



Designation: D4303 – 10 (Reapproved 2022)

Standard Test Methods for Lightfastness of Colorants Used in Artists' Materials¹

This standard is issued under the fixed designation D4303; 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 Four test methods to accelerate the effects of long term indoor illumination on artists' materials are described below. One of the natural daylight methods and one of the xenon-arc methods are used to categorize the lightfastness of colorants.

1.1.1 *Test Method A*—Exposure in southern Florida to natural daylight filtered through window glass.

1.1.2 *Test Method B*—Exposure in Arizona to natural daylight filtered through window glass.

1.1.3 *Test Method C*—Exposure in a non-humidity controlled xenon-arc device simulating daylight filtered through window glass.

1.1.4 *Test Method D*—Exposure in a humidity controlled xenon-arc device simulating daylight filtered through window glass.

1.2 These test methods are used to approximate the color change that can be expected over time in colorants used in artists' materials exposed indoors to daylight through window glass.

NOTE 1—The color changes that result from accelerated exposure may not duplicate the results of normal indoor exposure in a home, art gallery, or museum. The relative resistance to change, however, can be established so colored materials can be assigned to categories of relative lightfastness.

NOTE 2—Users who wish to test colored materials under fluorescent illumination should consult Practice [D4674](#).

1.3 Lightfastness categories are established to which colorants are assigned based on the color difference between specimens before and after exposure.

1.4 Color difference units are calculated by the CIE 1976 $L^*a^*b^*$ color difference equation.

1.5 These test methods apply to colored artists' materials.

1.6 The values stated in SI units are to be regarded as the standard. The values 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, 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

[D2244](#) Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

[D4302](#) Specification for Artists' Oil, Resin-Oil, and Alkyd Paints

[D4674](#) Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments

[D5067](#) Specification for Artists' Watercolor Paints

[D5098](#) Specification for Artists' Acrylic Dispersion Paints

[D5724](#) Specification for Gouache Paints

[D6901](#) Specification for Artists' Colored Pencils

[E284](#) Terminology of Appearance

[E1347](#) Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

[E1348](#) Test Method for Transmittance and Color by Spectrophotometry Using Hemispherical Geometry

[E1349](#) Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry

[G24](#) Practice for Conducting Exposures to Daylight Filtered Through Glass

[G113](#) Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

[G141](#) Guide for Addressing Variability in Exposure Testing of Nonmetallic Materials

[G151](#) Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

¹ These test methods are under the jurisdiction of ASTM Committee [D01](#) on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee [D01.57](#) on Artist Paints and Related Materials.

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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.

G155 Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials

3. Terminology

3.1 *Definitions*—Appearance terms used in these test methods are defined in Terminology **E284**. Terms relating to natural and artificial lightfastness tests are defined in Terminology **G113**.

3.1.1 *glass, n*—as used in these test methods, glass refers to single-strength window glass.

4. Summary of Test Method

4.1 Color measurements are made on duplicate specimens that have been prepared as directed in the specification for that material. Examples of specifications are: **D4302**, **D5067**, **D5098**, **D5724**, and **D6901**. Each contains colorants in a different vehicle. The measurements are recorded for comparison with readings made after the specimens have been exposed.

4.2 Lightfastness is determined by exposing the specimens to daylight filtered through glass outdoors either in southern Florida or in Arizona and also to xenon arc radiation through a window glass filter.

4.3 The colorants are classified by the amount of color change calculated as ΔE^* units in accordance with Practice **D2244**.

4.4 Variations in test results can be due to differences in specimen preparation, surface irregularities, color measurements and conditions of exposure. Allowance for these variations is made by assigning a wide range of color change n each of the five lightfastness categories. Colorants are placed in one of these categories based on the mean of the ΔE^* values obtained from two or more types of exposure. Only colorants that place in the first two categories conform to the requirements of this standard.

5. Significance and Use

5.1 The retention of chromatic properties by a colorant over a long period of years is essential in a work of art. Accelerated exposure simulates color changes that may reasonably be expected. The producer and the user of artists' materials, therefore, can be apprised of suitable colorants.

5.2 Variations in results may be expected between the test methods. Also, some variation may be expected when the same test is repeated. Variations in Methods A and B are due to differences in outdoor conditions that are not accounted for in testing to equivalent radiant exposures. Information on sources of variability and strategies for addressing variability in laboratory accelerated exposure tests is found in Guide **G141**.

5.3 This standard does not cover factors other than lightfastness that can affect the permanence of art materials.

6. Apparatus

6.1 *Outdoor Exposure Facilities* as described in Practice **G24**, using an exposure angle of 45°, facing the equator.

6.2 *Xenon-Arc Lightfastness Apparatus* as described in Practice **G155**.

6.3 *Spectrophotometer*, abridged spectrophotometer or colorimeter capable of excluding specular reflectance in its measurement.

7. Procedure

7.1 Prepare seven specimens of the art materials to be tested, following the directions given in the appropriate specification. If there is no specification for the art material, seven specimens must be prepared that are as similar, uniform, and opaque as possible.

7.1.1 Two specimens of each color shall be exposed in each of two test methods, either A or B and either C or D. One specimen of each color shall be retained for a visual comparison with the test specimens following exposure, and two specimens shall be retained for use in a third exposure if needed.

7.1.2 The retained, unexposed specimens are stored in the dark unless the formulation contains oil. Store specimens that contain oil in a light level of 500 lux to 700 lux (50 fc to 75 fc) to prevent yellowing. If specimens must be stored for as long as 100 days, store all specimens in the dark, but remove those containing oil and place in the light level specified above to prevent yellowing for at least 7 days before measurement or visual evaluation.

7.1.3 Cut the specimen to a size that will fit the holder to be used for exposure and the port of the color measuring instrument.

7.1.4 Determine if test specimens are opaque. Colors mixed with white, as described in the specifications for artists' paints, are opaque. Other materials must be applied over both a black substrate and a white substrate to determine opacity. Any measured color difference between the color over black and over white indicates a lack of opacity.

7.1.4.1 A measurement representative of the whole specimen must be obtained if the specimen is not opaque. To get a representative measure of the color, both before and after exposure, either (1) use a large measuring port of 25 mm (1 in.) diameter, or (2) using a small port, obtain the mean of a number of measurements of various areas of the specimens, and compare it with the mean of a second set of measurements of different areas. If the means agree, use that value as the representative color. Otherwise, repeat the procedure until agreement is obtained.

7.2 Immediately before exposure, measure all test specimens using a spectrophotometer or spectrocolorimeter (see Test Method **E1348** or **E1349**) or colorimeter (see Test Method **E1347**) using Illuminant D65 and the 1964 10° Observer and excluding specular reflection from the measurement. Record the CIELAB measurement data.

7.2.1 Measure specimen panels with any brush marks in the same direction and measure the same area of the panel before and after each exposure interval. If the design of the instrument allows, three readings at different locations on the panel should be made and the mean calculated. If feasible, mark on the back of the specimen the spot(s) measured, and remeasure these same spots following exposure.