Designation: E2264 – 23

Standard Practice for Determining the Effects of Temperature Cycling on Fenestration Products[1]

This standard is issued under the fixed designation E2264; 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 the testing of any fenestration products that are installed with the exterior surface exposed to weathering conditions. It is intended to measure the response of the fenestration product to temperature cycles with the temperature changes being induced by controlling the air temperature on the exterior (weather side) or by exposing the product to infrared radiation, or both. When tested using this practice, fenestration products are exposed to standard cycles of elevated and depressed ambient air and surface temperatures. Test methods are specified for evaluating changes in performance that may occur as a result of temperature cycling. With this practice, seasonal and diurnal temperature conditions are simulated in a controlled laboratory apparatus.

1.2 In this practice, two test methods, Test Method A and Test Method B, are described for exposing the exterior surface of fenestration products to the elevated portion of a standardized temperature cycle. The purpose for providing two test methods of exposure is to address two distinct needs of the fenestration industry.

1.2.1 Test Method A uses infrared radiation to increase the surface temperature of the fenestration product and uses a black panel temperature sensor placed in front of the specimen's exterior surface to sense the temperature. The surface temperature of the black panel temperature sensor is raised to a preset level above the exterior ambient air temperature. This provides a more realistic test for temperature exposure based on atmospheric solar radiation and its effect on the temperature increase of exterior building materials. This method should be used when the number of cycles can be large and the outcome is critical for field correlation. Test Method A is intended for comparative product evaluations.

1.2.2 Test Method B uses elevated temperature produced by convective hot air to achieve the exterior air temperature set-point. It provides a more severe test because it elevates the exterior air temperature to levels that are not obtainable under in-service conditions. This provides a more rapid degradation cycle for accelerating the effects of the temperature exposure cycling on some materials and fastening methods used in fenestration products. This method is intended to be used when the number of temperature cycles must be minimized or the outcome is not critical for field correlation. Test Method B is intended for research and development purposes and not for comparative product evaluations.

1.3 In this practice, three temperature exposure levels are suggested for each method: Level 1 is a low temperature exposure, Level 2 is a moderate temperature exposure, and Level 3 is a high temperature exposure. The purpose of providing three levels of temperature exposure is to accommodate different grades of fenestration products based on their designs and their potential geographic installation locations. Other temperature levels may be selected by the specifier.

1.3.1 Performance characteristic measurements are used to evaluate the effects on the fenestration product caused by temperature cycling. They are measured by the following tests:

1.3.1.1 Air leakage rates shall be measured in accordance with Test Method E283/E283M.

1.3.1.2 Water penetration resistance shall be measured in accordance with Test Method E331 or Test Method E547.

1.3.1.3 Structural strength shall be measured in accordance with Test Method E330/E330M. This test shall only be performed when specified and only after temperature cycling is completed.

1.3.2 The test specifier may also choose additional tests to characterize fenestration product performance. (See Note 4 for suggested additional tests.)

1.3.3 For the purposes of product comparison, these tests are performed at or near standard laboratory conditions, but for research and development purposes, they may also be performed during an elevated or depressed portion of the temperature cycle in order to measure the effects of the temperature extreme on the performance parameter being evaluated. For the purposes of comparative evaluation, the parameters defined in 11.2 shall be used.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.51 on Performance of Windows, Doors, Skylights and Curtain Walls.

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1.5 Testing organizations using this practice shall have staff knowledgeable in heat transfer, fluid mechanics, instrumentation practice, and the specific requirements for the test methods specified. Testing personnel shall have a general knowledge of fenestration systems and components being tested.

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.* Specific precautionary statements are given in Section 6.

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]

E283/E283M Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

E330/E330M Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

E331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

E547 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

E631 Terminology of Building Constructions

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

2.2 *ASHRAE Handbook:*[3]

ASHRAE Handbook of Fundamentals

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology E631 unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *exterior temperature exposure level*—the increased exterior (weather-side) specimen surface temperature above ambient temperature resulting from the amount of energy absorbed from a radiant source. The following temperature levels apply:

3.2.1.1 *Level 1*—for products that have limited exposure to direct solar radiation.

3.2.1.2 *Level 2*—for products that have moderate exposure to direct solar radiation.

3.2.1.3 *Level 3*—for products that have high exposure to direct solar radiation.

NOTE 1—These levels are used only to differentiate general levels of temperature exposure on fenestration products. There are many different criteria that are cited for each level and the specifier is permitted to select other levels if appropriate to the product being tested.

4. Summary of Practice

4.1 This practice requires installing a test specimen in an apparatus that holds the interior (room-side) of the product specimen at a constant temperature and relative humidity. The exterior (weather-side) of the product specimen is subjected to specific differential infrared radiation (Test Method A) or air temperature (Test Method B) extremes (temperature cycling), or both.

4.2 The specimen(s) shall have its exterior surface exposed to elevated ambient air temperature or infrared radiation, or both, at one of the three pre-specified temperature exposure levels.

4.3 The specimen(s) shall have its interior surface exposed to ambient air temperature and relative humidity levels that are consistent with typical room conditions.

4.4 The specimen(s) shall be subjected to performance characterization tests before, during, or after temperature cycling, or combinations thereof, to evaluate performance changes or structural damage that may occur as a result of exposure to the temperature extremes or cycling. Destructive testing is only done after temperature cycling and non-destructive testing are completed.

5. Significance and Use

5.1 Fenestration products, when exposed to differential temperatures (constant higher or lower temperatures on the exterior and room temperature on the interior), or temperature cycling (relatively constant room temperature on the interior and repeated cycling of higher and lower temperatures on the exterior), will have stresses induced on components that may cause failure or changes in overall system performance. Some of these changes may be temporary, with their effects on system performance lasting only during the cyclical temperature exposure. Other changes may be more permanent because of the failure of critical components or irreversible changes in those critical components that control overall system performance.

5.2 In this practice, a procedure is provided for evaluating the effects of exposure to temperature cycling at standardized conditions on fenestration products. It is useful for product evaluation and development. Interrelationships between window components can be studied under laboratory conditions simulating in-service temperature extremes.

5.3 Laboratory approximation of in-service temperature cycling and temperature extremes is a useful tool for the fenestration designer. These conditions help in evaluating designs and components for absolute and relative interactions

[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.

[3] Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, http://www.ashrae.org.