Designation: G224 – 23

Standard Practice for Operating UVC Lamp Apparatus for Exposure of Materials[1]

This standard is issued under the fixed designation G224; 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

1.1 This practice is limited to the basic principles for operating a low-pressure mercury lamp apparatus to assess degradation of materials due to exposure to UVC light; on its own, it does not deliver a specific result.

1.2 It is intended to be used in conjunction with a practice or method that defines specific exposure conditions for an application along with a means to evaluate changes in material properties. This practice is intended to reproduce the photodegradation effects that occur when materials are exposed to artificial light sources that emit radiation primarily in the UVC wavelength band, particularly in the range of 240 nm to 280 nm. This practice is limited to the procedures for obtaining, measuring, and controlling conditions of exposure.

NOTE 1—Practice G151 describes general procedures to be used when exposing materials in accelerated test devices that use laboratory light sources.

NOTE 2—A common use of UVC light sources is for the disinfection of surfaces and air, a process known as ultraviolet germicidal irradiation (UVGI). Water disinfection applications using UVC light sources have been in use for many decades.

1.3 This practice does not cover other light sources (e.g. LEDs, excimer lamps, etc.) or any lamps that emit wavelengths primarily outside the range in 1.2.

1.4 Specimens are exposed to UVC light controlled to a specified irradiance level under controlled temperature conditions.

1.5 Specimen preparation and evaluation of the results are covered in ASTM methods or specifications for specific materials. General guidance is given in Practice G151.

1.6 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G130 Test Method for Calibration of Narrow- and Broad-Band Ultraviolet Radiometers Using a Spectroradiometer

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials

2.2 *IEC Standards:*[3]

IEC 60335-1 Household and similar electrical appliances - Safety - Part 1: General requirements

3. Terminology

3.1 *Definitions:*

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 As used in this practice, the term *sunlight* is identical to the terms *daylight* and *solar irradiance*, *global* as they are defined in Terminology G113.

3.2.2 *UVC, n*—portion of the electromagnetic spectrum comprising wavelengths between 100 nm and 280 nm, also spelled UV-C.

4. Summary of Practice

4.1 Specimens are exposed to a UVC light source under controlled conditions of irradiance and temperature.

[1] This practice is under the jurisdiction of ASTM Committee G03 on Weathering and Durability and is the direct responsibility of Subcommittee G03.03 on Simulated and Controlled Exposure Tests.

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

NOTE 3—The effects of water in liquid or vapor form are not considered. It is expected that the relative humidity at the specimen surface will be less than 50 % and could be less than 10 % depending on test and laboratory conditions.

4.2 The exposure condition may be varied by selection of:

4.2.1 The lamp's irradiance level,

4.2.2 The use of alternating conditions of darkness and UVC exposure and the timing of each, and

4.2.3 The temperature during each exposure condition.

5. Significance and Use

5.1 Material resistance to photodegradation caused by exposure to artificial UVC light sources is a growing concern due to the use of ultraviolet germicidal irradiation (UVGI) to mitigate the spread of infectious diseases.

5.2 Materials and products intended for direct sunlight exposure are typically designed to resist the effects of the UVA and UVB light reaching the earth's surface, but generally they are not tested to determine the effects of exposure to UVC, which is filtered out by the atmosphere.

5.3 Compared to light in the UVA and UVB regions of the electromagnetic spectrum, UVC light, when absorbed by a material, can cause photodegradation to proceed at different rates and by different mechanisms as well as confining degradation to a thinner surface layer.

5.4 Indoor materials and products, which typically are not designed to withstand significant ultraviolet light exposure, are at even greater risk of premature degradation when subjected to UVC exposure.

5.5 This practice is intended to induce property changes consistent with those experienced by materials exposed to artificial UVC light sources with a similar spectral irradiance distribution to those specified in this practice.

6. Apparatus

6.1 Apparatus that comply with the requirements of Practice G154 meet the requirements of this standard provided they meet the additional requirements in this section.

6.2 *Laboratory Light Source*—The light source shall be one or more low-pressure mercury lamps, made with glass that blocks all emissions at wavelengths below 200 nm to prevent the generation of ozone.

NOTE 4—Low-pressure mercury lamps emit ultraviolet light primarily in two spectral lines: 254 nm and 185 nm (**1**)[4]. The 185 nm line is capable of generating ozone when exposed to air, but certain glass types are able to absorb it and prevent ozone production. These lamps emit additional spectral lines in the visible range, giving them a blue-violet appearance. The visible spectral lines are not considered in this document.

NOTE 5—Low-pressure mercury lamps are similar in construction to typical UV fluorescent lamps, except they lack the white phosphor coating that creates the fluorescence effect.

6.2.1 Low-pressure mercury lamps are differentiated from other mercury lamps by their significantly lower gas fill pressure. Other types of mercury lamps, such as medium or high pressure lamps, shall not be used.

NOTE 6—For example, medium-pressure mercury lamps have fill pressures of approximately 1 bar or higher, which significantly changes their spectral irradiance. In contrast, low-pressure mercury lamps typically have fill pressures less than 10 mbar.

6.2.2 Lamps meeting these requirements are referred to as UVC-254 lamps. A spectral irradiance distribution, bandpass corrected, is shown in Fig. 1. See Appendix X1 for information on measuring the spectral irradiance of low-pressure mercury lamps.

[4] The boldface numbers in parentheses refer to a list of references at the end of this standard.

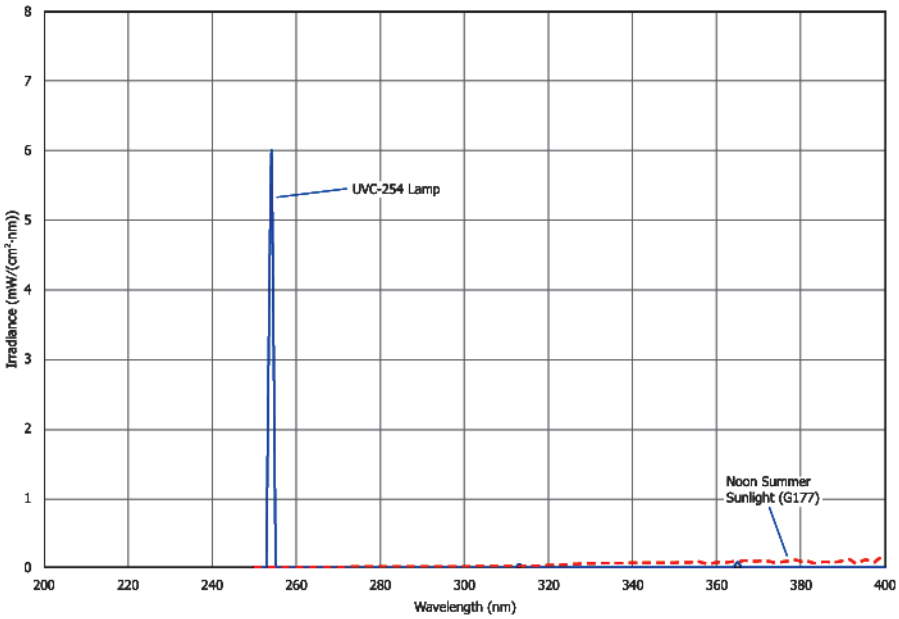

FIG. 1 Spectral Irradiance of UVA-254 Lamps, shown with irradiance of 6.0 mW/(cm²·nm) at 254 nm, and reference sunlight spectrum, G177