



Designation: D 1435 – 99

Standard Practice for Outdoor Weathering of Plastics¹

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

1. Scope

1.1 This practice is intended to cover procedures for the exposure of plastic materials to weather.

NOTE 1—See Practice G 24 for aging under glass.

1.2 This practice is limited to the method by which the material is to be exposed and the general procedure to be followed. It is intended for use with finished articles of commerce as well as with all sizes and shapes of test specimens.

1.3 Means of evaluation of the effects of weathering will depend on the intended use for the test material.

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

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.*

NOTE 2—This standard and ISO 877.2-1991, Method A, are technically equivalent.

2. Referenced Documents

2.1 ASTM Standards:

D 883 Terminology Relating to Plastics²

D 1600 Terminology for Abbreviated Terms Relating to Plastics²

D 1898 Practice for Sampling of Plastics³

E 772 Terminology Relating to Solar Energy Conversion⁴

E 824 Test Method for Transfer of Calibration from Reference to Field Radiometers⁵

E 913 Method for Calibration of Reference Pyranometers with Axis Vertical by the Shading Method⁵

E 941 Test Method for Calibration of Reference Pyranometers with Axis Tilted by the Shading Method⁵

G 7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials⁵

G 24 Practice for Conducting Exposures to Daylight Filtered Through Glass⁵

G 84 Practice for Measurement of Time-of Wetness on Surfaces Exposed to Wetting Conditions as in Atmospheric Corrosion Testing⁶

G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials⁵

G 141 Guide for Addressing Variability in Exposure Testing on Nonmetallic Materials⁵

G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests⁵

2.2 ISO Standard:

ISO 877.2-1991 Method A, Methods for Exposure to Direct Weathering, to Weathering Using Glass-Filtered Daylight, and to Intensified Weathering Using Fresnel Mirrors⁷

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in this practice, see Terminologies D 883, D 1600, G 113, and E 772.

4. Significance and Use

4.1 Tests conducted in accordance with this practice are used to evaluate the stability of plastic materials when they are exposed outdoors. The relative durability of plastics in outdoor use can be very different depending on the location of the exposure because of differences in ultraviolet (UV) radiation, time of wetness, temperature, pollutants, and other factors. It cannot be assumed, therefore, that results from one exposure in a single location will be useful for determining relative durability in a different location. Exposures in several locations

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ Discontinued 1998. See *1998 Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 12.02.

⁵ *Annual Book of ASTM Standards*, Vol 14.04.

⁶ *Annual Book of ASTM Standards*, Vol 03.02.

⁷ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

with different climates that represent a broad range of anticipated service conditions are recommended.

4.1.1 Because of year-to-year climatological variations, results from a single exposure test cannot be used to predict the absolute rate at which a material degrades. Several years of repeat exposures are needed to get an average test result for a given location.

4.2 The results of short-term exposure tests can provide an indication of relative outdoor performance, but they should not be used to predict the absolute long-term performance of a material. The results of tests conducted for less than 12 months will depend on the particular season of the year in which they begin.

5. Apparatus

5.1 The test site shall conform to the requirements of Practice G 7. Unless otherwise specified, position exposure racks so that they face the equator. The angle of the exposure rack relative to the horizontal can vary depending upon the end-use conditions that are being evaluated.

NOTE 3—Test sites at latitudes less than 23°27' from the equator in either hemisphere will have a period during the year when the declination of the sun will exceed the latitude of the site.

5.1.1 *At-Latitude Racks*—These racks shall be adjusted such that the exposed surfaces are at an angle from the horizontal corresponding exactly to the site latitude angle (Note 4).

NOTE 4—At-latitude exposure provides maximum annual total solar-radiant exposure at most non-subtropical sites. In most non-desert areas, however, maximum annual ultraviolet-radiant exposure is provided by exposure at an angle of the latitude angle minus 10°.

5.1.2 *45° Racks*—These racks shall be adjusted such that the exposed surfaces of specimens are at an angle of 45° to the horizontal.

5.1.3 *90° Racks*—These racks shall be adjusted such that the exposed surfaces of specimens are at an angle of 90° to the horizontal.

5.1.4 *Horizontal Racks*—These racks shall be positioned such that the exposed surfaces of the specimens are horizontal (Note 5).

NOTE 5—To provide moisture runoff for most horizontal-type testing of plastics, 5° south exposure is usually preferred. However, plastic roofing membranes, artificial turf, and other plastics that may be exposed at horizontal in their end-use condition should be exposed at 0° horizontal.

5.1.5 *Other-Angle Racks*—These racks shall be adjusted such that the exposed surfaces of specimens are at a tilt angle mutually agreed upon between the interested parties.

5.2 *Materials and Manner of Construction*—Test racks and hardware shall conform to the requirements of Practice G 7 and shall provide for attachment of specimens or holders of any convenient width and length. The structural members of the test racks shall not constitute a backing to the specimens under test. Fasteners used to attach specimens to the test rack shall provide for secure attachment but allow specimens to expand or contract with thermal changes, moisture absorption or desorption, or plasticizer loss.

5.3 *Specimen Holders:*

5.3.1 Most specimens under test will not be of an exact size for mounting directly on the frame. Specimen holders should be used to support the many sizes of specimens involved in this testing. In no case shall the specimen holder constitute a backing for that portion of the material to be evaluated.

5.3.2 The specimen holders shall be constructed of an inert material. (Aluminum extruded shapes have been found to be suitable.)

5.3.3 The design of the specimen holders shall be such that each specimen or sheet in a holder cannot shift its position, yet is not constrained (that is, it is free to expand or contract with thermal changes, swell because of moisture absorption, or shrink because of plasticizer loss).

5.3.4 *Frame Holders*—These holders are in the shape of a frame that may be subdivided as necessary to provide proper spacing of the specimens. The exposure aperture of each frame shall be of sufficient size to expose the entire test area of each specimen when sufficient specimens are contained.

5.3.5 *Plate Holders*—This type of holder is a universal panel consisting of a slotted-aluminum plate on which electrical white glaze porcelain insulators⁸ are mounted at proper positions to affix various-sized specimens. The specimens are mounted in the grooves of the insulators at a fixed distance of 11 mm from the slotted back plate. The insulators provide inert mounting while the slotted plate permits free circulation of air behind the specimen. This method of mounting is shown in Fig. 1.

5.4 *Instruments for Measuring Climatological Data:*

5.4.1 *Instruments Used to Measure Ambient Temperature and Relative Humidity*—Instruments and procedures used for measurement of ambient temperature and relative humidity shall be in accordance with Practice G 7.

5.4.2 *Instruments Used to Measure Solar Radiation*—Instruments and calibration procedures used for measurement of total solar radiation, total solar ultraviolet radiation, or narrow band solar ultraviolet radiation shall be in accordance with Practice G 7.

6. Sampling

6.1 Sampling shall be in accordance with the pertinent considerations outlined in Practice D 1898.

7. Test Specimens

7.1 Exposure test specimens may be of any size or shape that can be mounted in a holder or applied directly to the racks. They may be specimens suited to the means of evaluating the effects of weathering on a specific physical property, or they may be larger specimens from which smaller specimens for evaluation may be cut. Exposure test specimens should be large enough that mounting edges may be removed where evaluation test results would otherwise be affected.

7.2 As far as practical, exposure test specimens shall simulate service conditions of an end-use application. All materials of an unknown end use application will normally be run in an

⁸ A satisfactory insulator for this purpose is Catalog No. 615160, Special No. 6 Knob, dry-process, porcelain insulator, available from Porcelain Products, Carey, OH.