Designation: E2692 – 10

# Standard Test Method for Structural Performance of Thermal Barriers in Fenestration Products[1,2]

This standard is issued under the fixed designation E2692; 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 test method evaluates the longitudinal shear strength before and after thermal cycling for thermally broken composite thermal barriers used in framing of windows, doors, and skylights. It also evaluates the ability of a thermal barrier to maintain its longitudinal dimension after thermal cycling.

1.2 This test method is applicable to all fenestration products that are constructed with structural thermal barriers that are affixed along their length to the adjoining metal profile

1.3 This test method is meant to be applicable to many types of fenestration frame types and is not meant to be specific to any single frame construction type.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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 *AAMA Standards:*[3]

AAMA 505 Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure

AAMA TIR-A8 Performance of Composite Thermal Barrier Framing Systems

## 3. Terminology

3.1 *Definitions:*

3.1.1 *adhesive failure, n*—when an fenestration framing member loses the bond with the thermal barrier, during the application of the load in the shear test.

3.1.2 *cohesive failure, n*—when the thermal barrier in a fenestration framing member breaks apart within the matrix of the thermal barrier itself during the application of the load in the shear test.

3.1.3 *fenestration products, n*—windows, doors, and skylights.

3.1.4 *longitudinal shear, n*—shear in a longitudinal plane, or parallel to the longitudinal axis, of the fenestration framing member.

3.1.5 *metal failure, n*—yielding of the metal prior or equal to 3mm of displacement in the thermal barrier during the application of the load in the shear test.

3.1.6 *room temperature, n*—for this test method, it shall be defined as 22 ± 3°C.

3.1.7 *thermal barrier or thermal break, n*—structure connecting inner and outer metal profiles of a fenestration framing member that consists of a thermally insulating (nonmetallic) material used for the purpose of reducing heat transfer across the assembly.

3.1.8 *thermally broken composite, n*—a fenestration framing member composed of an inner and outer metal profile connected by a thermal barrier, affixed along their long axis.

## 4. Summary of Test Method

4.1 This test method subjects thermally broken fenestration extrusions to shear load before and after thermal cycling.

## 5. Significance and Use

5.1 Thermal barriers require sufficient structural strength to carry the loads imposed on fenestration members while reducing the heat transfer through the depth of the framing members throughout their service life.

5.2 Sustained gravity, bending and tensile loads that stress the thermal barrier (that is, glazing infill weight, wind loads, and glazing gasket pressure) are not covered by this test method.

[1] This test method 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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[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 the American Architectural Manufacturers Association (AAMA), 1827 Walden Office Square, Suite 550, Schaumberg, IL 60173-4268, http://www.aamanet.org.

5.3 The reader is encouraged to read AAMA TIR-A8 for further information on thermal barriers and testing.

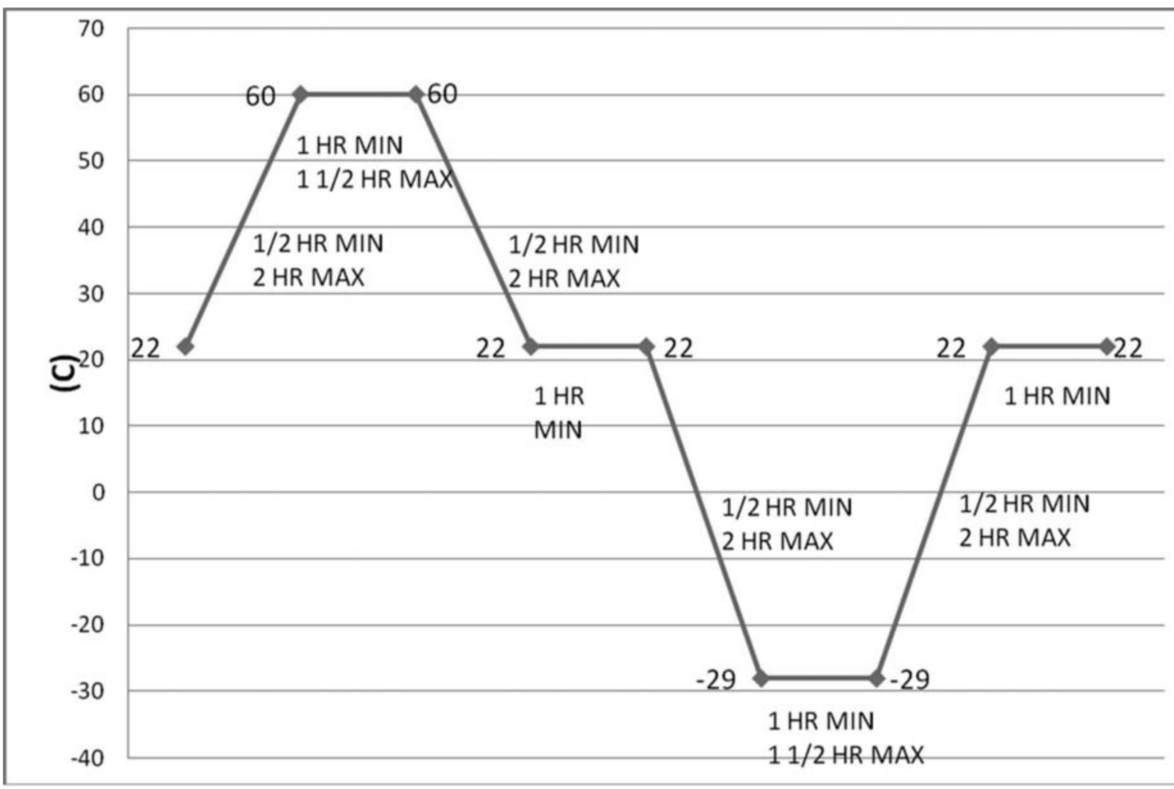
## 6. Apparatus

6.1 An environmental chamber shall be capable of maintaining a high temperature of 70 ± 3ºC and maintaining a low temperature of –29 ± 3ºC and the ability to ramp between the two temperatures at a controlled rate, within the time required on Fig. 1. The chamber shall have at least one thermocouple to monitor the interior temperature of the chamber.

6.2 A universal testing machine or similar equipment with a constant rate of crosshead movement shall be capable of exerting a measured force of up to 45 KN at a crosshead speed of 5 mm/min.

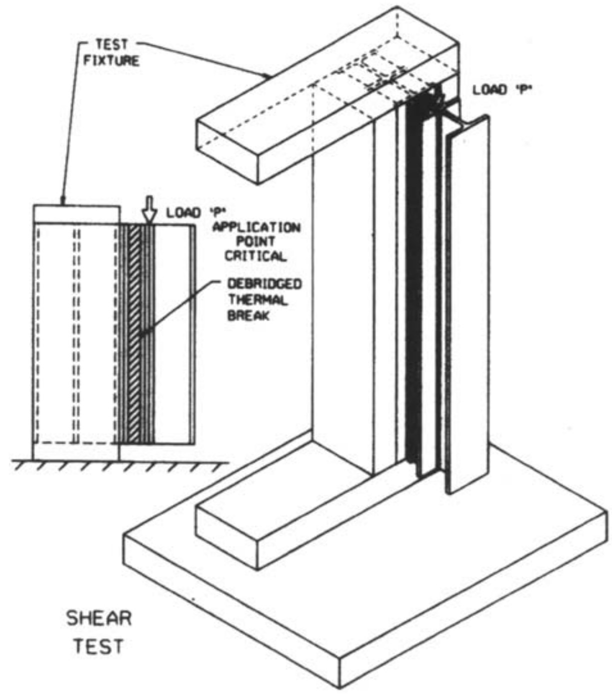
6.3 A test fixture shall be capable of holding one side of the fenestration framing member while exerting force on the opposite side of the fenestration framing member. (See Fig. 2.)

6.4 A measuring device capable of measuring 0.03 mm increments.




| | | | |
|---|---|---|---|
| Raise temperature | 60ºC | ½ h min | 2 h max |
| Hold temperature | 60ºC | 1 h min | 1 ½ h max |
| Lower temperature | 22ºC | ½ h min | 2 h max |
| Hold temperature | 22ºC | 1 h r min | NA |
| Lower temperature | -29ºC | ½ h min | 2 h max |
| Hold temperature | -29ºC | 1 h min | 1 ½ h max |
| Raise temperature | 22ºC | ½ h min | 2 h max |
| Hold temperature | 22ºC | 1 h min | NA |

**FIG. 1 Thermal Cycling Schedule: One Cycle Air Temperatures**




NOTE 1—Excerpted from AAMA 505 and used with permission of AAMA.

**FIG. 2 Shear Test Fixture**

## 7. Hazards

7.1 Take precautions when working near the testing machine for specimens breaking under loading and creating flying hazards. Take appropriate precautions when working around the hot and cold materials.

## 8. Test Specimens

8.1 Test specimens shall be actual window extrusions from a manufactures' production inventory. The test extrusion's pretreatment, finish, and coating shall be identified and consistent with the manufacturer's application technique and production inventory. In cases in which a complete window would use different profiles for sills, jamb, head, or intermediates, a jamb extrusion may be considered representative of the other members provided the thermal barrier cavity pocket design, pretreatment, finish type, and manufacturing method are the same. When the window system being tested is an operable window with frame and sash both using similar thermal barriers, then the jamb member of the sash shall be considered representative of the other members provided the thermal barrier cavity pocket design, pretreatment, finish type, and manufacturing method are the same.

8.2 Each individual specimen shall be a minimum of 700 mm in length. The width and thickness will vary.

8.3 A minimum of three specimens at 700 mm in length shall be submitted for testing.

## 9. Conditioning

9.1 The test specimens shall be cut from a prepared stock length not less than 2.5 m in length. The stock length material shall be conditioned a minimum of seven days at room temperature prior to cutting the three 700 mm specimens required for further testing.

## 10. Procedure

10.1 *Precycle Shear Strength Determination*—Before thermal cycle testing, cut a 100 ± 3 mm section off the lead end of each specimen (see Fig. 3). Place the specimens one at a time in the test fixture (see Fig. 2) and load to failure at a crosshead speed of 5 mm/min at room temperature. Record the peak load values and failure mode. Failure of the specimen shall be defined as the maximum load at failure of the sample or the maximum load up to a relative axial displacement of the metal faces of 3 mm measured at one of the metal/thermal barrier interfaces, whichever comes first. Report the mode of failure, if any was present, at the end of the testing. Failure mode examples are, metal failure, cohesive failure, and adhesive failure.

NOTE 1—For the purposes of this test procedure, room temperature is defined as 22 ± 3ºC.

10.2 *Cyclic Soak Thermal Test*—Place the test specimens, 600 ± 3 mm long, in an environmental chamber. Conditioned air shall be cycled over the specimens at temperatures between –29 and 60°C for 90 cycles in accordance with Fig. 3. Upon completion of 30 thermal cycles, observe each end of each specimen for thermal barrier movement relative to the metal extrusion, often referred to as dry shrinkage. Use the measuring device to determine if any dry shrinkage of the thermal barrier has occurred on each end of the fenestration frame member to the nearest millimeter and record the information. Displacement of the profile may occur and measurements need to be taken from the same side of the profile. Return the specimens

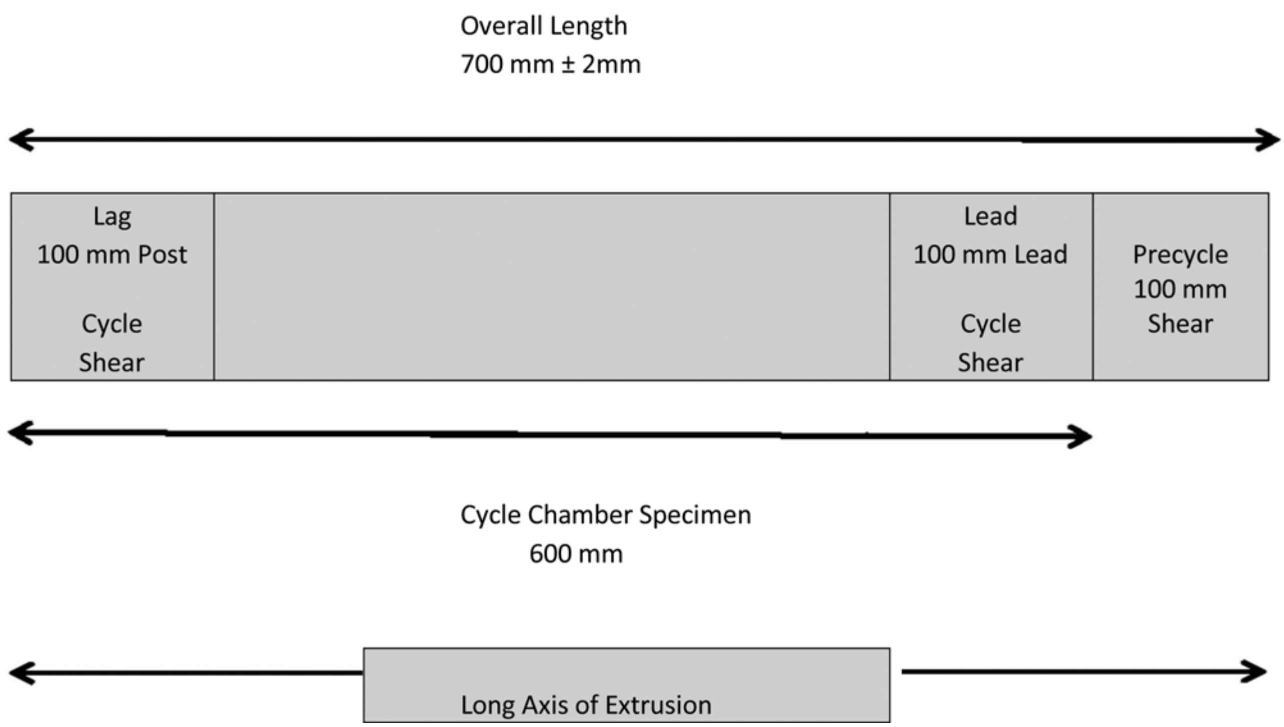



**FIG. 3 Cutting of Stock Material**

to the environmental chamber and continue testing. Upon the completion of 60 thermal cycles, observe each end of each specimen and measure any thermal barrier movement relative to the metal extrusion as done earlier. Return the specimens to the environmental chamber and continue testing. Upon the completion of 90 thermal cycles, observe each end of each specimen and measure any shrinkage as done earlier.

10.3 *Postcycle Shear Strength Determination*—Cut a 100 ± 3 mm section off each end of each specimen (see Fig. 3). Place the samples one at a time in the test fixture (see Fig. 2) and load to failure at a crosshead speed of 5 mm/min at room temperature. Record the peak load values and failure mode. Failure of the specimen shall be defined as the maximum load at failure. Report the mode of failure. Failure mode examples are metal failure, cohesive failure and adhesive failure.

## 11. Report

11.1 Report the complete description of the test specimens, including metal alloy and temper, finish, thermal barrier material, and supplier of thermal barrier material. If the supplier of the thermal barrier material has special handling and installation instructions for the fenestration manufacture, it should be acknowledged if these instructions were followed. List the manufacturer of the fenestration profile and the series of product. Include a diagram of the shape. Report any deviations from the test method procedure.

11.2 Report the test data and averages for the precycle shear strength, shrinkage at 30, 60, and 90 cycles and post cycle shear strength. Report the mode of failure, if any was present, at the end of the testing in 10.1 and 10.3 (for example, metal failure, cohesive failure, or adhesive failure.)

## 12. Precision and Bias

12.1 *Precision*—It is not possible to specify the precision of the procedure in this test method.

12.2 *Bias*—No justifiable statement can be made on the bias of the procedure in this test method because the bias of this test method within or between laboratories has not been established.

## 13. Keywords

13.1 doors; glazing leg; glazing pocket; skylights; thermal barrier; windows