Designation: F2036 – 05 (Reapproved 2011)

Standard Test Method for Evaluation of Larger Area Density and Background on Electrophotographic Printers[1]

This standard is issued under the fixed designation F2036; 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 test method describes the procedure for measuring the monochrome diffuse reflection print density and background for large areas on printed pages from electrophotographic printers. It describes the test target and calculations for evaluating the print density and background.

1.2 *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]

F1856 Practice for Determining Toner Usage for Printer Cartridges

2.2 *ANSI Standards:*

IT2.17–1995 (ISO 5-4) Density Measurements—Part 4: Geometric Conditions for Reflection Density[3]

IT2.17–1995 ANNEX A1 Density Measurements—Part 4: Geometric Conditions for Reflection Density, Backing Material[3]

3. Summary of Test Method

3.1 A standard test target is printed under specified conditions. Black areas and background areas of the print are measured using a diffuse reflection densitometer. The values are recorded and the results interpreted.

3.2 The diffuse reflection density is the logarithm of the inverse of the ratio of the reflected light to the incident light.

4. Significance and Use

4.1 This test method can be used for the evaluation of the electrophotographic printer output image quality, aesthetic appearance, visual impression of blackness and the ability to distinguish information from the background.

4.2 This test method can be used for the evaluation of new and remanufactured toner cartridges and their respective components used in an electrophotographic printing process.

4.3 This test method can be used to evaluate printer output image density and background under specified environmental conditions.

4.4 This test method is suitable for research and development and quality acceptance evaluations.

5. Interferences

5.1 Relative humidity can impact test results. The tests should be performed at a controlled temperature and humidity within the operating humidity range of the printer. This usually is between 20 and 80 % RH. All equipment and materials should be conditioned in the same temperature and relative humidity for at least 24 h prior to testing.

5.2 Printer related items such as the power supply, density control settings, resolution enhancements, toner saver settings, economy mode settings, and laser optics may impact image quality, print density and background.

5.3 The printer should be in good mechanical and electrical condition. Preferably, printers with a continuous history of preventative maintenance should be used.

5.4 Component wear can cause the print density and background to change during the life of the cartridge. Repeated tests may be required to evaluate the average print quality.

5.5 The printer variations and cartridge wear can cause variations in the print density on a single page.

6. Apparatus

6.1 *Electrophotographic Test Printer,* suitable for testing purposes.

6.2 *Printer Data System,* capable of generating the test target for density and background. A sample is shown in Fig. 1.

[1] This test method is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.04 on Electrostatic Imaging Products.

Current edition approved Oct. 1, 2011. Published September 2012. Originally approved in 2000. Last previous edition approved in 2005 as F2036–05ε1. DOI: 10.1520/F2036-05R11.

[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, 25 W. 43rd St., 4th Floor, New York, NY 10036.

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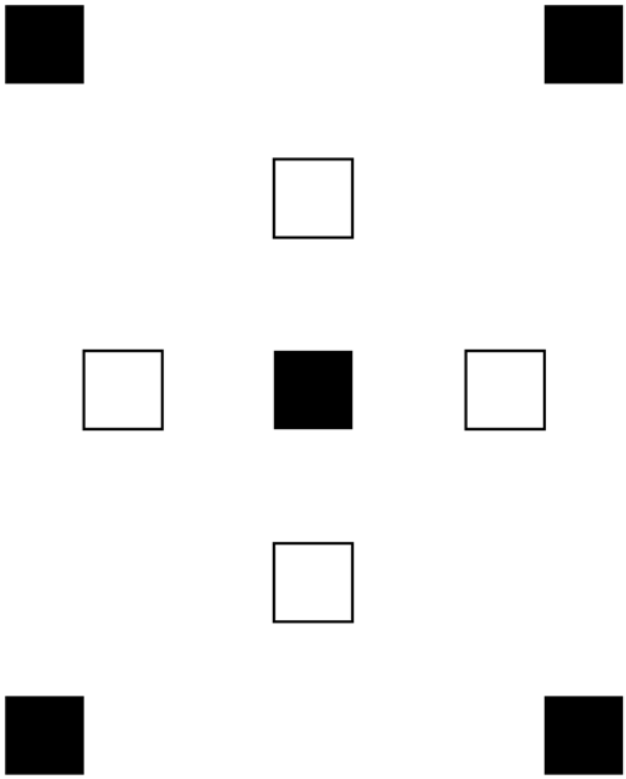

FIG. 1 Sample Density and Background Test Target

6.2.1 The target will have five solid black squares, approximately 25 mm square (1 in. square), located in each corner and center of the printable area.

6.2.2 The target will have four outlined nonimaged (blank) squares, approximately 25 mm square (1 in. square):

6.2.2.1 Two are centered on the left and right sides equidistant between the printable area edge and center of the target, and

6.2.2.2 Two are centered at the top and bottom sides equidistant between the printable area edge and center of the target.

6.2.3 The printable area is 8 in. × 10 in. (0.203 m × 0.254 m) making it usable for both U.S. standard letter and A4 paper sizes.

6.3 *Test Cartridge,* designed for use in the test printer.

6.4 *Conditioned Paper,* that meets the requirements of the printer. This same paper type and manufacturer should be used for all comparative tests.

6.5 *Densitometer,* meeting the requirements of ANSI IT2.17–1995 (ISO 5-4). The densitometer reads the diffuse reflection density, which is the logarithm of the inverse of the ratio of the reflected light to the incident light.

6.6 Black backing meeting the requirements of ANSI IT2.17–1995, Annex A1.

7. Test Procedure

7.1 Using conditioned paper print ten pages of a full page text target with approximately 5 % coverage. If available, use the test target in Practice F1856.

7.2 Immediately following 7.1 using conditioned paper print one page of the density and background target as described in 6.2.

7.3 Calibrate the densitometer according to the manufacturer's instructions.

7.4 Measure the reflection density of a conditioned sheet of paper before printing using a densitometer as specified in 6.5. Measure the reflection density at four different locations, at approximately the same locations as the four "blank" squares on the density and background test target. Use the correct black backing as described in ANSI 2.17–1995, Annex A1.

7.5 Measure the reflection density of the five solid black squares using a densitometer as described in 6.5. Use the black backing as described in ANSI 2.17–1995, Annex A1. Take one measurement per square in the center of the square.

7.6 Measure the reflection density of the four outlined nonimaged (blank) squares using a densitometer as described in 6.5. Use the black backing as described in ANSI 2.17–1995, Annex A1. Take one measurement per square in the center of the square.

7.7 Record values measured in 7.4 – 7.6.

8. Calculation

8.1 Calculate the average solid area density from the five values obtained in 7.5. Because the densitometer reads the logarithm of the inverse of the ratio of the reflected light to the incident light, the values must be converted from the logarithmic form before averaging and then converted back to the logarithmic form after averaging. This can be done by taking the inverse logarithm (base 10) of the density reading (see Table X1.1 in Appendix X1). This is equal to $1/10^{(\text{density reading})}$, where the density reading is the exponent of 10. The values in the form of percent reflection can then be averaged. The average value can be returned to the logarithmic (density) format by calculating the logarithm (see Appendix X1.2),

$$\text{Density} = \log_{10}\left[1/(\text{percent reflection})\right] \quad (1)$$

8.2 Determine the highest and lowest density of the five solid area density values in 7.5.

8.3 Calculate the average nonimaged (blank) density from the four values obtained in 7.6. Because the densitometer reads the logarithm of the inverse of the ratio of the reflected light to the incident light, the values must be converted from the logarithm to percent reflectance before averaging. A conversion table is shown in the Appendix as Table X1.3.

8.4 Calculate the average reflection density of a conditioned sheet of paper before printing from the four values obtained in 7.4. Because the densitometer reads the logarithm of the inverse of the ratio of the reflected light to the incident light, the values must be converted from the logarithm to percent reflectance before averaging. A conversion table is shown in the Appendix as Table X1.3.

8.5 Determine the average background by calculating the difference in the percent reflectance values obtained in 8.3 and 8.4. Subtract the percent reflectance value calculated in 8.3 from the percent reflectance value calculated in 8.4.

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