specimens

7.1 The composition and preparation of the substrate, specimen preparation, and the number of specimens shall be agreed upon prior to testing.

7.2 Follow the guidelines of Practice G85 and Practice D4587 on the preparation of specimens for the needs of those particular exposures.

7.2.1 Follow the guidelines of Practice G147 on conditioning and handling of specimens.

7.3 Unless otherwise agreed, flat specimens shall be 75 by 150 mm.

7.4 Expose at least one control specimen with every test. The control specimen should have known durability and be of similar composition to the test specimens. It is preferable to have two control materials: one of higher durability and one of lower durability.

7.5 It is recommended that at least three replicates of each specimen be tested, to compensate for variation within the chambers and variation between specimens.

8. Procedure

8.1 *Fluorescent UV-Condensation Exposure*:

8.1.1 Start the exposure in the fluorescent UV-condensation chamber.

NOTE 3—It has been found that in certain cases the exposure must start in the fluorescent UV/condensation device in order to get realistic rusting and staining as well as faster corrosion. It is thought that the initial UV damage to the coating allows the subsequent salt fog to produce a more realistic corrosion attack on the substrate.

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[3] Skerry, B. S. and Simpson, C. H., "Combined Corrosion/Weathering Accelerated Testing of Coatings for Corrosion Control," Presented at Corrosion 91, The National Association of Corrosion Engineers (NACE) Annual Conference 1991, and available from NACE, P.O. Box 218340, Houston, TX 77218.

[4] Simpson, C. H., Ray, C. J., and Skerry, B. S., "Accelerated Corrosion Testing of Industrial Maintenance Paints Using a Cyclic Corrosion Weathering Method," *Journal of Protective Coatings and Linings*, Vol 8, No. 5, May 1991, pp. 28–36.

[5] Cleveland Society for Coatings Technology, "Correlation of Accelerated Exposure Testing and Exterior Exposure Sites," *Journal of Coatings Technology*, Vol 66, No. 837, October 1994, pp. 49–61.

[6] Boocock, S. K., "A Report on SSPC Programs to Research Performance Evaluation Methods," *Journal of Protective Coatings and Linings*, October 1994, pp. 51–58.

[7] Cleveland Society for Coatings Technology, "Correlation of Accelerated Exposure Testing and Exterior Exposure Sites Part II: One-Year Results," *Journal of Coatings Technology*, Vol 68 , No 858, July 1996, pp. 47-61.