



Standard Practice for Determination of Abrasion and Smudge Resistance of Images Produced from Office Products (GA-CAT Method)¹

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1. Scope

1.1 This practice covers the procedure for determining the abrasion and smudge resistance of images produced from office products using a GA-CAT comprehensive abrasion tester.

1.2 This practice is applicable to images produced from business imaging products such as typewriters, copiers, impact printers, and nonimpact printers.

1.3 Other test methods using the Crockmeter, Sutherland rub tester, and Taber Abrader can be employed to evaluate smudge and abrasion characteristics. The results obtained by these units are not necessarily equivalent to those obtained with the GA-CAT.

1.4 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.

1.5 *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:*²

[D685 Practice for Conditioning Paper and Paper Products for Testing](#)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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

¹ This practice 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.

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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.

3.1.2 *receptor*—film or paper of standard abrasiveness onto which material removed from the specimen is deposited during the abrasion testing process.

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.

4. Summary of Practice

4.1 The test print and a receptor are sandwiched in the panel holder of the GA-CAT comprehensive abrasion tester, clamped together with a known force, and made to slide over each other at a known frequency and over a known distance for a predetermined time period.

4.2 The test specimen is examined for the degree of print degradation and the receptor for the amount of image material transferred from the specimen surface. The results may be rated relative to a comparative control run in the identical manner, or they may be quantified by comparison to a ranking scale numbered from zero to ten (with zero being the most abrasion/smudge resistant and ten being the least abrasion/smudge resistant).

5. Significance and Use

5.1 Abrasion and smudge resistance during handling, transport, and storage is essential to prevent the marring or smudging of images produced from business imaging products. Recognizing that the actual amount of abrasion/smudge occurring depends on relative humidity, temperature, and a host of other variables, this practice provides a means for comparing the abrasion and smudge resistance of images produced from business imaging products under laboratory conditions.

5.2 This practice may be used to determine the abrasion and smudge resistance of images produced from business imaging products such as typewriters, copiers, impact printers, and nonimpact printers.

5.3 This practice may also be used to evaluate the relative abrasion and smudge resistance of various ribbons, inks, and toners.

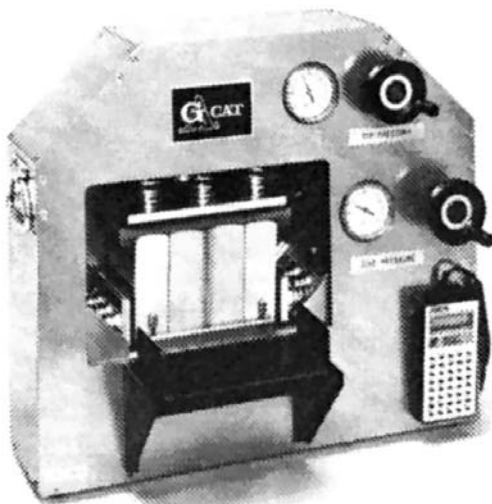


FIG. 1 GA-CAT Comprehensive Abrasion Tester

5.4 This practice may be used for control of product quality, comparative analysis of machines, or as a research and development tool.

6. Interferences

6.1 A number of factors may affect specimen image creation and contribute to inconclusive results. It is recommended that the following factors be taken into consideration:

6.1.1 Resistance to abrasion and smudge of images may vary as a result of the sequential position of a given print or copy in a series of prints or copies. For example, the abrasion and smudge resistance of the third copy or print of a run of 20 copies or prints may be different from that of the 15th copy or print.

6.1.2 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 may not be fused properly to the substrate and may be abraded or smudged easily.

6.1.3 If the temperature of the head on a thermal transfer printer is low, or too high, the image may not be affixed properly to the substrate and may be abraded or smudged easily.

6.1.4 Extreme variations in temperature and humidity may affect both the degree of image fixing and the copy quality. For this reason, it is recommended that the environmental conditions be noted when conducting comparison tests between machines or supplies. For the most accurate comparisons, the environment should be kept as constant as is reasonably possible during the entire test.

7. Apparatus

7.1 *GA-CAT Comprehensive Abrasion Tester*—See Fig. 1.³

³ Available from Gavarti Associates, Ltd., 9240 N. Sleepy Hollow Lane, Milwaukee, WI 53217.

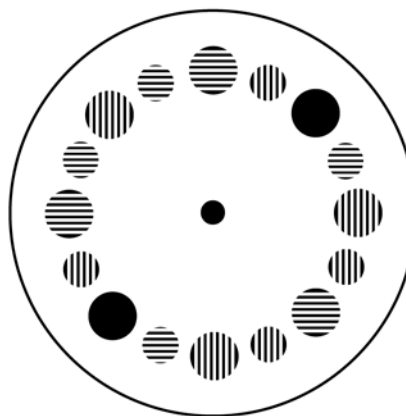


FIG. 2 Abrasion Test Target

7.2 *Ranking Book*,³ containing specimens whose degree of ruboff is ranked from 0 (no ruboff) to ± 10 (most ruboff).

7.3 *Test Copier or Printer*, adjusted and equipped with appropriate ribbons, paper, toner, fuser oil, and other supplies as required. If the copier or printer is to be used to evaluate a supply item, all other supply items should be unchanged during the duration of the comparison test.

7.3.1 If comparison tests are being made between copiers or printers, all supply items should be as specified by the manufacturer. Unless otherwise specified by the manufacturer, the same paper should be used in each machine.

7.4 *Copier Test Target*, available from ASTM. This test target incorporates designs suitable for various smudge and abrasion testers. Consult Fig. 2 for a printed example of the target. A suitable alternative may be used.

7.5 *Printer Test Target Diskettes*,⁴ available for several types of personal computer systems. The diskette allows the generation of an image comparable to the Copier Test Target. A suitable alternative may be used.

8. Materials

8.1 *Standard Receptors*, approximately 4 by 4 1/2 in. (102 by 114 mm), of an appropriate grade, as follows:

⁴ Available from Industry Analysts, Inc., Technical Services Division, 1275 Bloomfield Avenue, Building 3, Suite 50 C, Fairfield, NJ 07004.

8.1.1 C-5³—A nonglossy paper.

8.2 Foam Sheeting, ³ two pieces, each approximately 5/64 in. (2 mm) thick and cut to 4 by 4 1/2 in. (102 by 114 mm).

NOTE 1—The use of foam sheeting as a backing for the test specimen and the receptor is recommended to provide uniform pressure over the test surfaces and to prevent ink or other particles from becoming embedded in the sensitive surface of the panel holders.

8.3 Comparative Control:

8.3.1 An office or laboratory print, preferably having known abrasion and smudge resistance. The comparative control must have the same substrate, color(s), and subject matter as the test print.

8.3.2 Two or more test samples (produced by the same equipment under the same conditions) so results can be compared.

8.3.3 If all tests were performed under the same conditions (for example, paper, time, frequency, span, and offset), use the RANKING BOOK (7.2). If tests were performed under different conditions (for example, paper, time, frequency, span, and offset), note the variables in the final report.

9. Test Specimen and Conditioning

9.1 Specimen preparation and conditioning can have a dramatic effect on the test results. It is recommended that the following be taken into consideration:

9.1.1 The specimen length and width must not exceed 4 1/2 in. (114 mm). Care should be taken to avoid contaminating the test surface with fingerprints during specimen cutting and handling.

9.2 Condition the specimens in accordance with Practice D685 or in the same atmospheric conditions as those in which the test is to be conducted (see 9.3). Record the temperature and relative humidity of the conditioning atmosphere.

9.3 All comparison tests should be run under the same conditions of temperature and humidity. If a standard condition is not available, ensure that wide changes in temperature and humidity do not occur while the test is conducted. Record the temperature and relative humidity at the start and end of the test.

10. Preparation of Apparatus

10.1 Set the abrasion tester on a sturdy bench, preferably in a room conditioned at the temperature and relative humidity prescribed in 10.2. Ensure that the three-prong power cord is connected correctly.

10.2 Periodically check the liquid level in the hydraulic pressure system. Follow the instructions in the manufacturer’s manual if not full.

11. Procedure for Abrasion Testing

11.1 Loading the Instrument:

11.1.1 Move the tray containing the four panel holders to the front black support shelf. Ensure that the inscribed “L” appears on the upper left side of the panel and the “R” in the upper right side of the right panel holder (see Fig. 3). There should be a space of at least 1/2 in. (12.7 mm) between the two center panel holders.

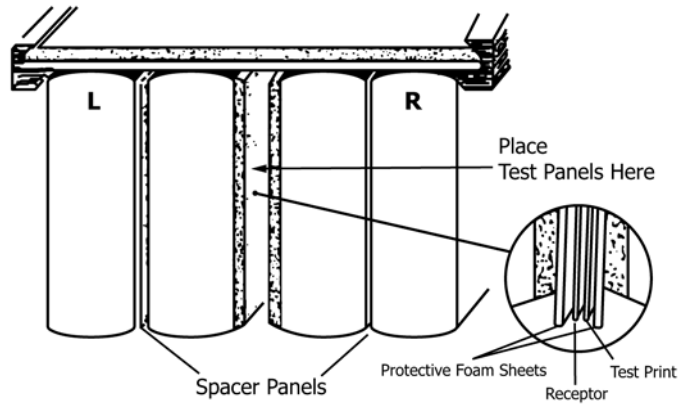


FIG. 3 Panel Holders

11.1.2 Face the test specimen on the receptor (selected in 8.2) and sandwich it between the foam sheets. Take care that the sandwich does not extend below the bottom of the panel holders.

11.1.3 Push the four panel holders together into an upright parallel position. Ensure that the sandwich is not pinched at the bottom of the panel holders; otherwise, it will tend to slide down during the test. Grab the pins and move the tray inside the instrument so that the two retaining pins drop into the carriage holes. If the pins do not drop into their respective holes, recenter the panel holders on the sample tray.

11.1.4 Apply side pressure by turning the lower black spindle until the corresponding dial reads 20 psi (138 kPa). Do not apply top pressure at this time.

11.1.5 The carriage inside the instrument is meant to move between two limit switches (used for centering) approximately 2 in. (50.8 mm) apart. If the carriage is not situated between these limits, manually center the carriage.

11.2 Testing Under the Preset Mode:

11.2.1 Turn the power switch on by pressing the upper side of the flip switch at the right side of the instrument.

11.2.2 After the control box window (LCD) displays “GA-CAT Ready,” press “CNTR;” the LCD will read “check limits” to ensure that the carriage is within the range of the limit switches. Press “CNTR” again, and the LCD will read “Release top pressure.” Press “CNTR” once more, and the carriage will move to the extreme right (limit switch) and then back to stop exactly in the center. At this point, the LCD will show that the carriage has been centered by showing a flashing square after “GA-CAT READY.”

11.2.3 After the instrument is centered, apply the top pressure of 40 psi (276 kPa).

11.2.4 Push the “STRT” button. The LCD will read “COMPUTING,” and after 3 s, the instrument will run under the following default values:

Time:	5.0 s
Frequency:	2.0 Hz
Span:	1.0 in. (25.4 mm)
Offset:	0.0 in.

11.2.5 When the instrument stops, release the top pressure, ensuring that the pressure plate is high enough to clear the panel holders. Push the “CNTR” button to re-center the

carriage. Release the side pressure and pull the panel holders out of the carriage. Remove the sandwich and examine the test specimen and the receptor.

11.2.6 To continue running the test with the same settings, reload the instrument as in 11.1, apply the top pressure as in 11.2.3, and push “STRT.” When the instrument stops, follow the procedure given in 11.2.5. Turn the switch off only at the conclusion of testing.

11.3 Changing the Default Values:

11.3.1 In the event that testing produces inconclusive results, the test should be repeated using a different set of conditions until a satisfactory set is produced. The default values for time, frequency, span, and offset may be changed to any of the following settings. For example, if no smudge or abrasion occurs, increase the settings; if excessive smudge and abrasion occurs, decrease the settings. If the default settings must be changed, the settings used must be noted in the final report.

Time:	Continuous from 1 to 3600 s
Frequency:	0.2 to 3.0 Hz (cycles per second) with a resolution of 0.1 Hz
Span:	0.1 to 1.3 in. (2.54 to 3.3 mm) with a resolution of 0.1 in. (2.54 mm)
Offset:	0.1 to 0.4 in. (2.54 to 10.1 mm) in increments of 0.1 in. (2.54 mm)

11.3.2 In order to change a setting, press the “MODE” button until the LCD displays the default value to be altered. Enter the new value on the number buttons, and then press “ENTER.” The LCD will read “NEW VALUE?.” If the value is correct, press “ENTER” a second time. If incorrect, enter another value, or press “CLEAR” and start over again.

NOTE 2—The instrument reverts to the original default values by pressing “RESET” and any time the instrument is turned off.

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12. Interpretation of Results

12.1 Run the test material and the comparative control in an identical manner. Examine each print for the degree of degradation (smudge) and each receptor for the amount of material transferred from or on the print. Report results for both abrasion and smudge relative to the comparative control as equal, slightly or appreciably less, or slightly or appreciably greater.

12.2 If all tests were performed under the same conditions (for example, paper, time, frequency, span, and offset), a numerical record of degree of abrasion/smudge ranging from zero to ten can be obtained from a comparison of the test specimen with examples in the RANKING BOOK (7.2). If tests were performed under different conditions (for example, paper, time, frequency, span, and offset), note variables in the final report.

13. Report

13.1 Report the following information:

13.1.1 Printer or copier make and model;

13.1.2 Test specimen type and physical specifications;

13.1.3 Standard receptor type (8.1.1);

13.1.4 Conditioning atmospheric conditions (9.2);

13.1.5 Testing atmospheric conditions at the beginning and end of test (9.3);

13.1.6 GA-CAT values (11.2.4 to 11.3.2); and

13.1.7 Data from 12.1 and 12.2.

14. Keywords

14.1 abrasion resistance; GA-CAT abrasion tester; image permanence; smudge resistance