



Designation: G155 – 21

Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials¹

This standard is issued under the fixed designation G155; 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 U.S. Department of Defense.

1. Scope

1.1 This practice is limited to the basic principles and procedures for operating a xenon arc lamp and water apparatus; 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 weathering effects that occur when materials are exposed to sunlight (either direct or through window glass) and moisture as humidity, rain, or dew in actual use. This practice is limited to the procedures for obtaining, measuring, and controlling conditions of exposure.

NOTE 1—A number of exposure procedures are listed in an appendix; however, this practice does not specify the exposure conditions best suited for the material to be tested.

NOTE 2—Practice **G151** describes general procedures and performance requirements to be used when exposing materials in an apparatus that uses laboratory light sources.

1.3 Test specimens are exposed to light from an optically-filtered xenon arc lamp under controlled environmental conditions. Different types of optical filters in combination with xenon arc light sources are described.

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

NOTE 3—General information about methods for determining the change in properties after exposure and reporting these results is described in Practice **D5870**.

1.5 This practice is not intended for corrosion testing of bare metals.

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 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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1.7 This practice is technically similar to the following ISO documents: ISO 4892-2, ISO 16474-2, ISO 105-B02, ISO 105-B04, ISO 105-B05, ISO 105-B06, and ISO 105-B10.

1.8 *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.*

1.8.1 *Should any ozone be generated from the operation of the lamp(s), it shall be carried away from the test specimens and operating personnel by an exhaust system.*

1.9 *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

D2565 Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications

D5870 Practice for Calculating Property Retention Index of Plastics

D6695 Practice for Xenon-Arc Exposures of Paint and Related Coatings

D7869 Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings

G26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Discontinued 2001) (Withdrawn 2000)³

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

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 The last approved version of this historical standard is referenced on www.astm.org.

- G151** Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
G153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G177 Tables for Reference Solar Ultraviolet Spectral Distributions: Hemispherical on 37° Tilted Surface

2.2 *ASTM Adjuncts:*

SMARTS2: Simple Model of the Atmospheric Radiative Transfer of Sunshine⁴

2.3 *CIE Standard:*⁵

CIE-Publ. No. 85: Recommendations for the Integrated Irradiance and the Spectral Distribution of Simulated Solar Radiation for Testing Purposes

2.4 *ISO Standards:*⁶

ISO 16474-2 Paints and Varnishes—Methods of Exposure to Laboratory Light Sources—Part 2: Xenon-arc Lamps

ISO 105-B02 Textiles—Tests for Colorfastness—Part B02 Colorfastness to Artificial Light: Xenon Arc Fading Lamp Test

ISO 105-B04 Textiles—Tests for Colorfastness—Part B04 Colorfastness to Artificial Weathering: Xenon Arc Fading Lamp Test

ISO 105-B05 Textiles—Tests for Colorfastness—Part B05 Detection and Assessment of Photochromism

ISO 105-B06 Textiles—Tests for Colorfastness—Part B06 Colorfastness to Artificial Light at High Temperatures: Xenon Arc Fading Lamp Test

ISO 105-B10 Textiles—Tests for Colorfastness—Part B10: Artificial Weathering—Exposure to Filtered Xenon Arc Radiation

ISO 4892-2 Plastics—Methods of Exposure to Laboratory Light Sources, Part 2, Xenon-Arc Sources

ISO TS 19022 Plastics—Method of Controlled Acceleration of Laboratory Weathering by Increased Irradiance

2.5 *SAE Standards:*⁷

SAE J2412 Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Xenon-Arc Apparatus

SAE J2527 Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Apparatus

3. Terminology

3.1 *Definitions*—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**.

⁴ Available from ASTM International Headquarters. Order Adjunct No. **ADJG0173**.

⁵ Available from IHS Markit, <https://global.ihs.com>.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁷ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

4. Summary of Practice

4.1 Specimens are exposed to repetitive cycles of controlled light, heat, and moisture.

4.2 The exposure condition may be varied by selection of:

4.2.1 The type of optical system used to adjust the spectrum,

including xenon arc lamp(s), optical filter(s), and reflector(s),

4.2.2 The lamp's irradiance setpoint,

4.2.3 Optional moisture exposure in the form of (controlled) relative humidity within the apparatus, spraying the test specimen(s) with demineralized/deionized water, immersing the specimens in water, or by condensation of water vapor onto specimens,

4.2.4 The sequence and duration of the various cycle step(s) (including light, dark, moisture), and

4.2.5 The temperature and types of thermometers and other temperature sensor(s) used.

5. Significance and Use

5.1 The apparatus exposes specimens to light, heat, and optionally moisture, often to attempt to replicate specimen property changes observed in outdoor and indoor end-use environments. Exposures are not intended to simulate the deterioration caused by localized weather phenomena, such as atmospheric pollution, biological attack, and saltwater exposure.

5.2 This practice allows a wide range of exposure conditions that may produce significantly different results. Therefore, no reference shall be made to results from its use unless accompanied by a report in conformance with Section **10** detailing the specific operating conditions.

5.2.1 A control (a similar material of known performance) should be exposed simultaneously with the test specimen to provide a reference for comparative purposes. It is best practice to use two different control materials: one known to have relatively poor durability and one known to have relatively good durability. At least three replicates of each test specimen and control material should be exposed concurrently to permit statistical evaluation of results.

5.3 Comparison of results obtained from specimens exposed in different apparatus (even if the apparatus is the same model) using the identical setpoints and operational controls should not be made unless reproducibility has been established between apparatus for the material to be tested.

5.4 Refer to Practice **G151** for cautionary guidance applicable to all laboratory weathering apparatus.

5.5 It is recommended that users follow good laboratory practices in order to reduce variability in exposures (**1**).⁸

6. Apparatus

6.1 *Laboratory Light Source*—The light source shall be one or more quartz-jacketed xenon arc lamps which emit radiation below 270 nm in the ultraviolet, throughout the visible spectrum, and into the infrared. In order for xenon arcs to

⁸ The boldface numbers in parentheses refer to the list of references at the end of this standard.