Designation: D 529 – 00

Standard Practice for Enclosed Carbon-Arc Exposures of Bituminous Materials[1]

This standard is issued under the fixed designation D 529; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice describes test conditions and procedures for enclosed carbon-arc exposures conducted according to Practices G 151 and G 153 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 Coatings[2]

D 1670 Test Method for Failure End Point in Accelerated and Outdoor Weathering of Bituminous Materials[2]

G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials[3]

G 141 Guide for Addressing Variability in Exposure Testing of Nonmetallic Metals[3]

G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests[3]

G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources[3]

G 153 Practice for Operating Enclosed Carbon-Arc Light Apparatus for Exposure of Nonmetallic Materials[3]

3. Summary of Practice

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 enclosed carbon-arc apparatus used shall conform to the requirements defined in Practices G 151 and G 153.

5.2 Unless otherwise specified, the spectral power distribution of the enclosed carbon-arc shall conform to the requirements in Practice G 153 for enclosed carbon-arc with borosilicate glass globes.

6. Test Specimens

6.1 Unless otherwise agreed upon, test specimens shall be approximately 70 by 150 mm (2¾by 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 At least two test specimens of each material shall be exposed.

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

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

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

[1] This practice is under the jurisdiction of ASTM Committee D08 on Roofing, Waterproofing, and Bituminous Materials and is the direct responsibility of Subcommittee D08.02 on Prepared Roofings, Shingles, and Siding Materials.

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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 prior to, during, and after exposure.

6.4 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 specimens is still exposed to temperature and humidity cycles that in many cases will affect results.

7. Procedure

7.1 Mount the test specimens vertically, and equidistant above and below the horizontal centre line of the source of radiation.

7.2 To ensure uniform total irradiation over the specimen surface, proceed in accordance with Section 9 of Practice G 153.

7.3 Unless otherwise specified, operate the apparatus according to one of the following schedules.

7.3.1 *Cycle A*:

Test Conditions	Time, min
Light only (60 ± 3°C (140± 5°F) black panel temperature)	51
Light with spray (spray water at 7.2± 3°C (45 ± 5°F) at the nozzle).	9
A complete cycle is 22 periods of	60
Total cycle time	22 h

7.3.2 *Cycle B*:

Test Conditions	Time, h
Water spray only (21 ± 3°C (70 ± 5°F) spray water)	1
Light exposure only (60 ± 3°C (140 ± 5°F) black panel)	1½
Water spray only (21 ± 3°C (70 ± 5°F) spray water)	2
Light exposure only (60 ± 3°C (140 ± 5°F) black panel)	16½
Cold exposure 18 ± 5°C (0 ± 10°F)	1¾
Total cycle time	22¾

NOTE 1—Cycle A requires automatic control of the periods of light and light with spray. In cycle B, light and water periods may be controlled either manually or automatically.

7.4 Control the temperature during the light only periods using the blackpanel thermometer unit, mounted in the same manner as the test specimens, in the upper row.

7.5 For devices capable of humidity control, operate with a relative humidity of 50 ± 10 % during the light only periods.

7.6 The water shall strike the test specimens in the form of a spray equally distributed vertically over the face of the specimens. The specimens shall pass through the spray once in each minute or revolution of the drum or rack for the duration of the spray period.

NOTE 2—Nozzle pressures may be considerably lower than pressures at the point of entry into the machine due to the drop in pressure caused by the size and length of pipe, valves, and fittings.

7.7 *Water Purity*:

7.7.1 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.

7.7.2 Follow the requirements for water purity described in Practice G 151.

7.7.3 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 7.7.2. 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 prior to resuming exposures.

7.7.4 The temperature of water used for specimen spray shall be 7.2 ± 3°C (45 ± 5°F).

7.7.5 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 7.7.

7.8 For the cold exposure period in Cycle B, the panels shall be placed in the refrigerator, previously cooled to −18 ± 5°C (0 ± 10°F). The transfer of the panels from the exposure apparatus to the refrigerator, and following this period, back to the test chamber, shall only take sufficient time to allow for inspection of panels between cycles.

7.8.1 Load the panels into the refrigerator in a rack which holds them vertically, and spaces them at least 10 mm (⅜ in.) apart.

7.9 Clean the lamp filter globe daily, at the end of the cycle, by washing with a mild detergent and water.

7.9.1 Replace the filter globe after 2000 h of operation, or when pronounced discoloration or milkiness develops, whichever occurs first. To provide more uniform irradiance over long periods, it is recommended that two globes be used in rotation with the older of the two being replaced after every 1000 h of lamp operation.

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 An agreed upon number of cycles of operation in accordance with either Cycle A or Cycle B, or

8.1.2 The number of cycles required to produce an agreed upon change in the test specimens, or

8.1.3 The number of cycles required to produce an agreed upon change in a reference specimen.

8.2 Changes in the exposed specimens may be evaluated visually at the end of each cycle by comparing them with unexposed samples, or by measuring a physical or chemical property.

8.2.1 Cracking or perforation of asphalt coatings on aluminum panels can be determined by Test Method D 1670.

9. Report

9.1 The report shall include the following information:

9.1.1 A description of the sample, including the thickness of asphalt coatings on aluminum panels,

9.1.2 The type of exposure apparatus used,

9.1.3 The cycle used (refer to A or B of this test method),

9.1.4 Any deviation from the standard test conditions,

9.1.5 The number of exposure cycles, and

9.1.6 The extent of physical or chemical change in the sample after exposure.

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; carbon-arc; degradation; exposure; light exposure; roofing; ultraviolet; waterproofing