



Designation: G 23 – 90

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials¹

This standard is issued under the fixed designation G 23; 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. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This practice covers the basic principles and operating procedures for light-exposure apparatus with and without water spray employing a carbon-arc light source.

1.2 This practice does not specify the exposure conditions best suited for the material to be tested. It is limited to the method of obtaining, measuring, and controlling the conditions and procedures of the exposure. Sample preparation, test conditions, and evaluation of results are covered in ASTM test methods or specifications for specific materials.

NOTE 1—Attention is called to the following test methods and practices for more information on use of this practice for specific materials:

Practices D 529, D 822, D 904, D 1499, D 3361, D 3815, E 765 and Test Methods C 732, C 734, C 741, D 750, D 3424 and D 3583.

1.3 This practice includes four procedures:

1.3.1 *Method 1*—Continuous exposure to light and intermittent exposure to water spray.

1.3.2 *Method 2*—Alternate exposure to light and darkness and intermittent exposure to water spray.

1.3.3 *Method 3*—Continuous exposure to light without water spray. Specific exposure conditions for testing fabric are found in AATCC Test Method 16A.

1.3.4 *Method 4*—Alternate exposure to light and darkness without water spray.

1.4 The values stated in SI units are to be regarded as the standard. The inch-pound unit equivalents of the SI units may be approximate.

1.5 *This standard does not purport to address the safety problems 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:

¹ This practice is under the jurisdiction of ASTM Committee G-3 on Durability of Nonmetallic Materials and is the direct responsibility of Subcommittee G03.03 on Simulated and Controlled Environmental Tests.

Current edition approved Oct. 26, 1990. Published December 1990. Originally published as E 42 – 42 T. Last previous edition G 23 – 89. Replaces E 42 – 69 and combines G 23 – 69 (1975) and G 25 – 81.

Practice G 25, Standard Recommended Practice for Operating Enclosed Carbon Arc Type Apparatus for Light Exposure of Nonmetallic Materials, is to be discontinued since it now is covered in this edition of G 23 and its Methods 3 and 4.

C 732 Test Method for Aging Effects of Artificial Weathering on Latex Sealants²

C 734 Test Method for Low-Temperature Flexibility of Latex Sealants After Artificial Weathering²

C 741 Test Method for Accelerated Aging of Wood Sash Face Glazing Compound²

D 529 Practice for Accelerated Weathering Test of Bituminous Materials³

D 750 Test Method for Rubber Deterioration in Carbon-Arc or Weathering Apparatus⁴

D 822 Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Light- and Water-Exposure Apparatus⁵

D 904 Practice for Exposure of Adhesive Specimens to Artificial (Carbon-Arc Type) and Natural Light⁶

D 1499 Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics⁷

D 3361 Practice for Operating Light- and Water-Exposure Apparatus (Unfiltered Open-Flame Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products Using the Dew Cycle⁵

D 3424 Method for Evaluating the Lightfastness of Printed Matter⁵

D 3583 Methods of Testing Joint Sealant, Hot-Applied, Elastomeric Type for Portland Cement Concrete Pavements, or Joint Sealant, Hot-Applied Elastomeric, Jet-Fuel-Resistant Type, for Portland Cement Concrete Pavements⁸

D 3815 Practice for Accelerated Aging of Pressure Sensitive Tapes by Carbon-Arc Exposure Apparatus⁹

E 765 Practice for Evaluation of Cover Materials for Flat Plate Solar Collectors¹⁰

2.2 AATCC Standards:¹¹

Blue Wool Lightfastness

Test method 16A Colorfastness to Light, Carbon-Arc Lamp, Continuous Light

² Annual Book of ASTM Standards, Vol 04.07.

³ Annual Book of ASTM Standards, Vol 04.04.

⁴ Annual Book of ASTM Standards, Vol 09.01.

⁵ Annual Book of ASTM Standards, Vol 06.01.

⁶ Annual Book of ASTM Standards, Vol 15.06.

⁷ Annual Book of ASTM Standards, Vol 08.01.

⁸ Annual Book of ASTM Standards, Vol 04.03.

⁹ Annual Book of ASTM Standards, Vol 15.09.

¹⁰ Annual Book of ASTM Standards, Vol 12.02.

¹¹ Available from the Secretary, American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

Laboratory _____
 Material _____
 G 23 Test Method No. _____
 Reference Standard Used: _____
 Other ASTM Test No. _____ Method No. _____
 Exposure Apparatus: ASTM Type _____
 Mfr. Model _____ Serial No. _____
 Light Source: Enclosed _____ Open Flame _____
 Filters: Type _____ Age _____ h.
 Elapsed Exposure Time: _____ h
 Exposure Conditions: Program _____ h
 Light _____ min Dark _____ min
 Black-Panel Temperature _____ °C (°F)
 Dry Bulb Temperature _____ °C (°F)
 Relative Humidity _____ %
 Specimen Water Spray _____ min
 Rack Spray (when used) _____ min
 Specimen Spray Water Type: _____
 Specimen Spray Nozzle Type: Mfg. Designation _____
 Specimen Relocation Procedure During Exposure: _____
 Identify Properties to be Determined on Test Specimens and Identify Test Procedures or Methods Used for Property Measurement.
 Operator/Date: _____
 Supervisor/Date: _____

FIG. 1 Report Form

2.3 ISO Standard:¹² ISO Gray Scale

3. Significance and Use

3.1 Several types of apparatus with different exposure conditions are available for use. No single operating procedure for light exposure apparatus with or without water can be specified as a direct simulation of natural exposure. This practice does not imply expressly or otherwise an accelerated weathering test.

3.2 Since natural environments vary with respect to geography, topography, and different exposure periods, it may be expected that the effects of natural exposure will vary accordingly. Furthermore, all materials are not affected equally by the same environment. Therefore, results obtained by use of this practice should not be represented as equivalent to those of any natural weathering test until the degree of quantitative correlation has been empirically established for the material in question.

3.3 Variations in results may be expected among instruments of different types and when operating conditions among similar type instruments vary within the accepted limits of this practice. Therefore, no reference should be made to results from use of this practice unless accompanied by the report form as specified in Fig. 1.

4. Apparatus¹³

4.1 The apparatus employed shall use one or two carbon-arc lamps as the source of radiation, and shall be one of the following types, or equivalent. The term "cycle" is defined as the total time for all exposure conditions (light, light plus water spray, dark periods) that are repeated.

NOTE 2—Several models of carbon-arc type exposure devices are no longer commercially available and should be considered obsolete. Exposures in these devices are not recommended and should only be made when mutually agreed upon by all interested parties.

4.1.1 *Type D*—Twin enclosed carbon-arc lamp apparatus, with a 762 mm (30 in.) diameter specimen drum rotating at 1 rpm, automatic control of temperature and cycle, and manually adjusted humidifier.

4.1.2 *Type DH*—Same as Type D, except with automatic control of the humidity.

4.1.3 *Type E*—Single open-flame sunshine carbon-arc lamp apparatus, with a 959 mm (37.75 in.) diameter specimen rack rotating at 1 rpm, automatic control of temperature and cycle, and manually adjusted humidifier.

4.1.4 *Type EH*—Same as Type E, except with automatic control of the humidity.

4.1.5 *Type H*—Single enclosed carbon-arc lamp apparatus, with a 508 mm (20 in.) diameter specimen rack, rotating at 1 rpm, automatic control of temperature and cycle, and manual regulation of the humidity.

4.1.6 *Type HH*—Same as Type H, except with automatic control of the humidity.

4.2 The apparatus should consist of a suitable frame within which is located a test chamber, and necessary compartments for housing control and regulating equipment.

4.3 Provision should be made for mounting or supporting the test specimens in a circular rack or drum that is rotated around the arc or arcs. This provides uniform distribution of the radiation on all specimens around the circumference of the rack. It does not, however, improve the distribution of the radiation along the vertical axis.

4.4 Adequate ventilation should be provided in the test chamber to prevent contamination of the specimens from combustion products of the arc.

4.5 The apparatus should include equipment necessary for measuring and controlling the following:

4.5.1 Arc current,

4.5.2 Arc voltage,

4.5.3 Black-panel temperature (Note 3),

¹² Available from American National Standards Institute, 1430 Broadway, New York, NY 10017.

¹³ Available from the Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 606132 and from Suga Test Instruments Co., Ltd. 4-14, Shinjuku 5-chome, Shinjuku-ku, Tokyo, 160, Japan.

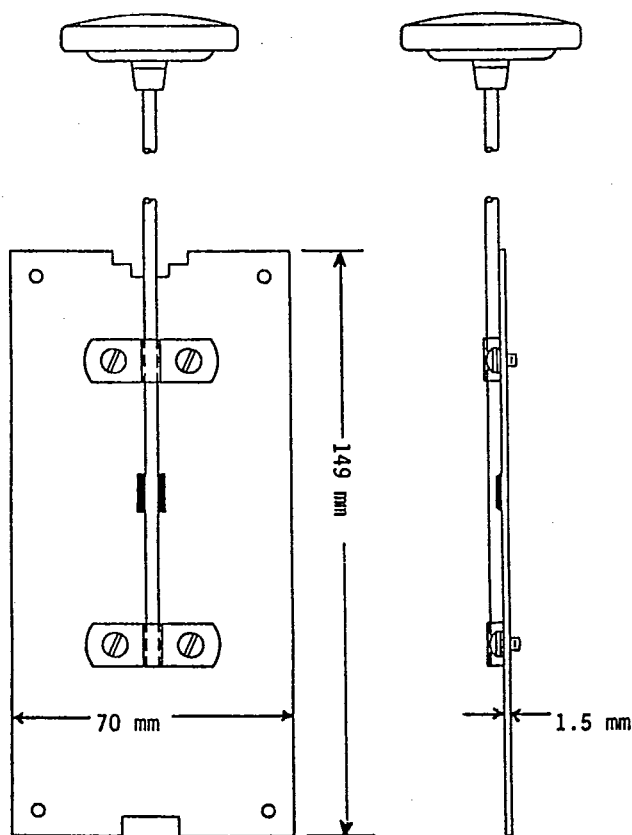


FIG. 2 Black Panel Thermometer Unit Using Dial Type Thermometer

- 4.5.4 Water-spray pressure,
- 4.5.5 Operating schedule or cycle,
- 4.5.6 Exposure time, and
- 4.5.7 Relative humidity (Types DH, EH, and HH only).

4.6 Types DH, EH, and HH apparatus are equipped with thermostatically actuated vaporizing units for adding moisture to the air as it passes through the conditioning chamber prior to its entry into the test chamber. Type H and some Types D, and E have manually regulated, electrically operated vaporizing units. Relative humidity of the air in the test chamber is calculated from the readings of the wet- and dry-bulb thermometers, either indicating or reporting, whose sensing portion is located in the air stream at its point of exit from the test chamber.

4.7 The black-panel thermometer unit should consist of a stainless steel panel 1 by 70 by 150 mm (.060 by 2.75 by 5.875 in.) to which is mechanically fastened a temperature sensing device. This device shall be capable of measuring temperature to a repeatability of $4 \pm 1^\circ\text{C}$ (see Figs. 2 and 3). The face of the panel with the temperature sensing device attached should be finished with two coats of baked-on black enamel selected for its resistance to light and water.

4.8 Detailed requirements and operating conditions of the apparatus are given in Table 1 and Figs. 4 to 6.

5. General Procedure

5.1 Prepare specimens of a suitable size and shape for mounting in the drum or rack of the apparatus in accordance

with the detailed requirements specified for the material to be tested.

5.2 Mount the test specimens, except those whose shape or other physical characteristics make it impractical, vertically both above and below the horizontal center line of the source of radiation. To assure that specimens receive the greatest uniformity of radiant exposure, reposition them vertically in a sequence which will provide each specimen equivalent exposure periods in each location. When the exposure interval does not exceed 24 h, each specimen should be located equidistant from the horizontal axis of the arc. For exposure intervals not exceeding 100 h, daily rotation of the specimens is recommended. Other methods of achieving uniform total irradiation may be employed if mutually agreed upon by concerned parties.

5.3 For enclosed arcs only, where physical characteristics do not permit suspension of specimens in a vertical position, expose them horizontally on a rack 165 mm (6.5 in.) below the horizontal center of the source or sources of radiation. Mount the specimens on a circular horizontal rack equipped with turntables, so that each specimen is rotated on its own axis as all of the specimens are rotated around the source or sources of radiation.

5.4 Temperature measurement and control should be based on the black-panel thermometer unit. Support the panel with the thermometer attached in the specimen drum or rack in the same manner as the test specimens so that it will be subjected to the same influences.

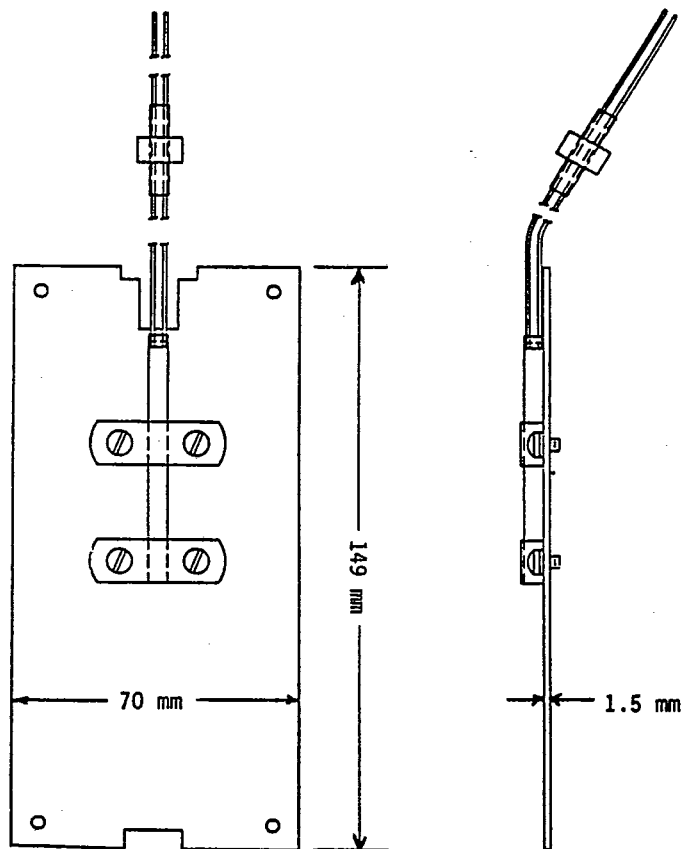


FIG. 3 Black Panel Thermometer Unit Using RTD Thermocouple Sensor