



Designation: D4798/D4798M – 11 (Reapproved 2021)

Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)¹

This standard is issued under the fixed designation D4798/D4798M; 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 test conditions and procedures for xenon-arc exposures according to Practices **G151** and **G155** for bituminous roofing and waterproofing materials. (See Terminology **G113**.)

1.2 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 nonconformance with the standard.

1.3 *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.*

1.4 *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

D1669/D1669M Practice for Preparation of Test Panels for Accelerated and Outdoor Weathering of Bituminous Coatings

D1670/D1670M Test Method for Failure End Point in Accelerated and Outdoor Weathering of Bituminous Materials

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G141 Guide for Addressing Variability in Exposure Testing 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

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

G169 Guide for Application of Basic Statistical Methods to Weathering Tests

3. Summary of Test Method

3.1 Thin films of bitumen are uniformly applied to aluminum panels. Shingles and similar products are cut to size and exposed to specified cycles of temperature, light, and water. A choice of two test cycles is given along with options for determining the period of exposure and evaluating results.

4. Significance and Use

4.1 Tests conducted according to this practice are used to compare the weathering characteristics of bituminous materials versus a control material of known outdoor durability. It is not possible to establish a single relationship that is applicable to all materials between time in accelerated tests conducted according to this practice and time in natural weathering because (1) there are geographical climatic variations, local weather variations, and variations in local pollutants, and (2) the relation between accelerated and natural weathering is material dependent with differences in acceleration factors between materials as well as for different formulations of the same material. Guide **G141** provides guidance regarding variability in outdoor and accelerated weathering tests and about the use of control materials.

NOTE 1—It is recommended that outdoor weathering be used to validate the laboratory accelerated test in terms of performance ranking.

NOTE 2—This practice can be used for other than bituminous materials, but the significance and use have not been evaluated.

5. Apparatus

5.1 The xenon-arc apparatus used shall conform to the requirements defined in Practices **G151** and **G155**.

¹ This practice is under the jurisdiction of ASTM Committee **D08** on Roofing and Waterproofing and is the direct responsibility of Subcommittee **D08.02** on Steep Roofing Products and Assemblies.

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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.

5.2 *Filters*—Daylight filter as described in Practice G155.

5.3 *Radiometer*—The use of a radiometer to monitor and control the amount of radiant energy received at the specimen is required. The use of the radiometer shall comply with the requirements in Practice G151.

6. Test Specimens

6.1 Unless otherwise agreed upon, test specimens shall be approximately 70 by 150 mm [$2\frac{3}{4}$ by $5\frac{7}{8}$ in.]. Bituminous materials with adequate flow resistance shall be applied as uniform coatings on aluminum panels in accordance with Practice D1669/D1669M. Fabricated materials such as bituminous roofing, shingles, and similar products shall be cut to size and their weather surfaces exposed. Bituminous materials that are too flexible to sustain their own weight when exposed in a vertical position are permitted to be mounted on aluminum panels using stainless steel or other non-rusting clips.

6.1.1 Unless otherwise specified, expose at least three replicate specimens of each test and control material.

6.1.2 Other test specimen sizes are permitted to be used to provide sufficient material for post-exposure testing when desired.

6.1.3 Follow the procedures described in Practice G147 for identification, conditioning, and handling of specimens of test and control materials before, during, and after exposure.

6.1.4 Do not mask the face of a specimen for the purpose of showing on one panel the effects of various exposure times. Misleading results may be obtained by this method, since the masked portion of the specimen is still exposed to temperature and humidity cycles that in many cases will affect results.

7. Procedure

7.1 Proceed in accordance with Section 9 of Practice G155.

7.2 Water Purity:

7.2.1 The purity of water used for specimen spray is very important. Without proper treatment to remove cations, anions, organics, and particularly silica, exposed panels will develop spots or stains that may not occur in exterior exposures.

7.2.2 Follow the requirements for water purity described in Practice G151.

7.2.3 When specimens are found to have deposits or stains after exposure in the apparatus, the water purity must be checked to determine if it meets the requirements of 7.2.2. On some occasions, exposed specimens can be contaminated by deposits from bacteria that can grow in the purified water used for specimen spray. When bacterial contamination is detected, the entire system used for specimen water spray must be flushed with chlorine and thoroughly rinsed before resuming exposures.

7.2.4 The temperature of water used for specimen spray shall be 7.2 ± 3 °C [45 ± 5 °F].

7.2.5 When the water purity requirements above are met and there is disagreement between parties on the extent of problems caused by stain or deposit, run referee tests in at least one other laboratory that can meet the water quality requirements described in 7.2.

7.3 Unless otherwise specified, operate the apparatus continuously with the device programmed to control irradiance at

340 nm at 0.35 W/(m²·nm) and operating according to the conditions described in Cycle A or Cycle B. Unless otherwise specified, place specimens in an exposure area where irradiance is at least 90 % of the maximum irradiance measured within the exposure area. In devices with rotating specimen racks, fill any empty spaces with blank metal panels in order to properly maintain the conditions within the exposure area.

NOTE 3—Information about the exposure areas that meet the 90 % irradiance uniformity requirement is available from the manufacturers of the exposure devices.

7.3.1 During equilibrium operation, the maximum allowable deviation from the desired irradiance at 340 nm is ± 0.02 W/(m²·nm) and the maximum allowable deviation from the desired uninsulated black panel temperature is ± 2.5 °C. During equilibrium conditions, when the meter or sensor indicating irradiance or black panel temperature shows a value that is outside the limits described above, discontinue the test and correct the cause of the problem before continuing.

7.3.1.1 *Cycle A-1*—51 min light-only exposure with device programmed to produce an uninsulated black panel temperature of 60 °C at equilibrium conditions. This is followed by a 9-min period with the light on and with water sprayed on the front of the specimens.

7.3.1.2 *Cycle A-2*—The same as Cycle A-1, except that water is sprayed on both the front and back surfaces of the specimens.

7.3.1.3 *Cycle B-1*—60 min with light on and water sprayed on the front of the specimens, 90 min light-only exposure, 120 min with light on and water sprayed on the front of the specimens, 990 min light-only exposure, 180 min of cold exposure. Program the device to produce an uninsulated black panel temperature of 60 °C at equilibrium conditions during the light-only periods.

7.3.1.4 *Cycle B-2*—The same as Cycle B-1, except that water is sprayed on both the front and back surfaces of the specimens.

NOTE 4—Typically, water is sprayed only on the front surface of the specimens. Some users operate their equipment so that water is sprayed on both the front and back surfaces. Results between exposures conducted with these two types of water spray may differ.

7.3.1.5 For the cold exposure, panels shall be placed in a freezer that is controlled at -18 °C [0 °F]. During equilibrium operation, the maximum allowable deviation from this temperature is ± 5 °C [± 9 °F]. The time to transfer test specimens from the xenon-arc device to the freezer or from the freezer back to the xenon-arc device (including any time used for inspection of the test specimens) shall not exceed 15 min. This time shall not be included as part of the 24-h exposure cycle.

7.3.2 Some users use equipment capable of controlling chamber air temperature or relative humidity, or both. When chamber air temperature is controlled, program the device to control chamber air temperature at 44 °C. For exposures in which relative humidity is controlled, it is recommended that the device be programmed to control at 50 % RH. When chamber air temperature or relative humidity, or both, are controlled, the setting of these parameters must be included in the test report.