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Standard Practice for Outdoor Weathering of Construction Seals and Sealants[1]

This standard is issued under the fixed designation C1589/C1589M; 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 describes outdoor exposure procedures to be used as part of a test designed to determine the weatherability of building construction, seals and sealants.

NOTE 1—See Practice G24 for Exposures to Daylight Filtered Through Glass.

1.2 This practice includes three procedures for outdoor weathering. Procedure A exposes specimens to outdoor weathering without movement. Procedure B and Procedure C are, respectively, continuous natural and periodic manual techniques for subjecting specimens to the combination of cyclic movement and exposure to outdoor weathering.

1.3 This practice is limited to the method by which the construction seals or sealants are exposed to outdoor weathering as part of a test program. It refers to the types of evaluations to be performed following the outdoor exposure but does not describe the test methods.

1.4 Means of evaluation of the effects of weathering will depend on the intended use of the test material.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values 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.

1.6 *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.*

1.7 *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:*[2]

C717 Terminology of Building Seals and Sealants

C719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

C1135 Test Method for Determining Tensile Adhesion Properties of Structural Sealants

C1735 Test Method for Measuring the Time Dependent Modulus of Sealants Using Stress Relaxation

E631 Terminology of Building Constructions

E772 Terminology of Solar Energy Conversion

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

G24 Practice for Conducting Exposures to Daylight Filtered Through Glass

G84 Practice for Measurement of Time-of-Wetness on Surfaces Exposed to Wetting Conditions as in Atmospheric Corrosion 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

G169 Guide for Application of Basic Statistical Methods to Weathering Tests

G178 Practice for Determining the Activation Spectrum of a Material (Wavelength Sensitivity to an Exposure Source) Using the Sharp Cut-On Filter or Spectrographic Technique

3. Terminology

3.1 *Definitions*—Definitions are found in Terminologies C717, G113, E631, and E772.

4. Significance and Use

4.1 Tests conducted in accordance with this practice are used to evaluate the weatherability of construction seals and sealant materials when they are exposed to outdoor weather conditions. The weatherability of seals and sealants in actual

[1] This practice is under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and is the direct responsibility of Subcommittee C24.40 on Weathering.

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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.

outdoor use can be very different depending on the location because of differences in solar radiation, moisture, temperature, pollutants, and other factors. Sealant color may also affect weatherability.

4.2 This practice allows for three options: Option 1 – Procedure A in which the effect of movement during weathering is not considered; Option 2 – Procedure B in which specimens are weathered in conjunction with movement based on thermal changes. The applied strain is proportional to a combination of the temperature at the time the equipment is set up and subsequent thermal changes. This option closely mimics the actual movements that occur in many sealant installations, but is less repeatable than the movement in Procedure C; Option 3 – Procedure C in which the strain during weathering is manually applied. This procedure allows for excellent control and repeatability, but is less representative of movement in actual use conditions than the movement in Procedure B. Options 2 and 3 have been added to this practice based on peer reviewed scientific literature demonstrating that applied strain separately and in combination with other weathering stresses causes changes in the weatherability of sealants.

4.3 The type, frequency and amount of movement of sealants varies with location and may affect weatherability. It cannot be assumed, therefore, that results from one exposure in a single location will be useful for determining weatherability in a different location. Exposures in several locations with different climates (for example, solar radiation, moisture, temperature, pollutants, biological and other factors) that represent a broad range of anticipated service conditions are recommended.

4.4 It is strongly recommended that control materials of similar composition and construction to the test specimens and with known weatherability be exposed along with the test specimens for the purpose of comparing the performance of test materials to the controls. (See 6.2).

4.5 The results of short-term exposure tests can provide an indication of relative outdoor performance, but they shall not be used to predict the absolute long-term performance of a seal or sealant material. The results of tests conducted for less than 12 months will depend on the particular season of the year in which they begin.

4.6 Because of year-to-year climatatological variations, results from a single exposure test cannot be used to predict the absolute rate at which a seal or sealant degrades. Several years of repeat exposures are needed to determine an average test result for a given location.

4.7 Climatic and construction factors can impose cyclic movement upon sealed joints in use. This movement can impact the effects of outdoor weathering and often causes types of failure that are not produced by weathering without movement. Thus, the ability of building joint sealants to withstand temperature-induced movements of compression and expansion is an important property.

4.8 Outdoor weathering of specimens in combination with natural or forced cyclic movement during exposure can provide a more realistic assessment of the ability of a seal or sealant to withstand the combined effects of climate and movement encountered by seals and sealants in building construction applications.

5. Test Sites and Exposure Racks

5.1 The test site shall conform to the requirements of Practice G7, and preferably, samples should be tested at a suitable number of climatologically different sites representing the variable conditions under which the construction seal or sealant will be used. Climatological variations within these areas may include those represented by desert, seashore (salt air), industrial locations, tropical, and subtropical regions, plus areas exhibiting a wide range of solar radiant energy. The area beneath and in the vicinity of the weathering racks shall be typical of the ground cover in that climatological area. In desert areas in which sand is the prevailing ground cover, coarse gravel is required to prevent abrasion and significant dust accretion due to wind-blown sand (Note 2). The ground cover shall be low-cut grass in most temperate, tropical, and subtropical areas.

NOTE 2—Sand as a ground cover may be desirable where the abrasive effects of exposure to wind-blown sand is a part of the desired exposure.

5.2 Weathering test racks shall be located in cleared areas. The racks and hardware shall conform to the requirements of Practice G7 and shall provide for the attachment of specimens or holders of any appropriate width and length. The structural members of the test racks shall not constitute a backing to the specimens under test. Fasteners used to attach specimens to the test rack shall provide for secure attachment but allow specimens to expand or contract with thermal changes, moisture absorption or desorption, or plasticizer loss.

5.3 Unless otherwise specified, position the racks at 45° relative to horizontal, facing the equator. The angle of the exposure rack, and the orientation relative to the equator can vary depending upon the in-service application of the material. Consult Practice G7 for information on other exposure rack orientations. If other rack orientations are used they must be reported.

6. Test Specimens

6.1 Follow the manufacturer's instructions for mixing or preparing, or both, materials to be tested. The specimens shall be cured under standard conditions as defined in Terminology C717. As far as practical, test specimens shall simulate those used in service conditions of an end-use application. When conditions of use are known, the specimen exposed will consist of seal or sealant material being evaluated plus suitable substrate or installation materials to conform to the projected practice. The effect of substrate or installation materials is highly significant and contributes to the degradation due to reflectance, heat absorption, moisture retention, etc.

6.2 It is recommended that a similar material of known performance under use conditions (a control) be exposed simultaneously with the test specimen for evaluation of the performance of the test materials relative to that of the control. It is preferable to use two control materials, one with relatively poor weatherability and the other with good weatherability. It

is strongly recommended that control materials and test materials be of the same dimensions.

6.3 The use of at least three replicate specimens of each experimental and control material being tested is recommended in order to allow for variability. Consult Guide G169 for performing statistical analysis.

6.4 The total number of specimens will be determined by the number of exposure periods, number of replicates exposed, and the number of unexposed file specimens. When destructive tests are used to evaluate the effect of weathering, ensure that sufficient unexposed file specimens are retained to be tested each time the exposed materials are tested. These unexposed file specimens shall be retained at conditions of 23.0 ± 2°C. They shall be covered with inert opaque wrapping to exclude light during the storage period.

6.5 Refer to Practice G147 for procedures on specimen identification, handling and conditioning.

7. Specimen Holders

7.1 Specimen holders shall be used to support the specimens. In no case shall the specimen holder constitute a backing for that portion of the material to be evaluated.

7.2 The specimen holders shall be constructed of a material agreed upon by the mutual parties.

8. Instruments for Measuring Climatological Data

8.1 *Instruments Used to Measure Ambient Temperature and Relative Humidity*—Instrument and procedures used for measurement of ambient temperature and relative humidity shall be in accordance with Practice G7.

8.2 *Instruments Used to Measure Solar Radiation*—Instrument and calibration procedures used for measurement of total solar radiation, total solar ultraviolet radiation, or narrow band solar ultraviolet radiation shall be in accordance with Practice G7.

9. General Procedure

9.1 Mark the test specimens to be exposed with an identifying number, letter, or symbol so that they may be identified readily after exposure. The marking shall be such that there is no interference with either the exposure or the subsequent testing. (Preferably, mark both specimen and specimen holder on the side not exposed to weather, as extended exposure can obscure even deeply scribed marks.)

9.2 Record the initial appearance and physical-property data appropriate to the evaluation method used.

9.3 Mount the test specimens in the holder or directly to the exposure rack. It is convenient to group specimens to be removed from exposure at the same time in one holder.

9.4 Record a diagram of the test specimen holder layout, and record the date of installation and length of exposure planned.

9.5 Ensure that the pyranometer is mounted at a tilt and azimuth angle that is identical to that of the test specimens.

9.6 Mount the specimens on racks for the prescribed time, solar radiant energy, or total UV radiant energy or narrow band UV radiant energy.

9.7 Establish a fixed procedure of cleaning, visual examination, conditioning, and testing of the specimens. This procedure will vary with materials, but it must be uniform in a series of tests on one material to provide comparative results.

9.8 The face of the specimen shall not be masked for the purpose of showing the effects of various exposure times on one panel. Misleading results can be obtained by this method since the masked portion of the specimen is still exposed to temperature and humidity that will affect the results in many cases.

9.9 Unexposed file specimens shall be used for visual comparison to exposed specimens and for destructive tests compared with those of exposed specimens at various exposure stages.

9.10 Exposures and evaluations shall be planned to permit reporting one of the following for the test material(s) and control(s), if used:

9.10.1 Change after a specified exposure,

9.10.2 Amount of time for a specified change in properties to occur, and

9.10.3 A record of measurements after various exposure periods.

10. Exposure Procedures With and Without Movement

10.1 *Procedure A*—Outdoor Weathering Without Movement

10.1.1 *Test Specimens:*

10.1.1.1 Test specimens may be of any size or shape that can be mounted in a fixture, a holder or applied directly to the racks. The specimen dimensions can either be suited to the methods of evaluating the effects of weathering on specific properties, or larger from which smaller specimens for evaluation are cut. The exposure test specimens shall be large enough to allow for removal of the mounting edges, which would affect the evaluation of test results.

10.1.1.2 Test specimens can be made with any substrate. Standard substrates are glass, aluminum and concrete.

10.1.2 *Apparatus:*

10.1.2.1 Test racks and hardware shall conform to the requirements of Practice G7 and shall provide for the attachment of specimens or holders of any convenient width and length. The structural members of the test racks shall not constitute a backing to the specimens under test.

10.1.2.2 Specimen holders shall be used to support the many sizes of specimens involved in this testing. The specimen holders shall be constructed of a material agreed upon by the mutual parties. Aluminum panels, glass, and marble shapes have been found suitable for static exposures. In no case shall the specimen holder constitute a backing for that portion of the material to be evaluated.

10.1.2.3 Fasteners used to attach specimens to the test rack shall provide for secure attachment but allow specimens to expand or contract with thermal changes, moisture absorption or desorption, or plasticizer loss.