



Standard Test Method for Determination of Abrasion and Smudge Resistance of Images Produced from Business Copy Products (Crockmeter Method)¹

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1. Scope

1.1 This test method describes a procedure for determining the amount of image transferred onto the surface of a white cloth by rubbing.

1.2 The test method can be employed to evaluate the abrasion and smudge resistance of business imaging products produced by impact printers, thermal transfer printers, and non-impact printers or copiers.

1.3 The test method can be used to evaluate the amount of material removed from the sample (smudge or crock). Testing focuses on determining the amount of material deposited on the crockmeter cloth or redeposited in a new location on the sample. The test method can also be employed to measure performance characteristics for a product. The user should select test equipment which is appropriate for measuring the abrasion to the samples. Samples are tested before and after rubbing and comparisons of results made. In this test method product performance evaluations are optional.

1.4 Other test methods employing the Sutherland rub tester, Taber Abrader and Gavarti GA-C.A.T. can be employed to evaluate the smudge and abrasion characteristics. Results by these units are not necessarily equivalent to those obtained with the Crockmeter.

1.5 *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:

F 335 Terminology Relating to Electrostatic Copying²

F 360 Practice for Image Evaluation of Electrostatic Business Copies²

F 497 Practice for Use of the Electric and Electronic Typewriter as a Test Instrument²

¹ This test method is under the jurisdiction of ASTM Committee F-5 on Business Imaging Products and is the direct responsibility of Subcommittee F05.04 on Electrostatic Copy Products.

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² *Annual Book of ASTM Standards*, Vol 15.09.

F 1174 Practice for Using a Personal Computer as a Test Instrument²

F 1175 Practice for Using the Computer Impact Print-Out Unit as a Test Instrument for Manifold Comparison²

2.2 ANSI Standards:³

IT2.17–95 Density Measurements-Geometric Conditions for Reflection Density

PH2.18 Density Measurements-Special Conditions

3. Terminology

3.1 Definitions:

3.1.1 *abrasion resistance*—the ability of an image to withstand the frictional forces attempting to remove the surface material.

3.1.2 *crock*—material transferred by rubbing from an imaged sample onto a cloth patch.

3.1.3 *smudge*—the tendency of an image to smear or streak onto an adjacent area when rubbed. Smudge involves the redeposition of abraded material.

3.1.4 *smudge resistance*—the ability of an image to withstand smudging.

3.1.5 General definitions related to electrostatic copying can be found in Terminology F 335.

4. Summary of Test Method

4.1 This test method is used to evaluate the degree of image transfer (crock) from a solid imaged area to the surface of a white, cotton cloth patch by linear rubbing. The degree of image transfer to the cloth is measured by reflectance optical densitometry or reflectometry. Alternatively, the imaged business copy product can be evaluated for performance characteristics.

5. Significance and Use

5.1 The degree of image transferred by rubbing (crock) from a copy or printed image can be affected by various factors including the type of machine, the condition of the machine, supplies employed, time since imaging (ribbons) and environmental conditions. As many as possible of these variables should be controlled during the test. A control sample with

³ Available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

known characteristics, if available, should be run along with the test samples.

5.2 The test is designed to simulate the type of damage resulting from paper rubbing against the printed image.

5.3 The test method can be used for control of product quality as well as a research and development tool.

5.4 The method is adaptable to images produced from most types of impact and non-impact printers and copiers.

5.5 Two different printers employing the same technology may yield prints with variations in optical densities. It may be possible to remove more toner or ink from the darker image yet the performance of the smudged image may be satisfactory. An optional evaluation procedure is available whereby the functional properties of the smudged or abraded image is examined if this is of primary concern.

6. Interferences

6.1 The crock (or smudge) resistance of large, solid filled areas may be different than the crock resistance of smaller print areas and lines such as normally encountered in text and line graphics printing.

6.2 Certain areas on a copy or print may be more sensitive to image damage or removal than others. This is dependent upon certain machine design characteristics which vary from one machine model to another.

6.3 Resistance to abrasive damage of images can also vary as a function of the sequential position of a given print or copy in a series of prints or copies. For example, the image abrasion resistance of the third copy of a run of 20 copies on a given machine may be different from that of the fifteenth copy of that same run.

6.4 Variations in the optical densities of the test samples can affect the crock results. For best results, the range in optical densities of the samples should be limited to 0.2.

6.5 The fusing temperature of the laser printer, copier or other toner-based unit will affect the degree of abrasion and smudge resistance. If the temperature is low, the toner will be incompletely fused to the substrate and will be easily removed.

6.6 If the temperature of the head on a thermal transfer printer is low, the image will be incompletely affixed to the substrate. The image will be easily abraded or smudged.

7. Apparatus

7.1 *Rub Tester*⁴ modified with an aluminum sliding arm in place of the original steel arm (see Fig. 1). The mass of the arm is approximately 450 g ($\pm 5\%$) and has the same dimensions as the original. The weight of the finger onto the test material is approximately 300 g ($\pm 5\%$).

7.2 *Test Cloth*, 80 by 84 fibers/in.² combed cotton, desized, bleached with no optical brightener or finishing material present.⁵

7.3 *Densitometer* or reflectometer with calibration plate meeting the requirements for daytime luminous reflectance of

⁴ AATCC Crockmeter Model CM5 or equivalent has been found suitable. The modified aluminum arm outfitted with the solid acrylic finger is available as an accessory. Available from Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

⁵ Crockmeter test cloth from Atlas or Testfabrics or equivalent has been found suitable. Available from Testfabrics Inc, P.O. Drawer O, Middlesex, NJ 08843.

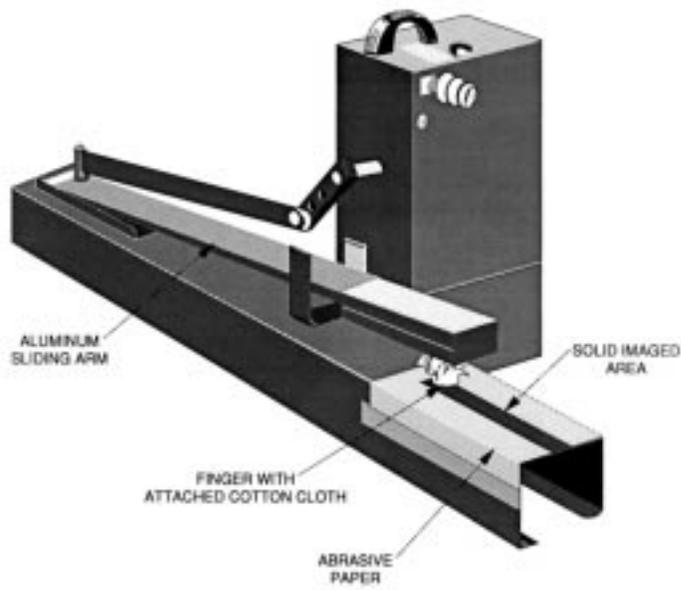


FIG. 1 Crockmeter

ANSI IT2.17 and PH2.18. A 2 to 4 mm aperture is recommended.

7.4 Abrasive paper, 400 grit, waterproof silicon carbide or equivalent⁶ to prevent slippage of test specimen during test.

7.5 *Optional*—Other test equipment which measures specific performance characteristics such as MICR testers, OCR readers and bar code verifiers.

8. Materials

8.1 *Test Samples for Copiers or Printers Which Can Operate as Copiers:*

8.1.1 The target should contain a section which will provide a solid image of dimensions 5½ by ½ in. (14.0 by 1.3 cm), minimum. The target should be prepared according to Practice F 360. The maximum test sample image optical density may not be produced by some copiers unless the optical density of the test target is at least 1.6.

8.1.2 Generate the required number of test samples according to the procedures in Practice F 360.

8.2 *Test Samples From Printers Which Cannot Operate as Copiers:*

8.2.1 Prepare the test sample to contain a solid section with minimum dimensions of 5½ by ½ in. (14.0 by 1.3 cm). If the printer is unable to prepare this type of sample, any printed region which is representative of the printer and imaging media can be substituted. All test samples for evaluation should contain equivalent images.

8.2.2 Generate the required number of test samples in accordance with the appropriate Practice (F 497, F1174, or F1175) for the printer being tested.

9. Procedure

9.1 Cut a 4 by 6 in. (10.2 by 15.2 cm) piece of abrasive

⁶ Abrasive paper, Wet or Dry Trimit W-400-A Soft Back manufactured by 3M or equivalent has been found acceptable. Also available from Atlas Electric Devices.

paper and tape it, abrasive side up, to the rub tester as shown in Fig. 1.

9.2 Cut a 3.5 by 5.5 in. (8.9 by 14.0 cm) specimen from the test print which includes the solid imaged area running in the long direction.

9.3 Place the specimen on the base of the tester, image side up, so that the specimen rests flat on the abrasive paper. Position the specimen with the long dimension in the direction of rubbing and the Crockmeter finger centered on the solid area to be smudged.

9.4 Mount two 2 by 2 in. (5.1 by 5.1 cm) squares of white testing cloth over the end of the finger which projects from the sliding arm. Position the weave of the cloth obliquely to the direction of the rubbing. Secure the cloth with a spiral wire clip supplied by the manufacturer.

9.5 Adjust the counter for five revolutions and lower the covered finger onto the specimen.

9.6 Turn on the instrument while holding the specimen in place by hand. The finger will slide back and forth five times over the imaged area.

9.7 Lift the arm from the sample and remove the top test cloth square. Measure the optical density or reflectance of the discolored area with a densitometer or reflectometer calibrated and operating according to the manufacturer's instructions. A minimum of five readings is recommended. Additional readings may be taken to improve statistical significance. The size of the aperture must be smaller than the size of the spot to be measured. The preferred aperture size is 2 to 4 mm.

9.8 Repeat the procedure in steps 9.2 to 9.7 on four additional samples employing a fresh test cloth square each time.

9.9 Utilizing the densitometer or reflectometer, measure the density or reflectance of a fresh cloth sample.

9.10 *Optional*—The optical density or reflectance of the sample can be measured and compared to similar measurements taken prior to smudging. Other test equipment, operated according to manufacturer's directions, can be employed to evaluate the functional performance of the printed sample. For example, a bar code verifier can be used to evaluate a bar code. Or a MICR test unit can be used to examine the scannability of MICR images.

10. Calculation and Report

10.1 Calculate and report the average value and standard deviation obtained from the five test samples. When calculating the crock density, the density value for the fresh sample (see 9.9) can be subtracted from the average sample density. If reflectometer readings have been measured, report the two average values: crock sample and unused cloth sample.

10.2 *Optional*—Calculate and report the average value and standard deviation of the density, reflectance or other test results obtained in 9.10.

11. Precision and Bias

11.1 Precision:

11.1.1 The results are reproducible for one laboratory and one set of test samples. The results may not be comparable between laboratories. A reproducible ranking order may be established.

11.1.2 A repeatability study of this test method was conducted by one operator on one unit covering several days. The samples represented copies from several electrostatic copying processes including liquid toner and color. The test pattern on each material consisted of a solid bar approximately 0.5 by 4.5 in., oriented in the machine direction or the cross direction to the paper. Five readings were taken on each crock cloth, and five samples were tested for each bar on each material. The density readings ranged from 0.094 to 0.536 with an average of 0.153. The average standard deviation was 0.025 with a range from 0.07 to 0.059. The standard deviation was linearly proportional to the average density value with a correlation coefficient (r) of 0.84. The average coefficient of variation was 11.9% (range 5.8 to 16.8%).

11.2 *Bias*—Bias cannot be determined as there are no standard materials.

12. Keywords

12.1 abrasion resistance; copying; Crockmeter; impact printers; inked ribbons; MICR; non-impact printers; OCR; smudge resistance; thermal transfer ribbons; toner images

APPENDIX

(Nonmandatory Information)

X1. OIL RESISTANCE

X1.1 This method may be adapted to study the oil resistance of toner-based images by using suitable materials which simulate human skin oils. Detailed instructions on how to

conduct such a test are left to the individual user of this method.

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