



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

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1. Scope

1.1 This test method covers test conditions and procedures for xenon-arc exposures according to Practices G 151 and G 155 for bituminous roofing and waterproofing materials that have a minimum softening point of approximately 95°C (200°F) as determined by Test Method D 36. (Also see Terminology G 113.)

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)²
- D 1669 Practice for Preparation of Test Panels for Accelerated and Outdoor Weathering of Bituminous Coatings²
- D 1670 Test Method for Failure End Point in Accelerated and Outdoor Weathering of Bituminous Materials²
- G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials³
- G 141 Guide for Addressing Variability in Exposure Testing on Nonmetallic Materials³
- G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests³
- G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources³
- G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials³

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 It is not possible to establish a precise correlation between accelerated and natural weathering because of geographical climatic variations, local weather variation from normal, and local pollutants. This weathering apparatus and procedure are used for comparing the weathering characteristics of bituminous materials against a reference material for which the outdoor weathering characteristics are known. Guide G 141 provides guidance regarding this issue.

5. Apparatus

5.1 The xenon-arc apparatus used shall conform to the requirements defined in Practices G 151 and G 155.

5.2 *Filters*—Daylight filter as described in Practice G 155.

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 G 151.

6. Test Specimens

6.1 Unless otherwise agreed upon, test specimens shall be approximately 70 by 150 mm (2¾ by 5⅞ in.). Bituminous materials shall be applied as uniform coatings on aluminum panels in accordance with Practice D 1669. Fabricated materials such as bituminous roofing, shingles, and similar products shall be cut to size and their weather surfaces exposed. If these are too flexible to sustain their own weight in a vertical position, they may be mounted on aluminum panels.

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 may be used to provide sufficient material for postexposure testing when desired.

6.1.3 Follow the procedures described in Practice G 147 for identification, conditioning, and handling of specimens of test,

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² *Annual Book of ASTM Standards*, Vol 04.04.

³ *Annual Book of ASTM Standards*, Vol 14.04.

control, and reference 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 G 155.

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 G 151.

7.2.3 If 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. If 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 $7.2 \pm 3^{\circ}\text{C}$ ($45 \pm 5^{\circ}\text{F}$).

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 according to one of the following schedules for 24 h at a light intensity of 0.35 W/m^2 at 340 nm.

7.3.1 *Cycle A*—51-min light exposure, 9-min light and water spray; black panel temperature ($60 \pm 3^{\circ}\text{C}$).

7.3.2 *Cycle B*—60-min water spray, 90-min light exposure, 120-min water spray, 990-min light exposure, 180-min cold exposure; black panel temperature ($60 \pm 3^{\circ}\text{C}$).

7.3.3 The 24-h cycle requires automatic control of the periods of light and light with spray.

7.3.4 For the cold exposure period in Cycle B, the panels shall be placed in the refrigerator, previously cooled to $-18 \pm 5^{\circ}\text{C}$ ($0 \pm 10^{\circ}\text{F}$). If inspection of the panels is to be performed at any stage in the cycle or sequence of cycles, the interruption of the test procedure should take only sufficient time to allow

for such inspection. When inspection of the panels is not performed, the transfer of the panels from the exposure apparatus to the refrigerator, and following this period, back to the test chamber, shall not require more than 15 min.

7.3.5 The time taken for inspection of the panels shall not be counted as part of the 24-h exposure cycle.

8. Period of Exposure and Evaluation of Test Results

8.1 The duration of the exposure under this test method shall be one of the following:

8.1.1 A mutually agreed upon number of 24-h cycles of operation in accordance with either Cycle A or Cycle B,

8.1.2 The number of 24-h cycles required to produce a mutually agreed upon minimum amount of change in the test specimen, or

8.1.3 The number of 24-h cycles required to produce mutually agreed upon minimum acceptable changes in either the test specimen or a mutually agreed upon reference sample.

8.2 Changes in the exposed specimens may be evaluated visually at the end of each 24-h cycle by comparing them with unexposed samples, or in terms of the number of cycles required to produce physical or chemical changes as determined by Test Method D 1670.

9. Report

9.1 In addition to the items specified in Practice G 151, the report shall include the following information:

9.1.1 Cycle used (refer to this test method),

9.1.2 Level of irradiation used,

9.1.3 Coating thickness used, and

9.1.4 Method of sample rotation used.

10. Precision and Bias

10.1 *Precision*—The repeatability of results obtained in exposures conducted according to this practice will vary with the materials being tested, the material property being measured, and the specific test conditions and cycles that are used. It is essential to determine reproducibility of the exposure/property measurement process when using the results from exposures conducted according to this practice in product specifications.

10.2 *Bias*—Bias cannot be determined because no acceptable standard weathering reference materials are available.

11. Keywords

11.1 accelerated weathering; bituminous materials; degradation; exposure; light exposure; roofing; ultraviolet; waterproofing; xenon-arc

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