



Standard Practice for Determining the Relative Lightfastness of Ink Jet Prints Exposed to Window Filtered Daylight Using a Xenon Arc Light Apparatus¹

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1. Scope

1.1 This practice covers specific procedures and test conditions that are applicable for xenon-arc exposure of ink jet media prints conducted in accordance with Practices **G 151** and **G 155**. The laboratory accelerated procedure is intended to determine the relative lightfastness of ink jet prints in office environments where window filtered daylight is used for illumination.

1.2 The two criteria used to determine relative lightfastness are instrumental color change and change in optical density.

1.3 This practice is useful in determining the relative lightfastness of a series of prints or the relation of the lightfastness of the print of interest to the performance of controls with known lightfastness exposed simultaneously.

1.4 *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.* Specific precautionary statements are given in section 8.

1.5 There is no equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*²

D 1729 Practice for Visual Evaluation of Colors and Color Differences of Diffusely-Illuminated Opaque Materials

D 2244 Test Method for Calculation of Color Tolerances and Differences from Instrumentally Measured Color Coordinates

D 3424 Test Methods for Evaluating the Relative Lightfastness and Weatherability of Printed Matter

E 1347 Test Method for Color and Color-Difference Mea-

surement by Tristimulus (Filter) Colorimetry

E 1348 Test Method for Transmittance and Color by Spectrophotometry Using Hemispherical Geometry

E 1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional Geometry

G 113 Standard Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G 151 Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G 155 Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

2.2 *ANSI Standard:*

ANSI/NAPM IT9.9-1990 Stability of Color Photographic Images-Methods for Measuring

IT2.17-1995 ANNEX A1 Density Measurements-Part 4: Geometric Conditions for Reflection Density, Backing Material

3. Terminology

3.1 *Definitions:*

3.1.1 The definitions given in **G 113** are applicable to this Practice.

3.1.2 Ink jet media substrates used by ink jet printers to receive inks. The substrate may be paper, plastic, canvas, fabric, or other ink receptive material. The substrate may, or may not be, coated with one or more ink receptive layers.

4. Summary of Practice

4.1 Printed ink jet media are exposed to radiant energy from a xenon arc light source equipped with a Window-Glass Filter.

4.2 The duration of the exposure may vary widely depending on the lightfastness of the ink/media.

4.3 During the course of the exposure, changes in color and optical density in the printed samples are periodically evaluated. Color changes are determined either visually by comparison with the unexposed file specimens or instrumentally by comparison with the color of the same specimen prior to exposure and reported as color difference, ΔE . The color changes of a series of prints are compared with each other or with those of a control exposed at the same time for which

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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.

performance under use conditions are known. The change in optical density is determined instrumentally and reported as percent retained optical density.

4.4 The exposure may be continued for a specific duration of time, or until a predetermined color change and change in optical density has been achieved.

5. Significance and Use

5.1 Lightfastness of printed ink jet media for specified periods of time is pertinent to the end use of these materials. Since the ability of ink jet prints to withstand color changes is a function of the spectral power distribution of the light source to which it is exposed, it is important that lightfastness be assessed under the conditions appropriate to the end use application. While ink jet prints may be handled and displayed under a variety of conditions, this practice is intended to produce the color changes that may occur in ink jet prints upon exposure to irradiation from daylight filtered through window glass by simulating these conditions.

5.2 The accelerated procedure covered in this practice is intended to provide a means for the rapid evaluation of relative lightfastness under laboratory test conditions. The Practice does not provide a rating of the lightfastness of the prints, but determines the lightfastness ranking of a series of prints or the performance compared to controls with known lightfastness. Test results are useful for specification acceptance between producer and user, for quality control, and for research and product development.

5.3 Color changes may not be a linear function of duration of exposure. The preferred method of determining effect of the light is to expose the prints for a number of intervals and to assess the exposure time required to obtain a specific color change or change in optical density.

6. Interferences

6.1 It is recognized that the rate of photo degradation of ink jet prints will vary significantly due to factors such as initial color density, the area printed (solid versus half-tone), the substrate, the ink type (dye versus pigment inks), and the coating type and thickness. Consequently, test results must be determined individually for each printed substrate.

6.2 Variations in exposure time, temperature and humidity may also affect results.

7. Apparatus

7.1 Use xenon-arc apparatus with a Window Glass Filter that conform to the requirements defined in Practices **G 151** and **G 155**.

7.2 Use an uninsulated black panel thermometer as described in **ASTM G 151**.

7.3 Unless otherwise specified, the spectral power distribution (SPD) of the xenon arc shall conform to the requirements of Table 2 in Practice **G 155** for a xenon arc with a Window Glass Filter. Also refer to **Fig. X1.1** of **Appendix X1** for a representative spectral power distribution graph of a xenon arc with a Window Glass Filter.

7.4 Use an appropriate spectrophotometer, spectrophotometer or colorimeter for measuring color changes and a densi-

tometer for measuring changes in optical density. Alternatively, a spectrodensitometer can be used for both color and optical density measurements.

8. Test Specimen

8.1 The substrate, method of printing, ink lay-down, and handling of printed specimens shall be consistent with the anticipated end use of the specimens.

8.2 The test image may be generated with personal computer word processing, drawing/graphics or page layout software, saved as a print file for each printer/method of printing (contributing its unique ink and ink/receiver interactions that may impact in the image light stability), trial-printed, and evaluated for appropriate ink lay-down (purity and amount) and ease of printing and testing. Each print file should have its filename, type, and version identified in the image area and a place for experimental notes (for example, time, printer, environmental conditions, operator). The printer settings and a trial print of each print file version should be archived.

8.3 The recommended test image shall consist of a standardized arrangement of color patches printed using print files containing the appropriate printer setup specific for each application. This test image shall contain color patches at maximum print density (100 % fill) for each of the primary colors (cyan, magenta, yellow, and black), secondary colors (red, green, blue), and composite black (cyan plus magenta yellow). In addition, since lightfastness may vary as a function of print density, low optical density patches are recommended to test the lightfastness of binary images of discrete ink spots. A step wedge containing patches with a range of optical densities (for example 25 %, 50 %, 75 %, and 100 % fill) may be useful for this test.

8.4 For visual examination, the specimen size as indicated in practice **D 1729** is a minimum of 3-1/2 by 6-1/2 in. (90 by 165 mm). For instrumental evaluation, the specimen must be large enough to cover the specimen port; a minimum size of 1.25 in. × 1.25 in. (35 mm × 35 mm) is satisfactory for many instruments.

8.4.1 Unless otherwise specified, expose at least three replicate specimens of each test material and of the control material, if used.

8.5 The unexposed file specimens are prepared for visual evaluations or measured for instrumental evaluations as described in **8.5.1** and **8.5.2**, respectively.

8.5.1 For visually evaluated tests, set aside a replicate print or cut off a segment of suitable size; store in a dark, dry place.

8.5.2 For instrumentally evaluated tests, make color measurements in the relevant specimen area(s) prior to exposure.

NOTE 1—The unexposed file specimen control should not be a masked specimen. Even though shielded from radiation, some materials may undergo color changes, due to the heat or moisture present during the test.

8.6 Test prints on opaque substrates do not require backing material and shall be tested in accordance with their intended use. Transparencies shall be backed with a white backing material. Translucent substrates shall be backed with a diffuse black backing material with an image density of 1.5 ± 0.2 as described in **ANSI IT2.7-1995 Annex A1**.