Standard Test Method for
Exposure of Firestop Materials to Severe Environmental Conditions[1]

This standard is issued under the fixed designation E2785; 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.

INTRODUCTION

Firestops are installed in buildings to prevent the spread of fire. Each firestop design is dependent on its specific arrangement, thickness, density, and shape of materials used in its construction and upon the specific assembly in which it is fire tested. There are at least five types of materials used in firestops. They are endothermic, intumescent, insulative, subliming, and ablative. Some firestops use more than one type in a specific design. The purpose of this test method is to provide a common set of procedures for evaluating the potential behavior of materials used in firestops to various environmental conditions. There are other materials used in firestop systems that are not of the five types listed above, which are not intended to be evaluated by this test method.

1. Scope

1.1 This test method evaluates a change in physical properties, chemical properties, or both, of firestop materials after a standardized environmental exposure. This test method does not evaluate the fire performance of the firestop materials.

1.2 This test method establishes indicators that will aid in determining the use of the tested material in buildings.

1.3 This test method evaluates the properties of component products used within a firestop system, and does not evaluate the properties of assembled firestop systems.

NOTE 1—This test method does not preclude the possibility of exposing complete firestop systems to one or more severe environmental exposures and then exposing the complete firestop system to a fire test.

1.4 This test method is intended to be a screening method in the evaluation of the relative behavior of a specific material before and after a standardized set of severe exposure criteria. Individual tests are not intended to be the only determining factor in evaluating or selecting a firestop material because each test has limitations.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C1442 Practice for Conducting Tests on Sealants Using Artificial Weathering Apparatus
D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
D870 Practice for Testing Water Resistance of Coatings Using Water Immersion
D2041/D2041M Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
D3045 Practice for Heat Aging of Plastics Without Load
D3850 Test Method for Rapid Thermal Degradation of Solid Electrical Insulating Materials By Thermogravimetric Method (TGA)
D4434/D4434M Specification for Poly(Vinyl Chloride) Sheet Roofing

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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.

D4637/D4637M Specification for EPDM Sheet Used In Single-Ply Roof Membrane

D4714 Test Method for Determination of Effect of Moist Heat (50 % Relative Humidity and 90°C) on Properties of Paper and Board (Withdrawn 2010)[3]

D5510 Practice for Heat Aging of Oxidatively Degradable Plastics (Withdrawn 2010)[3]

D5893/D5893M Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

D6083 Specification for Liquid Applied Acrylic Coating Used in Roofing

D6754/D6754M Specification for Ketone Ethylene Ester Based Sheet Roofing

D6878/D6878M Specification for Thermoplastic Polyolefin Based Sheet Roofing

D6947/D6947M Specification for Liquid Applied Moisture Cured Polyurethane Coating Used in Spray Polyurethane Foam Roofing System

E84 Test Method for Surface Burning Characteristics of Building Materials

E119 Test Methods for Fire Tests of Building Construction and Materials

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

E176 Terminology of Fire Standards

E473 Terminology Relating to Thermal Analysis and Rheology

E631 Terminology of Building Constructions

E814 Test Method for Fire Tests of Penetration Firestop Systems

E2786 Test Methods for Measuring Expansion of Intumescent Materials Used in Firestop and Joint Systems

F495 Test Method for Weight Loss of Gasket Materials Upon Exposure to Elevated Temperatures

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

G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Terminology

3.1 *Definitions*—Definitions in the following standards will prevail for terms not defined in this test method.

3.1.1 For definitions of general terms used in this test method related to building construction, refer to Terminology E631.

3.1.2 For definitions of general terms used in this test method related to fire standards, refer to Terminology E176.

3.1.3 For definitions of general terms used in this test method related to thermal analysis and rheology, refer to Terminology E473.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *ablative, adj*—characterized by the capability for rapidly dissipating heat from a substrate.

3.2.2 *endothermic, adj*—characterized by a process or change that takes place with absorption of heat and requires high temperature for initiation and maintenance.

3.2.3 *insulative, adj*—characterized by an extremely low dielectric constant, low thermal conductivity or both.

3.2.4 *intumescent, adj*—characterized by foaming and swelling when exposed to high surface temperatures or flames.

3.2.5 *subliming, adj*—characterized by the direct passage of a substance from solid to vapor without appearing in the intermediate (liquid) state.

4. Summary of Test Method

4.1 This test method describes the following test sequence and procedure:

4.1.1 The firestop material is measured for its physical properties or chemical properties, or both, before exposure to standardized severe environments.

4.1.2 The firestop material is exposed to standardized severe environmental exposures for a specific time period and retested for its physical properties or chemical properties, or both, at various time periods.

4.1.3 After the total exposure time period, the firestop material's physical properties or chemical properties, or both, and performance is calculated and reported as a percentage of initial values.

5. Significance and Use

5.1 This test method is intended to evaluate the material performance after exposure to a standardized set of severe environmental conditions. It is understood that these performance values are dependent upon these standardized exposure periods and environmental concentrations. Other values are possible if the exposure period or severe environmental concentration, or both, is changed.

5.2 This test method is intended to be used where the material is exposed to the specific extreme environmental condition in its intended field of application.

5.3 The user shall establish which properties are relevant to the application at hand, in order to determine the properties to be tested.

NOTE 2—It is not intended for all properties to be tested in all cases.

5.4 This test method is intended to evaluate only the following types of materials, as defined by their physical properties or chemical properties, or both, and used in penetration firestops:

5.4.1 Endothermic,

5.4.2 Intumescent,

5.4.3 Insulative,

5.4.4 Ablative, and

5.4.5 Subliming.

5.5 This test method determines initial physical properties, chemical properties, or both, to allow comparison with physical properties, chemical properties, or both after exposure. The following properties are to be considered, as applicable:

5.5.1 Weight loss or gain,

5.5.2 Volume expansion,

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[3] The last approved version of this historical standard is referenced on www.astm.org.

5.5.3 Thermal conductivity,
5.5.4 Thermogravimetric analysis (TGA),
5.5.5 Differential scanning calorimetry (DSC),
5.5.6 Tensile strength and elongation,
5.5.7 Visual observations, and
5.5.8 Loss on ignition.

5.6 This test method uses the following exposures:
5.6.1 Elevated temperature,
5.6.2 High humidity,
5.6.3 Carbon dioxide and sulfur dioxide with moisture present,
5.6.4 Water immersion,
5.6.5 Temperature cycling,
5.6.6 Wet-freeze-dry cycling, and
5.6.7 Weathering.

5.7 This test method does not provide any information regarding the actual fire performance of the firestop before or after the exposure tests.

5.8 This test method will provide a comparison between formula and processing changes in materials.

5.9 This test method only provides for a comparison of the tested material before and after a standardized exposure process.

5.10 This test method shall be used as one element in evaluating materials or selecting firestop material(s) for a specific application. Other factors shall be considered, such as its fire performance as tested in accordance with Test Methods E814 or E119, flame spread as tested in accordance with Test Method E84, durability, and its compatibility with its adjacent materials.

6. Apparatus

6.1 *Accelerated weathering unit* as described in Practice G151 and, more specifically, Practice G155.

6.2 *Cold box or freezer.*

6.3 *Vented air circulating oven*, complying with Specification E145 that is capable of exposing samples at 212 ± 3.6°F (100 ± 2°C).

6.4 *Balance*, calibrated to weigh specimens to the nearest 0.00035 oz (0.01 g)

6.5 A 6 in. (152 mm) *dial caliper* with a division of 0.01 in. (0.25 mm) or smaller

6.6 A small *hydraulic press* with platens larger than 5 in. (127 mm) square.

6.7 Two nominally 0.125-in. (3.2-mm) thick *metal shims* at least 4 in. (102 mm) long.

6.8 *Release liner paper.*

6.9 A *steel ruler* graduated to 1⁄64 in. (0.40 mm).

6.10 *Environmental chamber* that can be sealed for use of gas.

6.11 A *TGA system*.

6.12 A *DSC system*.

6.13 A *volume expansion measuring system*.

6.14 Other apparatus as specified in the referenced standards.

7. Sampling, Test Specimens, and Test Units

7.1 Use as-commercially-supplied material from the manufacturer, with dimensions or form modified to meet the exposure and property testing required. See 7.2 and Section A1.1.

7.2 Some materials that are used to seal a penetration in the field require special preparation before samples are exposed to the required environments.
7.2.1 Cast or form samples into the cured or dry state before exposure to the environmental conditions for sealants, putties, coatings, sprays, mortars, and foams.
7.2.2 Cut sheet-type materials such as wrap strips, boards, mats, blankets, pillows, preformed plugs, and sponges into a form designed to be exposed to the environmental conditions.
7.2.3 Make measurements on no less than three specimens for each time increment. Obtain and prepare samples for all exposures.

8. Conditioning

8.1 All test specimens shall be conditioned to equilibrium by weight in a room or chamber with a temperature of 72 ± 5°F (22 ± 3°C) at 50 ± 5 % RH. Weigh and record the weight of each test specimen once a day until equilibrium is reached. Equilibrium is considered achieved when the weight change is less than 1 % per day. After the samples have reached equilibrium, they are to be retrieved and tested within 1 h after removal from the conditioning environment.

9. Procedure

9.1 *Control Samples*—For each individual physical property or chemical property, or both, as enumerated in 5.4, determine and record benchmarks for each material. The benchmark value shall be the measurement prior to any environmental exposure test.

9.2 Subject test specimens to any of the following in 9.2.1 – 9.2.7, as requested by the test sponsor, and record the results. The results shall be reported for each required time increment.
9.2.1 *Elevated Temperature Exposure* in accordance with Practice D3045, Test Method D4714, or Practice D5510.
9.2.2 *High Humidity* in accordance with Annex A1.6.
9.2.3 *Concentrated Carbon Dioxide and Sulfur Dioxide* in accordance with Annex A1.2.
9.2.4 *Water Immersion* in accordance with Practice D870.
9.2.5 *Temperature Cycling* in accordance with Annex A1.3.
9.2.6 *Wet-Freeze-Dry Cycling* in accordance with Annex A1.4.
9.2.7 *Weathering* in accordance with Practice C1442 using the Xenon-arc procedure. Irradiance level is to be set at 0.51 W/($m^2 \cdot$ nm) at 340 nm for 102 min of light and 18 min of light plus moisture, as detailed in 7.2.3 of Practice C1442. As an option, for users who are required to operate the machine at irradiance level of 0.35 W/($m^2 \cdot$ nm), this exposure may be used with an adjustment using the equation for determining equivalent radiant exposures at different irradiance levels in A1.2 of Practice C1442.

9.3 After exposing samples to the conditions in 9.2, determine and record the properties specified in 5.5.1 – 5.5.8, as applicable.

9.3.1 Mass.

9.3.2 The intumescent expansion ratio, in accordance with Test Methods E2786, for material type 5.4.2.

9.3.3 The thermal conductivity in accordance with Test Method C177 for material type 5.4.3.

9.3.4 The thermo degradation measured by TGA in accordance with Test Method D3850 for material types 5.4.1, 5.4.4, and 5.4.5.

9.3.5 The calorific value measured by DSC in accordance with Test Method D2041/D2041M for material types 5.4.1, 5.4.4, and 5.4.5.

9.3.6 Tensile strength and elongation in accordance with Test Methods D412.

9.3.7 Visual appearance.

9.3.8 Loss on ignition according to Test Method F495.

10. Calculation or Interpretation of Results

10.1 Express the final results of the exposure tests as a percentage of the change in each physical property or chemical property, or both (LOI, mass, specific heat, etc.), calculated as follows:

$$P = [(A - O)/O] \times 100 \qquad (1)$$

where:

P = percentage change in property,
O = original value, and
A = value after environmental exposure.

11. Report

11.1 Report the following information:

11.1.1 Name of company supplying material

11.1.2 Name and lot number of material tested.

11.1.3 Designation of active material type (that is, intumescent, endothermic, etc.).

11.1.4 All data for each time interval for each test method.

11.1.5 Test method and designation for standard used for each test method.

11.1.6 Variation to any test method used including reason for variation.

11.1.7 Sample preparation procedure for all exposure tests and property tests.

11.1.8 Temperature or temperatures selected for exposure studies with reason for selection (for example, 194°F (90°C), as material reacts (intumesces) above 212°F (100°C)).

11.1.9 Irradiance level and exposure times used for Xenon-arc exposure.

11.2 All data shall be in a form similar to Table 1.

11.3 All graphs (before exposure and after exposure to environmental conditions) for TGA, DSC, and temperature profile for exposure data if more than one temperature is used in study.

12. Precision and Bias

12.1 The repeatability standard deviation has been determined in other test methods for the standards listed.

12.2 The reproducibility of this test method has been determined in the other test methods for the standards listed.

TABLE 1 Exposure Data

Company Name: _______________ *Material Name:* ________________________ *Lot #:* ________________________
____
Material Form:[A] _______________ *Material Type:*[B] ________________________ *Test Lab:* ________________________
____
Type of Exposure:[C] ____

Test	Test Standard[D]	Control (Non-Exposed)	Days Exposed[E]	Days Exposed[E]	Days Exposed[E]	Days Exposed[E]	Days Exposed[E]	Final % Change[F]
Mass (g)								
Thickness (in.)								
Length (in.)								
Width (in.)								
Intumescent Expansion Ratio (Method A)								
Intumescent Expansion Ratio (Method B)								
Thermo Conductivity (total mass loss in grams)								
TGA (mass loss)								
DSC (J/g)								
LOI (% mass loss)								

[A] Caulk, putty, sheet, device, board, foam, wrap strip, etc.
[B] Type, such as intumescent, endothermic, insulative, ablative, or subliming.
[C] Heat exposed humidity, water immersion, etc.
[D] ASTM or other methods used for testing.
[E] Put number of days or hours in this column and data in column below.
[F] See Section 10.

12.3 No information can be presented on the bias of the procedure in this test method for measurement of the intumescent level because no material having an accepted reference value is available.

13. Keywords

13.1 accelerated; artificial; cold; environmental exposure; firestop; heat; humid; penetration; wet

ANNEX

(Mandatory Information)

A1. SPECIFIC TEST METHODS

A1.1 Initial Specimen Preparation

A1.1.1 The following shall be needed to prepare some test specimens:

A1.1.1.1 A 6-in. (152-mm) dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.1.1.2 A drying oven capable of reaching and maintaining 212°F (100°C).

A1.1.1.3 A balance beam accurate to ±0.00035 oz (±0.01 g).

A1.1.1.4 A small hydraulic presses with platens larger than 5 in. (127 mm) squares.

A1.1.1.5 Two nominally 0.125 to 0.25 in. (3.18 to 6.35 mm) thick metal shims at least 4 in. (102 mm) long to create the needed product thickness in the press.

A1.1.1.6 Release liner paper.

A1.1.1.7 A steel ruler graduated to 1⁄64 in. (0.40 mm).

A1.1.2 All test specimens shall be prepared from the samples collected in 7.1.

A1.1.3 All test specimens shall be stored in a stable environment (conditioning room) with an ambient temperature of 73.4 ± 5°F (23 ± 3°C) and a relative humidity of 50 ± 5 %.

A1.1.4 All test specimens shall be conditioned to a constant weight. The material weight shall be defined as constant when it does not change more than ±1.0 % within 24 h prior to testing.

A1.1.5 Number each test specimen.

A1.1.6 Measure physical dimensions and mass.

A1.1.7 Prepare each caulk and putty test specimen according to the following:

A1.1.7.1 Cut two pieces of release liner paper into 5 in. (127 mm) squares for each test specimen. Place enough material in the center of one sheet so that when compressed it will create a nominal 4.25 in. (108 mm) square between 0.125 to 0.25 in. (3.18 to 6.35 mm) thick. Place the other sheet of release liner paper squarely over the top of the first, sandwiching the material between them.

A1.1.7.2 Place the metal shims along the outer edges of the press platen.

A1.1.7.3 Place the release liner paper and material sandwich between and in the center of the press platens.

A1.1.7.4 Close the press so that it stops at the metal shims. Leave the release liner paper and material sandwich in the press for at least 30 seconds.

A1.1.7.5 Allow the material to cure in accordance with the manufacturer's specifications. The material weight shall be stable so that it does not change more than 1 % in 24 h.

A1.1.7.6 Remove the top and bottom layers of the release liner paper and cut the cured material into the 4 in. (102 mm) square test specimen.

A1.1.7.7 These test specimens shall be processed further if required by a specific test method.

A1.1.8 Prepare each test specimen for other materials that start in liquid form according to the following:

NOTE A1.1—Examples include sprays, mortar, foam, and self-leveling sealants.

A1.1.8.1 For flexible materials, a sample shall be created which has dimensions of 4 in. (102 mm) by 4 in. (102 mm) by 0.125 to 0.25 in. (3.18 to 6.35 mm) thick.

A1.1.8.2 For rigid or brittle materials, a sample shall be created which has dimensions of 4 in. (102 mm) by 4 in. (102 mm). Thickness shall be between 0.125 to 0.5 in. (3.2 to 12.7 mm).

A1.1.9 Solid pliable materials

NOTE A1.2—Examples include intumescent wrap strips, mats, and pillows.

A1.1.9.1 If practicable, the product shall be cut to a dimension of 4 in. (102 mm) by 4 in. (102 mm) for testing.

A1.1.9.2 If the dimensions of the product cannot practicably be cut down to 4 in. (102 mm) by 4 in. (102 mm), or to a 4 in. (102 mm) length for elongated materials, these materials shall be tested in the form supplied.

A1.1.10 Solid non-pliable materials and assemblies

NOTE A1.3—Examples include mechanical systems, collars, and cast-in-place devices.

A1.1.10.1 Firestop products that are used as part of prefabricated assemblies shall have any active components removed and only those components tested as described in this test procedure. Active components are those, which have one of the properties enumerated in 5.4.

NOTE A1.4—An example of this would be the removal of the intumescent wrap strips from a collar.

A1.1.10.2 If practicable, the active component shall be cut to a dimension of 4 in. (102 mm) by 4 in. (102 mm) for testing.

A1.1.10.3 If the dimensions of the active component cannot practicably be cut down to 4 in. (102 mm) by 4 in. (102 mm), or to a 4 in. (102 mm) length for elongated materials, it shall be tested in the form supplied.

A1.2 Concentrated Carbon Dioxide and Sulfur Dioxide

A1.2.1 Test specimens that have been conditioned in accordance with Section 8.

A1.2.2 The following apparatus are required to perform the test:

A1.2.2.1 Environmental chamber that can be maintained with 1.0 ± 0.1 % of carbon dioxide and sulfur dioxide gases.

A1.2.2.2 A 6-in. (152-mm) dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.2.2.3 A balance accurate to ±0.00035 oz (±0.01 g).

A1.2.3 Weigh each test specimen and record the value to the nearest ounce.

A1.2.3.1 If the test specimen is not a bulk type material (that is, mass of fibers or granules), measure and record its thickness, length, and width.

A1.2.4 Precondition the chamber as follows:

A1.2.4.1 Establish temperature to 90 ± 5°F (32 ± 3°C).

A1.2.4.2 Place 0.034 fluid oz (1 ml) of water in the chamber.

A1.2.4.3 Place test specimens in the chamber.

A1.2.4.4 Introduce 1.0 ± 0.1 % of carbon dioxide and sulfur dioxide gases into the chamber.

A1.2.5 Each day purge the chamber with air and reintroduce the gases in accordance with A1.2.4.4.

A1.2.6 Examine and photograph test samples at intervals of 7, 14, and 21 days.

A1.2.6.1 Record all observations.

A1.2.6.2 Subject three test specimens to each applicable test in 9.3 and record values in Table 1.

A1.3 Temperature Cycling

A1.3.1 Test specimens that have been conditioned in accordance with Section 8.

A1.3.2 The following apparatus are required to perform the test:

A1.3.2.1 Circulating air oven with variable temperature adjustment to at least 212ºF (100°C) and accurate to at least ±5ºF (±3°C).

A1.3.2.2 Cold box with variable temperature adjustment to at least –58ºF (–50°C) and accurate to at least ±5ºF (±3°C).

A1.3.2.3 A 6 in. (152 mm) dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.3.2.4 A balance beam accurate to ±0.00035 oz (±0.01 g).

A1.3.3 Weigh each test specimen and record the value to the nearest ounce.

A1.3.3.1 If the test specimen is not a bulk type material (that is, mass of fibers or granules), measure and record its thickness, length, and width.

A1.3.4 Cool the cold box to –40 ± 3°F (–40 ± 2°C) and preheat circulating air oven to 140 ± 3°F (60 ± 2°C).

A1.3.5 *Test Cycle:*

A1.3.5.1 Place test specimens in the cold box for 24 h ± 5 min.

A1.3.5.2 Immediately remove them from the cold box and place them in the circulating air oven for 24 h ± 5 min.

A1.3.5.3 Expose each test specimen to five complete cycles.

A1.3.5.4 After the five cycles, remove test specimens. Let them reach ambient room temperature.

A1.3.5.5 Examine and photograph test samples after cycling.

A1.3.5.6 Record all observations.

A1.3.5.7 Subject three test specimens to each applicable test in 9.3 and record values in Table 1.

A1.4 Wet-Freeze-Dry Cycling

A1.4.1 Test specimens that have been conditioned in accordance with Section 8.

A1.4.2 The following apparatus are required to perform the test:

A1.4.2.1 Wet cycle requires a container:

(1) With a sealable lid.

(2) That will contain water and will not leak, and

(3) Large enough that it will accommodate the test specimens.

A1.4.2.2 A 6-in. (152-mm) dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.4.2.3 Cold box with variable temperature adjustment to at least –58ºF (–50°C) and accurate to at least ±5ºF (±3°C).

A1.4.2.4 Circulating air oven with variable temperature adjustment to at least 212ºF (100°C) and accurate to at least ±2.5ºF (±1.4°C).

A1.4.2.5 A balance beam accurate to ±0.00035 oz (±0.01 g).

A1.4.3 Weigh each test specimen and record the value to the nearest ounce.

A1.4.3.1 If the test specimen is not a bulk type material (that is, mass of fibers or granules), measure and record its thickness, length, and width.

A1.4.4 Cool the cold box to –40 ± 3°F (–40 ± 1°C) and preheat circulating air oven to 140 ± 3°F (60 ± 1°C).

A1.4.5 *Test Cycle:*

A1.4.5.1 Place test specimens in the container, fill it with water, mark the water level and maintain the water level for 24 h ± 5 min.

A1.4.5.2 Immediately remove them from the container and place them in the cold box for 24 h ± 5 min.

A1.4.5.3 Immediately remove them from the cold box and place them in the circulating air oven for 24 h ± 5 min.

A1.4.5.4 Expose each test specimen to five complete cycles.

A1.4.6 After the five cycles, remove test specimens. Let them reach ambient room temperature.

A1.4.7 Examine and photograph test samples after cycling.

A1.4.7.1 Record all observations.

A1.4.7.2 Subject three test specimens to each applicable test in 9.3 and record values in Table 1.

A1.5 Weathering

A1.5.1 Test specimens that have been conditioned in accordance with Section 8.

A1.5.2 The following apparatus are required to perform the test:

A1.5.2.1 An xenon arc artificial weathering apparatus with daylight type filters to simulate direct exposure to solar radiation and conform with the spectral power distribution in Practice G155.

A1.5.2.2 A dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.5.2.3 A balance accurate to ±0.00035 oz (±0.01 g).

A1.5.3 Weigh each test specimen and record the value to the nearest ounce.

A1.5.3.1 If the test specimen is not a bulk type material (that is, mass of fibers or granules), measure and record its thickness, length, and width.

A1.5.4 Operation of an artificial weathering apparatus.

A1.5.4.1 The irradiance and exposure cycle shall be set as indicated in 9.2.7.

A1.5.4.2 The operation of the test shall be in accordance with Practice G155.

A1.5.4.3 Duration of exposure is determined by the test sponsor in accordance with procedure guidelines found in 9.6 of Practice C1442. Refer to Section X1.3 for additional guidance.

A1.5.5 *The Test Specimen:*

A1.5.5.1 Mount the test specimen in accordance with Practices G151 and G155.

A1.5.5.2 Record all observations.

A1.5.5.3 Subject three test specimens to each applicable test in 9.3 and record values in Table 1.

A1.6 High Humidity

A1.6.1 Test three test specimens that have been conditioned in accordance with Section 8.

A1.6.2 The following apparatus are required to perform the test:

A1.6.2.1 Environmental chamber that can be maintained at 90 ± 3°F (32 ± 2°C) and 98 ± 2 % relative humidity.

A1.6.2.2 A 6 in. (152 mm) dial caliper with a smallest division of 0.001 in. (0.025 mm).

A1.6.2.3 A balance beam accurate to ±0.00035 oz (±0.01 g).

A1.6.3 Weigh each test specimen and record the value to the nearest ounce.

A1.6.3.1 If the test specimen is not a bulk type material (that is, mass of fibers or granules), measure and record its thickness, length, and width.

A1.6.4 Precondition the chamber to 90 ± 5ºF (32 ± 3°C) and 98 ± 2 % relative humidity.

A1.6.5 Place test specimens in the chamber.

A1.6.6 Examine and photograph test samples at intervals of 7, 14, and 21 days.

A1.6.6.1 Record all observations.

A1.6.6.2 Subject three test specimens to each applicable test in 9.3 and record values in Table 1.

APPENDIX

(Nonmandatory Information)

X1. COMMENTARY AND PURPOSE

X1.1 The purpose of this test method is to evaluate effects of severe environmental exposures on firestop products as it relates to comparing physical and chemical properties of various types and forms of materials before and after exposure. During task group discussions, it was brought up as a concern that there is no part of this test standard that addresses resultant firestop performance after exposure. It was agreed amongst the group that this effort, being under the scope of Commitee E06, cannot directly require a fire test performance criteria. In an effort to address this concern, Note 1 was added to indicate this test method does not prevent the ability of the user to employ these methods of exposure as a means to condition products for fire testing.

X1.2 Publishing a standard that would address a firestopping product or firestopping system's ability to work as intended when exposed to severe environmental conditions and a subsequent fire was deemed as unachievable during the development of this test method. The variability of real life environmental exposure and fire itself does not lend itself to development of the aforementioned standard. This test method was developed to provide standardized severe environmental exposure to firestopping materials such that test sponsors and test report reviewers would have a comparable basis. Firestopping materials may be exposed to the severe environmental conditions indicated in this test method and then tested to determine the variance of a physical property from a control (not exposed) sample of the same material. The results of the testing should not be considered pertinent to the material's ability to act as a firestopping system during or after the severe environmental exposure in real life conditions.

X1.3 Practice G151 indicates in Section 8, that weathering exposure times should be sufficient to produce a defined change in the material property of the product. As a general guideline for estimated duration, the following specifications are provided for general product types:

X1.3.1 For acrylic roofing materials, the exposure duration in specified in Specification D6083 to be 1000 h at an irradiance level of 0.35 W/(m^2 · nm) at 340 nm. Since the irradiance level standard is chosen to be 0.51 W/(m^2 · nm) at 340 nm, the revised exposure is 686 h in accordance with Equation A1.1 in Practice C1442. This is a suggested target duration for acrylic- or latex-based products.

X1.3.2 For polyvinyl chloride- (PVC) based products, the exposure duration is specified in Specification D4434/D4434M to be 5000 h at 0.35 W/(m^2 · nm) at 340 nm. The revised exposure duration for irradiance of 0.51 W/(m^2 · nm) at 340 nm is 3430 h in accordance with Equation A1.1 in Practice C1442. This is a suggested target duration for any products that may use PVC as a polymer base.

X1.3.3 For ketone ethylene ester- (KEE) based products, the exposure duration is specified in Specification D6754/D6754M to be 5000 h at 0.35 W/(m^2 · nm) at 340 nm. The revised exposure duration for irradiance of 0.51 W/(m^2 · nm) at 340 nm is 3430 h in accordance with Equation A1.1 in Practice C1442. This is a suggested target duration for any products that may use KEE as a polymer base.

X1.3.4 For thermoplastic polyolefin-based products, the exposure duration is specified in Specification D6878/D6878M to be 5500 h for irradiance of 0.51 W/(m^2 · nm) at 340 nm. This is a suggested target duration for any products that may use thermoplastic polyolefin as a polymer base.

X1.3.5 For ethylene propylene diene monomer (EPDM)-based products, the exposure duration is specified in Specification D4637/D4637M to be 1400 h for white product and 2800 h for black product at an irradiance of 0.51 W/(m^2 · nm) at 340 nm. They also include a provision to increase the temperature to 80°C and the cycle is to consist of a ½ h water spray per 12 h of light. This is a suggested target duration for any products that may use EPDM as a polymer base.

X1.3.6 For silicone-based products, the exposure duration is specified in Specification D5893/D5893M to be 5000 h exposure for irradiance of 0.51 W/(m^2 · nm) at 340 nm. This is a suggested target duration for any products that may use silicone as a polymer base.

X1.3.7 For polyurethane-based products, the exposure depends on whether the compound is an aliphatic or an aromatic. Aliphatics are generally more resistant to weathering conditions and may require an extended duration than that suggested below. For polyurethane materials, the exposure duration in specified in Specification D6947/D6947M to be 1000 h at an irradiance level of 0.35 W/(m^2 · nm) at 340 nm. Since the irradiance level standard is chosen to be 0.51 W/(m^2 · nm) at 340 nm, the revised exposure is 686 h in accordance with Equation A1.1 in Practice C1442. This is a suggested target duration for polyurethane-based products.[4]

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[4] *Hawley's Condensed Chemical Dictionary*, 13th edition.