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Standard Practice for Determining the Waterfastness of Images Produced by Ink Jet Printers Utilizing Four Different Test Methods—Drip, Spray, Submersion and Rub[1]

This standard is issued under the fixed designation F2292; 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 covers methods that can be used to determine the waterfastness of an image produced by an inkjet printer. Waterfastness is determined by the presence of ink transferred from a specific printed area to a non-printed area, or to neighboring printed areas of a different color.

1.2 This practice can be used to evaluate the waterfastness of the primary print colors (cyan, magenta, yellow and black), the secondary colors (red, blue and green) and composite black (cyan plus magenta plus yellow).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

F909 Terminology Relating to Printers

F1125 Terminology of Image Quality in Impact Printing Systems

F1174 Practice for Using a Personal Computer Printer as a Test Instrument

F1623 Terminology Relating to Thermal Imaging Products

F1857 Terminology Relating to Ink Jet Printers and Images Made Therefrom

2.2 *ANSI Standards:*[3]

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

3. Terminology

3.1 For definitions of terms, refer to Terminologies F909, F1125, F1623, and F1857.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *ink jet media, n*—recording elements 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. Significance and Use

4.1 This procedure may be used to determine how water will affect solid-fill color images produced by ink jet printers.

4.2 Four different test methods are outlined to simulate the most common ways that materials are exposed to water.

4.3 The method of water application may greatly affect the outcome of the test. While one or more of the test methods may be performed, to best qualify a product all four test methods should be used.

4.4 The drip and spray test are evaluated visually, while the submersion and rub tests can be evaluated visually and instrumentally.

4.5 Test results are useful for specification acceptance between producer and user, for quality control, and for research and product development.

5. Interferences

5.1 Ink jet media and ink sets may be purchased from a variety of sources and may affect the waterfast characteristics

[1] This practice is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.07 on Ink Jet Imaging Products.

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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 the American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

produced by a given printing system. A variety of media types and ink sets may be used depending on the purpose of the test. The side of the media that should be used for imaging is the one recommended by the manufacturer/supplier.

5.2 Interpretation of results should be made by one evaluator.

5.3 Fluctuations in temperature and humidity may affect the media being tested.

5.4 Prints should be dry prior to testing since inadequate drying time may affect the results. Twenty-four hours should be sufficient for most inks and media.

5.5 All comparative tests should be performed under the same environmental and viewing conditions.

5.6 The following evaluations utilize digital test originals that are created using personal computer software. Always use the same originals when comparing printers, ink sets and substrates.

5.7 Visual interpretations of a failure or success may vary from one individual to another.

6. Apparatus

6.1 *Ink Jet Printer and a Personal Computer.*

6.2 *Personal Computer Word Processing, Drawing/Graphics, or Page Layout Software,* for creating the test page original.

6.3 *Distilled Water.*

6.4 *Pan,* 2 in. deep.

6.5 *Ordinary Household Spray Bottle .*

6.6 *Pipette.*

6.7 *Paper Towels.*

6.8 *Soft Cloth,* sweatshirt type material.

6.9 *Timer.*

6.10 *Spectrodensitometer.*

6.11 *Board.*

7. Calibration

7.1 Adjust the printer used to conduct the test per the manufacturer's instructions or in accordance with Practice F1174.

8. Test Specimens

8.1 The 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 of 100 % for each of the primary colors of cyan, magenta, yellow and black, 200 % for the secondary colors of red, green, and blue, and 300 % for process black.

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 on the image light stability), trial-printed, and evaluated for appropriate ink laydown (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 size of the color patches shall be approximately 1.25 by 1.25 in. (35 by 35 mm).

9. Conditioning

9.1 Condition the printer, supplies and test substrates 24 h in the same atmospheric conditions as those present where the test is to be conducted.

9.2 Waterfastness should be tested at least 24 h after printing to allow the prints to sufficiently dry.

10. Drip Test

10.1 Prepare two printed ink jet test samples. Mount the printed ink jet test samples to a board in order to make them rigid so that they are supported during the test.

10.2 Position the mounted sample at a 45° angle to a horizontal tabletop.

10.3 Hold the tip of the pipette about 5 to 10 mm above the top of the color patch, deliver 0.05 cc of distilled water on each of the print colors and repeat 2 more times.

10.4 About 15 s after the final water delivery, place the print sample flat and allow it to fully dry. Note if there is any ink bleeding, smearing or transfer.

11. Spray Test

11.1 Prepare two printed ink jet test samples. Mount the printed ink jet test samples to a board in order to make them rigid so that they are supported during the test.

11.2 Position the mounted sample at a 90° angle, so that it is perpendicular to the floor.

11.3 Place sample over a tray, sink or place paper towels under sample to gather excess water.

11.4 Load the spray bottle with distilled water and holding the bottle 12 in. away from the test sample, spray the sample. Thoroughly soak the sample with the water, allowing the water to flow off the print.

11.5 After about 15 s after the water spray, place the print sample flat and allow the print to fully dry. Note if there is any ink bleeding, smearing or transfer.

12. SubmersionTest

12.1 Prepare two printed ink jet test samples. Mount the samples to a support, such as stainless-steel, in order to make them rigid and easy to submerge in water.

12.2 Fill a pan with distilled water, so that there is a minimum of 1 in. of water in the pan. The water should be at room temperature or allowed time to come to room temperature.

12.3 Place the prints print side up in the pan and make certain the prints are fully submerged. The use of weights may be needed to accomplish this. Set a timer for 10 min.

12.4 After 10 min, remove the sample prints from the water, being cautious not to touch the printed portions. Hold the samples vertically, allowing excess water to drain off.

12.5 Place the print sample flat and allow it to fully dry. Note if there is any ink bleeding, smearing or transfer.

NOTE 1—Color density and L*a*b values may be measured before and after the samples have been submerged in water to assess color changes.

13. Rub Test

13.1 Use the second print from the drip, spray, or submersion tests or prepare new prints as specified above. Immediately after dripping, spraying or submerging the print, allow the excess water to drain off and using a cotton pad with moderate pressure, rub all of the printed colors a minimum of 3 passes in each direction. Replace the cotton pad for each color.

13.2 Place the print sample flat and allow it to fully dry. Note if there is any ink bleeding, smearing or transfer.

NOTE 2—Color density and L*a*b values may be measured before and after treatment to assess color changes.

14. Interpretation

14.1 If any ink bleed, smearing or transfer is observed, then the test is deemed a failure.

14.2 Density losses or L*a*b value changes are not considered a test failure.

15. Report

15.1 Report the printer model, printing method, and ink and substrate lot numbers.

15.2 Report the failure or success of each of the different test methods.

15.3 Report the test results from the instrumental color change evaluation (percent retained optical density and Delta E) of the color patches, and the initial and final density or L*a*b values. Delta E shall be calculated per Test Method D2244. Densities shall be measured per ANSI/NAPM IT9.9, sections 3.3–3.6. Percent retained density shall be calculated as follows:

$$\% \text{ Retained Density} = \frac{\text{Optical Density After Exposure}}{\text{Optical Density Before Exposure}} \times 100$$

NOTE 3—If instrumental color measurements are used, the type of equipment, the method, and the color-difference equation used must be stated.