



Designation: G 23 – 81

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 practice has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

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 methods or specifications for specific materials.

NOTE 1—See the following for recommendations on specific materials:

ASTM Recommended Practice G 26, for Operating Light Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.²

ASTM Recommended Practice G 53, for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-condensation Type) for Exposure of Nonmetallic Materials.²

ASTM Recommended Practice D 822 for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products.²

ASTM Recommended Practice D 529, for Accelerated Weathering Test of Bituminous Materials.³

ASTM Recommended Practice D 1499, for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics.⁴

ASTM Recommended Practice D 750 for Rubber Deterioration in Carbon-Arc Weathering Apparatus.⁵

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. These exposure conditions are those specified by AATCC Test Method 16A 1977 Colorfastness to Light,

Carbon-Arc Lamp, Continuous Light.

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.

2. Significance

2.1 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.

2.2 Since the natural environment varies with respect to time, geography, and topography, it may be expected that the effects of natural exposure will vary accordingly. All materials are not affected equally by the same environment. 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 established for the material in question.

2.3 Variations in results may be expected among instruments of different types or when operating conditions among similar type instruments vary within the accepted limits of this recommended practice. Therefore, no reference should be made to results from use of this practice unless accompanied by the report form as specified in Fig. 4.

3. Apparatus

3.1 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 of the time intervals of light and water spray.

3.1.1 *Type A*—Single enclosed carbon-arc lamp apparatus⁶ 762 mm (30 in.) diameter specimen drum, automatic control of temperature and cycle with 1 rpm of the specimen drum, and no automatic control of humidity.

3.1.2 *Type AH*—Same as Type A, except with automatic control of humidity.

3.1.3 *Type B*—Not recommended, see Appendix.

3.1.4 *Type C*—Not recommended, see Appendix.

3.1.5 *Type D*—Twin enclosed carbon-arc lamp apparatus, 762 mm (30 in.) diameter specimen drum, automatic control

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.

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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.

² Annual Book of ASTM Standards, Vol 06.01.

³ Annual Book of ASTM Standards, Vol 04.04.

⁴ Annual Book of ASTM Standards, Vol 08.01.

⁵ Annual Book of ASTM Standards, Vol 09.01.

⁶ Available from the Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

of temperature and cycle with 1 rpm of the specimen drum, and no automatic control of humidity.

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

3.1.7 *Type E*—Single open-flame sunshine carbon-arc lamp apparatus, 959 mm (37.75 in.) diameter specimen rack, automatic control of temperature and cycle with 1 rpm of the specimen rack, and no automatic control of humidity.

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

3.1.9 *Type F*—Not recommended, see Appendix.

3.1.10 *Type G*—Not recommended, see Appendix.

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

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

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

3.3 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, providing uniform distribution of the radiation on all specimens.

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

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

3.5.1 Arc current,

3.5.2 Arc voltage,

3.5.3 Black-panel temperature (Note 2),

3.5.4 Water-spray pressure,

3.5.5 Operating schedule or cycle,

3.5.6 Exposure time, and

3.5.7 Relative humidity (Types AH, DH, EH, and HH only).

3.6 Types AH, 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 A, 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 wet- and dry-bulb thermometers, either indicating or recording, whose sensing portion is located in the air stream at its point of exit from the test chamber.

3.7 The black-panel thermometer unit should consist of 1.5 mm stainless steel panel 70 by 149 mm (2.75 by 5.875 in.) to which is mechanically fastened a stainless steel

TABLE 1 Detail Requirements and Operating Conditions of Light- and Water-Exposure Apparatus

	Type ^A			
	A, AH	D, DH	E, EH	H, HH
Line voltage, V: 208 to 250	X	X	X	X
Arc voltage, V: 120 to 145 48 to 52	X	X	X	X
Arc current, A: 15 to 17, ac 58 to 62, ac 12 to 14, dc 58 to 62, dc	X	X	X	X
Carbon electrodes, upper: neutral cored or solid ^B copper-coated sunshine ^C	X	X	X	X
Carbon electrodes, lower: neutral cored or solid ^B copper-coated sunshine ^C	X	X	X	X
Filter, globe, or flat pane for removing undesired wavelengths of radiation and preventing byproducts of combustion of the arc from contaminating the specimens:				
Globe of optical, heat-resistant glass with cut-off at 2750 Å, with an increase in transmission to 91 % at 3700 Å ^D	X	X		X
Flat panes of optical, heat-resistant glass with cut-off at 2550 Å, with an increase in transmission to 91 % at 3600 Å ^E			X	
Diameter of specimen rack or drum, mm (in.): 508 (20) 762 (30) 960 (37.7)	X	X	X	X
Speed of rotation of specimen drum or rack: 1 rpm	X	X	X	X
Automatic arc feed: Solenoid-operated Motor-operated	X	X	X	X
Spray (see figure indicated for arrangement, location, and capacity)	Fig. 1	Fig. 1	Fig. 2	Fig. 3

^A "X" in column indicates application to that type of apparatus.

^B No. 70 Solid Carbon Electrodes and No. 20 Cored Carbon Electrodes or equivalent.

^C No. 22 Copper-Coated Sunshine Carbon Electrodes and No. 15.5 Copper-Coated Sunshine Carbon Electrodes or equivalent.

^D No. 9200-PX Globe or equivalent.

^E 7058 Corex Filter Panes or equivalent.

bimetallic dial-type thermometer. This thermometer shall have a stem 3.9 mm (0.156 in.) in diameter with a 44.4-mm (1.75-in.) dial. The sensitive portion extending 38 mm (1.5 in.) from the end of the stem should be located in the center of the panel 64 mm (2.5 in.) from the top and 48 mm (1.875 in.) from the bottom of the panel. The face of the panel with the thermometer stem attached should be finished with two coats of a baked-on black enamel selected for its resistance to light and water. Control of the black-panel temperature should be accomplished preferably by a continuous flow of air over the specimen at a controlled temperature, but an on-off flow of room temperature air is permissible.

3.7.1 A thermocouple or resistance bulb thermometer mounted on the center face of the black-panel, which provides temperature values equivalent to the dial thermometer may be used.

3.8 Detailed requirements and operating conditions of the apparatus are given in Table 1 and Figs. 1 to 3.

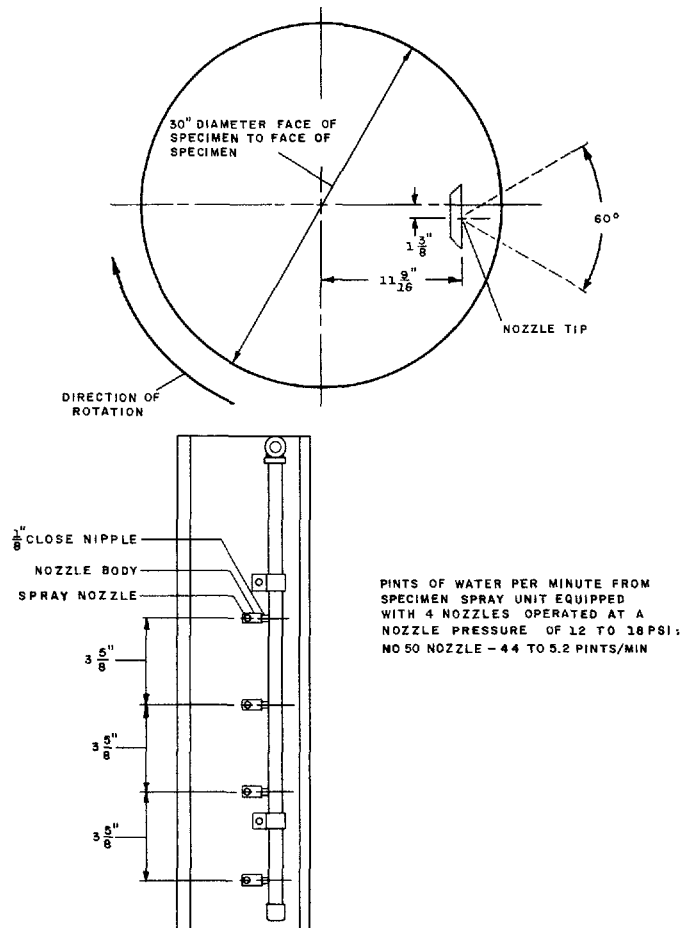
4. General Procedure

4.1 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.

4.2 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 uniform total irradiation over the specimen surface, specimens should be repositioned 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.

4.3 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.



Metric Equivalents							
mm	3.3	34.9	92.1	101.6	293.2	762	83 to 124 kPa
in.	¹ / ₈	1 ³ / ₈	3 ⁵ / ₈	4	11 ¹ / ₁₆	30	12 to 18 psi
							2.5 to 2.9 dm ³ 4.4 to 5.2 pt

FIG. 1 Specimen Spray Arrangement for Types, A AH, B, C, D, and DH Apparatus