Designation: ~~G24 – 05~~ G24 – 13

Standard Practice for Conducting Exposures to Daylight Filtered Through Glass[1]

This standard is issued under the fixed designation G24; 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.

1. ~~Scope~~ Scope*

1.1 This practice evaluates the resistance of nonmetallic materials to solar radiation filtered through ~~glass.~~glass in passively ventilated and non-vented enclosures. For exposures in under glass enclosures with forced air circulation, refer to Practice G201.

1.2 For direct exposures, refer to Practice G7.

1.3 This practice is limited to the method of conducting the exposures. The preparation of test specimens and evaluation of results are covered in various standards for the specific materials.

1.4 Exposure conducted according to this practice can use two types of exposure cabinets.

1.4.1 *Type A*—A cabinet that allows passive ventilation of specimens being exposed behind glass.

1.4.2 *Type B*—Enclosed cabinet with exterior painted black that ~~allows no~~ does not provide for ventilation of specimens exposed behind glass. Exposures conducted using a Type B cabinet are typically referred to as "black box under glass exposures."

1.5 Type A exposures of this practice are technically similar to Method B of ~~ISO 877.~~ISO 877-2.

1.6 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.7 *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:*[2]

C1036 Specification for Flat Glass
D3424 Practice for Evaluating the Relative Lightfastness and Weatherability of Printed Matter
D4303 Test Methods for Lightfastness of Colorants Used in Artists' Materials
D6901 Specification for Artists' Colored Pencils
E824 Test Method for Transfer of Calibration From Reference to Field Radiometers
E903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
E1084 Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight
G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials
G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials
G173 Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface
G177 Tables for Reference Solar Ultraviolet Spectral Distributions: Hemispherical on 37° Tilted Surface
G201 Practice for Conducting Exposures in Outdoor Glass-Covered Exposure Apparatus with Air Circulation

2.2 *Other Documents:*

WMO Guide to Meteorological Instruments and Methods of Observation WMO No. 8, ~~Fifth~~Seventh Edition.[3]
ISO 105 B01 Textiles—Tests for Colour Fastness, International Standards Organization, Geneva, Switzerland.[4]

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[1] This practice is under the jurisdiction of ASTM Committee G03 on Weathering and Durabilityand is the direct responsibility of Subcommittee G03.02 on Natural and Environmental Exposure Tests.

Current edition approved ~~Jan. 1, 2005~~June 1, 2013. Published ~~February 2005~~July 2013. Originally approved in 1973. Last previous edition approved in ~~1997~~2005 as ~~G24 – 97.~~G24 – 05. DOI: ~~10.1520/G0024-05.~~10.1520/G0024-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from World Meteorological ~~Organization, Geneva, Switzerland.~~ Organization (WMO), 7bis, avenue de la Paix, Case Postale No. 2300, CH-1211 Geneva 2, Switzerland, http://www.wmo.int.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY ~~10036.~~10036, http://www.ansi.org.

***A Summary of Changes section appears at the end of this standard**

ISO ~~877~~877-1 ~~Plastics—Methods~~ Plastics – Methods of Exposure to ~~Direct Weathering, to Weathering Using Glass-Filtered Daylight, and to Intensified Weathering by Daylight Using Fresnel Mirrors, International Standards Organization, Geneva, Switzerland~~Solar Radiation – Part 1: General Guidance[4]
ISO 877–2 Plastics – Methods of Exposure to Solar Radiation – Part 2: Direct Weathering and Exposure Behind Window Glas
AATCC ~~16C~~TM 16, Option 6 Colorfastness to Light, Daylight[5]
AATCC Test Method 16.1-2012 Colorfastness to Light: Outdoor

3. Terminology

3.1 *Definitions:*

3.1.1 The definitions contained in Terminology G113 are applicable to this practice.

4. Significance and Use

4.1 Since solar ~~irradiance,~~radiation, air temperature, relative humidity, and the amount and kind of atmospheric contaminants vary continuously, results from exposures based on elapsed time may differ. The variations in the results may be minimized by timing the exposures in terms ~~of one or more environmental parameters such as solar radiant exposure, or in terms of a predetermined property change of a reference specimen with known performance.~~of:

4.1.1 One or more environmental parameters such as solar radiant exposure, or

4.1.2 A predefined property change of a weathering reference specimen with known performance.

4.2 Variations in temperature, moisture and atmospheric contaminants can have a significant effect on the degradation caused by solar radiation. In addition, exposures conducted at different times of the year can cause large differences in rate of degradation. Different materials may have different sensitivities to heat, moisture, and atmospheric ~~contaminants. This~~contaminants, which may explain differences in rankings of specimens exposed to equivalent solar radiant exposure when other environmental conditions vary.

4.3 Since the method of mounting may influence the temperature and other parameters during exposure of the ~~specimen during exposure,~~ specimen, there should be a mutual understanding as to the method of mounting the specimen for the particular exposure test under consideration.

4.4 There can be large differences among various single strength window glasses in their ~~transmission~~transmittance in the 300 to 350 nm region. For example, at 320 nm, the percent ~~transmission~~transmittance for seven different lots of single strength window glass ranged from 8.4 to ~~26.8 %. For this range of transmission, the rate of degradation for materials sensitive to short wavelength UV from 300 to 320 nm could vary by as much as 300 %.~~26.8 %. At 380 nm, the percent transmittance ranged from 84.9 % to 88.1 %.[6]

4.5 Differences in UV ~~transmission~~transmittance between different lots of glass persist after solarization. The largest differences among window glasses in UV ~~transmission~~transmittance are in the spectral range of 300 to 320 nm. ~~Use of radiant exposure based on total solar radiation or total solar UV radiation to determine exposure periods is not sensitive to these differences. For materials very sensitive to differences in short wavelength UV radiation, monitoring UVB radiation behind glass may be the best approach~~

[5] Available from American Association of Textile Chemists and Colorists (AATCC), ~~One Davis Dr.,~~ P.O. Box 12215, Research Triangle Park, NC ~~27709-2215.~~ 27709, http://www.aatcc.org.

[6] Ketola, W. D., and Robbins, J.S., III, "UV Transmission of Single Strength Window Glass," *Accelerated and Outdoor Durability Testing of Organic Materials, ASTM STP 1202*, Warren D. Ketola and Douglas Grossman, Eds., American Society for Testing and Materials, Philadelphia, 1994.

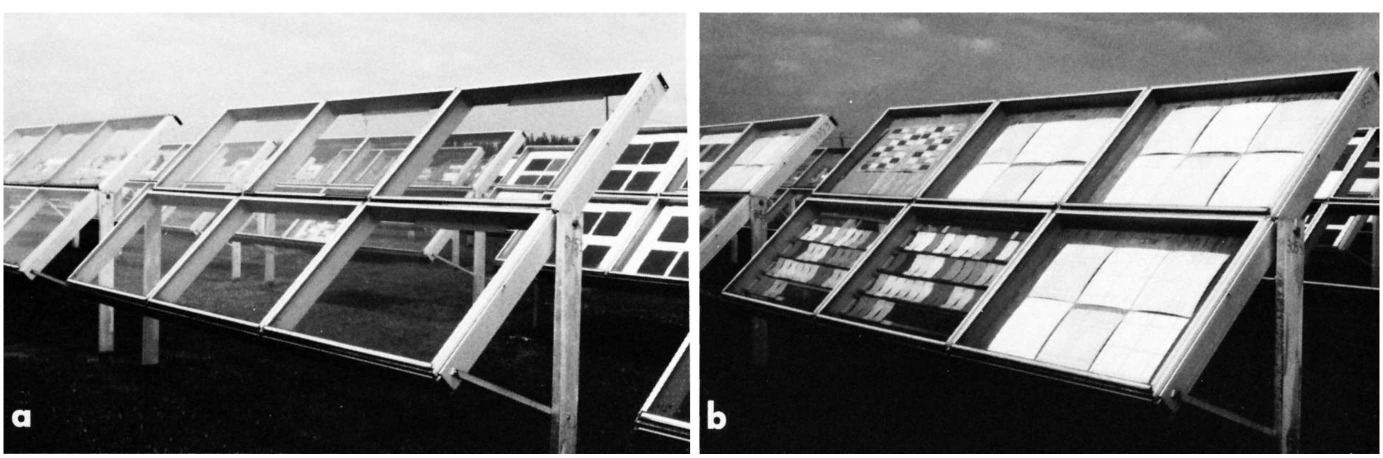

FIG. 1 a and 1b Typical ~~Well-Ventilated~~Passively-Ventilated Under Glass Exposure Cabinet, Type A

FIG. 2 Typical Non-Ventilated Enclosed Under Glass Exposure Cabinet, Type B (Black Box Under Glass)

~~for use when radiant energy is used to determine the length of exposures. However, for materials sensitive to long wavelength UV or visible radiation, monitoring UVB radiation or using reference materials that are very sensitive to short wavelength solar ultraviolet radiation to determine exposure periods may produce erroneous results.~~

4.6 This practice is best used to compare the relative performance of materials tested at the same time behind the same lot of glass. Because of variability between lots of glass and between exposures conducted at different times of the year, comparing the amount of degradation in materials exposed for the same duration or radiant exposure at separate times, or in separate fixtures using different lots of glass is not recommended.

4.7 It is strongly recommended that at least one control material be exposed with each test. The control material should be of similar composition and construction. and be chosen so that its failure modes are the same as that of the material being tested. It is preferable to use two control materials, one with relatively good durability, and one with relatively poor durability. If control materials are included as part of the test, they shall be used for the purpose of comparing the performance of the test materials relative to the controls.

4.8 There are other standards which describe exposures to glass filtered daylight. ~~Three~~Six cited standards are D3424, D4303, D6901, ISO 105-B01, ~~ISO 877, and~~ISO 877-1, ISO-877-2, AATCC TM 16C.

4.9 Because of the possibility that certain materials may outgas during exposure, it is recommended that only similar materials be exposed in the same under glass ~~cabinet.~~cabinet at the same time.

5. Apparatus

5.1 *Exposure Cabinet:*

5.1.1 *Type A*—~~Exposures shall be conducted in a~~ A glass-covered enclosure or cabinet of any convenient ~~size. It shall be constructed of wood, metal, or other satisfactory material, in order~~ size, constructed to protect the specimens from ~~rain and weather, and~~ rain. It typically is constructed of metal or wood, and shall be open on the back or sides to allow ambient air to passively circulate over the specimens (Fig. 1a and b).

5.1.2 *Type B (Black Box Under Glass)*—~~Exposures shall be conducted in a~~ A glass-covered enclosure or cabinet of any convenient size. It shall be constructed of corrosion resistant metal and be enclosed to prevent ambient air from circulating over specimens. Exterior non-glass surfaces shall be painted flat black. The interior shall remain unpainted (Fig. 2).

NOTE 1—For some exposures (for example Method B of D4303 or Method A of D6901), a small fan is inserted into the Type B enclosure to minimize condensation. For enclosures with forced air circulation, refer to Practice G201.

NOTE 2—The black box under glass ~~test method~~ enclosure is often used to simulate under glass exposures under conditions of high temperature, such as the interior of an automobile. However, because black box under glass cabinets are enclosed, air temperatures may exceed 80°C under conditions of high outside ambient air temperature and solar irradiance. In addition, significant differences in air and specimen temperatures can be experienced between upper and lower portions of the cabinet. Frequent temperature measurement and specimen repositioning may be required to properly use this ~~test method.~~enclosure.

5.1.3 Unless otherwise specified the glass cover shall be a piece of non-laminated, transparent flat glass, greenhouse quality Q4 or better as specified in section 4.1 of Specification C1036. ~~Glass thickness~~ Thickness shall be ~~2~~2.0 to 3.2 mm.

5.1.3.1 In order to reduce variability due to changes in UV ~~transmission~~transmittance of glass, all new glass shall be exposed facing the equator, at any convenient exposure tilt angle within the range of 5 to 45°, according to Practice G7, or on an empty under glass exposure cabinet, for at least three months prior to installation in test cabinets.

5.1.3.2 After the three-month pre-exposure period, it is recommended that the spectral transmittance of representative samples from each lot of glass be measured. Typically, "single strength" glass will have a transmittance of 10 to 20 % at 320 nm and at