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

This standard is issued under the fixed designation F 1571; 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 covers a procedure for determining the amount of image transferred from one site and redeposited at another site (smudge) on a document. The Sutherland Ink Rub Tester[2] with 4-lb (1.82-kg) test block is the test instrument for producing the transfer and either a reflectometer or densitometer is employed for measuring the change in images. Alternatively, a visual rating order can be employed to establish a ranking order. The degree to which the original image is unaltered upon rubbing is considered to be the abrasion resistance.

1.2 This test method can be employed to evaluate the smudge resistance of business imaging products produced by typewriters, and impact printers.

1.3 This test method can also be employed to measure performance characteristics for a product. The user should select test equipment that is appropriate for measuring the degree of 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 Crockmeter, 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 Sutherland.

1.5 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.6 *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:*

D 5264 Test Method for Abrasion Resistance of Printed Materials by the Sutherland Rub Tester[3]

F 149 Terminology Relating to Optical Character Recognition[3]

F 221 Terminology Relating to Carbon Paper and Inked Ribbon Products and Images Made Therefrom[3]

F 497 Practice for the Use of the Electric and Electronic Typewriter as a Test Instrument[3]

F 909 Terminology Relating to Printers[3]

F 1125 Terminology of Image Quality in Impact Printing Systems[3]

F 1174 Practice for Using a Personal Computer as a Test Instrument[3]

F 1175 Practice for Using the Computer Impact Print-Out Unit as a Test Instrument for Manifold Comparison[3]

F 1319 Test Method for Determination of Abrasion and Smudge Resistance of Images Produced from Business Copy Products[3]

F 1443 Practice for Using 0.008 in. (0.203 mm) Aperture Reflectometers as Test Instruments for Measuring Visual Image Quality of Business Copy Images[3]

2.2 *ANSI Standard:*

CGATS.4 Graphic Technology —Graphic Arts Reflection Densitometry Measurements—Terminology, Equations, Image Elements and Procedures[4]

3. Terminology

3.1 *Definitions:*

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

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

[1] This test method is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.02 on Inked Transfer Imaging Products.

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[2] Available from James River Corp., Mechanical Services Dept., 243 E. Paterson Street, Kalamazoo, MI 49007.

[3] *Annual Book of ASTM Standards*, Vol 15.09.

[4] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

3.1.4 General definitions relating to terms employed in this test method can be found in Terminology F 149 (optical character recognition), Terminology F 221 (carbon paper and inked ribbon products and images), Terminology F 909 (printers), Terminology F 1125 (impact printer image quality) and ANSI/CGATS.4 (reflection densitometry).

4. Summary of Test Method

4.1 This test method is intended to present a procedure for measuring the abrasion resistance and smudge tendency of typewritten and impact printed images.

4.2 The Sutherland Ink Rub Tester[2] and 4-lb (1.82-kg) test block covered with Buehler Ltd. microcloth[5] is used to perform the abrasion and smudge test on images generated on a typewriter or printer. The recommended test pattern uses a series of six lines with thirty capital "I" 's per row. Spacing between characters should be sufficient to allow the positioning of the aperture of the reflectometer (or densitometer) without touching the characters.

4.3 Once the smudge has been produced by the rub tester, measure the optical density of the paper in the area adjacent to the images using a reflectometer (or densitometer). These results are compared to the reflectance (or density) values obtained on the same area prior to imaging. If a densitometer is used, the readings must be converted to percent reflectance prior to making any calculations. This procedure recommends adjusting the reflectance meter to 1.00 or densitometer to 0.00 before measuring the smudge level. In this case the smudge value will be equal to the reflectance or density of the smudged area.

4.4 For the evaluation of abrasion, reflection density readings of individual characters are measured before and after application of the rub tester.

4.5 Alternative methods for evaluation of the results include establishing a rank order of the samples or evaluation of performance characteristics of the images.

5. Significance and Use

5.1 This test method is designed to simulate the type of damage resulting from paper rubbing against a printed image. The primary method of evaluation is either reflectance or optical density readings. Depending upon the objective of the test, comparison of either the image or the area adjacent to the image is evaluated before and after rubbing.

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

5.3 As written this test method is intended for use only with impact printed images involving ribbons. However, it can be modified to evaluate other types of business images such as those produced by non-impact printers and copiers, ink jet printers, and thermal transfer printers.

5.4 The degree of image transferred by rubbing from a printed image can be affected by various factors including the type of printer, the condition of the unit, supplies employed, time since imaging, and environmental conditions. As many as possible of these variables should be controlled during the test. A control sample with known characteristics, if available, should be run along with the test samples.

6. Interferences

6.1 Equipment cleanliness is important for accurate readings. Residual oil, dirt, or other contaminants may be transferred to the test samples and result in erroneous measurements. Care must be taken to avoid skin contact with either of the two surfaces involved in the rubbing action.

6.2 Variations in paper surfaces may affect ribbon smudge level. If sheeted paper is used, the user should be aware that sheet to sheet smoothness and brightness variations within a ream may have a significant effect on reflectance readings. Most papers contain a felt and a wire side that have different surface smoothness levels and this in turn can also affect test results. Special precautions should be taken when using preprinted or colored papers because they may affect both the reflectometer (or densitometer) calibration and measurements.

6.3 Running the test under conditions outside those found in the normal office environment may affect the degree of smudge and abrasion.

6.4 Image smudging may be affected by printer or typewriter parameters such as hammer energy level, hammer dwell time, hammer flight time, platen hardness, and print character to platen angle.

6.5 The time from print sample generation to running of the smudge test has a direct impact on the final results. If prints are to be compared the elapsed time from printing to smudge testing should be stated.

7. Apparatus and Materials

7.1 *Sutherland Ink Rub Tester* [2] with 4-lb (1.82-kg) test block, or its equivalent. See Fig. 1 for a picture of the apparatus.

7.2 *Standard Typewriter*, (electric or electronic) or printer.

7.3 *Microcloth*, Buehler Ltd. #4C—7228[5] with adhesive backing or equivalent.

7.4 *Reflectometer*, or densitometer with an aperture smaller than the space between characters. The primary method of evaluation is reflectance or optical density. The choice of which unit to employ depends on the density of the area to be measured. Reflectometers perform best when the image density is light, whereas densitometers give the best results where the image density is dark. If readings are desired on individual printed characters, equipment and methods referenced in Practice F 1443 can be employed.

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

8. Conditioning

8.1 For best results the paper must be conditioned at 73°F (23°C) and 50 % relative humidity and all testing conducted under these same conditions. If controlled conditions are not available, samples to be compared must be run under the same environmental conditions, on the same type of paper and at the same elapsed time between printing and smudge testing.

[5] Available from Buehler, Ltd., 41 Waukegan Rd., Lake Bluff, IL 60044.

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