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Standard Practice for Comparative Evaluation of Imaging Properties of Liquid Electrostatic Toners[1]

This standard is issued under the fixed designation F505; 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.

INTRODUCTION

This practice is a pragmatic test for the consumer who may or may not have access to sophisticated laboratory equipment.

1. Scope

1.1 This practice guides the consumer toward preparing a test for liquid toners used in copiers, which has significance to their specific copying needs, and suggests ways in which test prints may be made and used for each evaluation.

1.2 This practice does not include those procedures necessary for the evaluation of nonimpact printing toners, those toners used in the preparation of offset masters, or other specialty toners.

1.3 *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.* See Section 7 for specific hazards statements.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F335 Terminology Relating to Electrostatic Imaging

F360 Practice for Image Evaluation of Electrostatic Business Copies

F807 Practice for Determining Resolution Capability of Office Copiers

F875 Test Method for Evaluation of Large Area Density and Background on Office Copiers

3. Terminology

3.1 *Definitions*—For definitions of terms relating to electrostatic copying, see Terminology F335.

4. Summary of Practice

4.1 This practice involves the comparative evaluation of one or more toner supplies by rating subjectively a number of significant characteristics of imaged copies made under controlled conditions on a liquid toner electrostatic copier.

5. Significance of Use

5.1 Subjective comparative evaluation of copies made from the same test originals can be used to determine the usefulness of a given toner supply in a specific user application.

6. Interferences

6.1 Many copy systems are subject to variation due to fluctuation of line voltage. It is conceivable that such fluctuations may cause a normally useful system to give poor results. The manufacturer of the equipment should be consulted regarding the need for voltage-stabilizing devices which can usually be installed easily.

6.2 Results from a copy system can vary depending upon the length of time the system has been operating. The first print after a system has been shut down for a prolonged time period can be of different quality than subsequent prints made after some time of operation.

6.3 Variations in copy system performance after continuous copying over relatively long periods can occur (that is, several hours or more). It is recommended that the procedure be repeated if significant variation in copy system performance occurs.

6.4 Variations in copy system performance can occur as a result of copier adjustments (for example, before and after service calls).

[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.

6.5 Excessively high or low relative humidity can also cause variation in performance not encountered under normal conditions.

6.6 All tests should be conducted in the same copier, during the same relative time period and environmental conditions.

6.7 Toner supplies (including both toner and diluents) are often purchasable from several sources and can affect results of the given copy system.

6.8 Paper supplies can be purchased from several sources and also can affect results of a given copy system. The user should use only the grade and weight of paper recommended by the copier manufacturer when evaluating one or more toner supplies. All paper supplies utilized should be from the same manufacturing source, and the user should try to use all paper supplies from the same production number (provided one is listed). Some inherent variability within the paper may affect image quality evaluation as will certain unintentional paper defects. Some variability may be encountered from one roll to the next or from one package of sheets to a second package, and sometimes within a package.

6.9 Variations in toner concentration strongly affect copy quality and should be minimized to the extent made available by the mechanics of the copy system.

6.10 Toners for these systems usually have a finite shelf life. The user should carefully follow the manufacturer's recommendations on storage conditions and length of storage.

7. Technical Hazards

7.1 This practice is intended to orient the user toward observing meaningful and significant characteristics of imaged copies obtained from a limited number of imaged copies. It does not encompass those defects of which the user should be aware such as deterioration, abrasion or scratching, or other adverse actions that could reduce the effectiveness of the operation of the copier with the test toner supplies. The manufacturer of the test toner supplies should be consulted prior to the evaluation of the supplies in order to ascertain what long-term functional testing (including compatability results with the copier and current reference toner supplies used by the user) has been performed by the test toner supplier on the particular model copier the user possesses. The manufacturer of the copier should also be contacted prior to any test should any question of consequential damages to the copier be involved.

7.2 Many toner copier manufacturers require that only trained service people should be permitted access to specific internal copier components. Prior to any testing, the manufacturer of the copier should be consulted as to which components or copier areas, or both (if any), the consumer may have access to for visual evaluation of toner build-up. It may be necessary for the user to require the copier manufacturer's service personnel to perform all necessary component clean-up. Should this step be required, the user should be present to observe and record all observations regarding this maintenance step.

8. Sampling

8.1 Sampling is not applicable to this practice.

9. Procedure

9.1 Before beginning this practice comparison, the manufacturer's instructions on the operation of the copier must be read, understood, and followed. The toner being evaluated is best tested in a copy system at the site of its proposed installation under the line voltage conditions that would normally apply. The test target should be prepared as described in accordance with the Test Original section of Practice F360. Additional targets are described in Practice F807 and Test Method F875.

9.2 Clean the copier as follows:

9.2.1 Drain the system thoroughly, either by pouring it if the tray is removable or by siphon or drain tube provided by the manufacturer if it is not removable.

9.2.2 Flush out the tray several times with clear diluent or dispersant, using 1 to 2 pt (or ½ to 1 L) for each rinse, depending on the size and shape of the tray. Some developer units include a circulating pump, which may trap some of the developer liquid. If so, rinse by returning the unit to the copier and allowing the clear diluent to circulate for about 2 min. In this case, the diluent quantity should be the minimum that will circulate freely.

9.2.3 If the tank and tray appear reasonably clean, return the tray to the copier (if it has been removed), fill it with clean diluent, and make copies of any subject. If an image is visible, it indicates cleaning was not complete. Repeat 9.2.1 and 9.2.2 until copies made with clear diluent show no images. Remove the excess diluent.

9.3 Load the supplies into the copier. Follow the manufacturer's directions for adjustments of the various controls.

9.4 Turn on the copier and allow several minutes for warm-up.

9.5 Set the exposure control (if one is provided) to either end of the exposure range.

9.6 Using the prepared test target, make a copy. Record the exposure setting, time (if desired), and date on the copy.

9.7 Image copies at various exposure settings. Record the setting, time, environmental conditions, sequence number, and date on each copy. The operator each time should move the exposure setting in the same direction on the exposure control device when preparing a sequence of imaged copies. The starting point on the exposure control device should always be at the same point for each set of copies.

9.8 Determine the copier setting that, in your opinion, is the one yielding the best appearing copy. This is referred to as the "optimum copy."

9.9 At this optimum setting, make the number of copies that would constitute a normal length of run. This will allow comparison of toner uniformity as well as the toner replenishment system (if replenishment is part of the copier mechanics). Place or set the test subject into the copier in the same orientation each time.

9.10 At the optimum setting, reverse the orientation of the test subject placed or set into the copier and make a copy. This copy can then be compared to previous copies to determine the effect of subject orientation variations. Record all pertinent information on this copy such as exposure setting, time, date, and test target orientation for possible future reference.

9.11 Image a sufficient number of copies at the optimum setting, that would constitute a very large copy run, for example 500 to several thousand. Care should be taken during this test by the user to follow any recommended maintenance steps by the copier manufacturer, for example changing electrostatic masters, etc if this step is part of the copier mechanics. During the course of this long-range test sequence, the user should note and record the following observations:

9.11.1 Any jamming encountered including the number of and location.

9.11.2 Cleanliness of the copy on both the imaged and back sides.

9.11.3 The user if possible, should inspect the toner in the developer unit at random intervals to ascertain any formation of sludge. Should any buildup of toner be observed that cannot be easily broken up, this result is considered unsatisfactory.

9.11.4 During this large copy run, the special features that are included on the test copier should be operated to determine the range of toner capability. These special features may include light document control, colored background control, image reduction or enlargement control, duplexing control, etc.

9.11.5 At the end of the large copy run, the user should inspect the accessible copier internal components and record any toner buildup, deposits on the various copier components. The user should record the location of any buildups and should rate any observations using the following recommended rating scale: 5—light, 3—medium, and 1—heavy.

9.12 To test a different lot or type of toner from the same or from another supplier (see 7.2) remove the toner system in the copier using the cleaning technique outlined in 9.2. When the copier and the toner developing system is clean, add the supplies to be tested according to the supplier's recommendation, and make a set of copies for comparison to the previously made reference set (9.6-9.11).

10. Interpretation of Results

10.1 In evaluating the short and long run results from a toner under test in a copying machine, examine the following points (or those the user anticipates are pertinent to their particular copying needs) and compare to the reference toner. In the long-copy run evaluation, the user may want to only inspect either every 50th, 100th, 200th, etc, imaged copy.

10.1.1 Density, apparent optical contrast, or relative blackness of characters.

10.1.2 Development of large solid image areas; are they filled in evenly, or is there a density variation?

10.1.3 Color and cleanliness of background.

10.1.4 Freedom from objectionable face or backmarking characteristics when compared to the reference toner supplies.

10.1.5 Uniformity of the imaged copy compared to the test target.

10.1.6 Fidelity of the imaged copy to the test target.

10.1.7 Distortion of characters.

10.1.8 Smudge characteristics upon removing the imaged copy from the copier or in a stack of copies. To evaluate this characteristic, lay either a single imaged copy or stack of copies face up on a suitable flat surface. The single copy can be evaluated as is, while the stack of copies should be opened to the approximate center of the stack. The evaluator should gently but firmly, slide either the palm of the hand or the fingers across the imaged surface. Movement across the imaged surface should cover letter imaged areas, solid black filled areas, and gray areas on the copy. This test can be performed as the copy emerges from the copier or from a stack of copies either immediately or after several minutes of exposure to the environment. Both the reference and test toner supplies should be evaluated in the same manner and time period.

10.1.9 Freedom from feathering (blasting) of the images.

10.1.10 Reproduction of colored lines and characteristics.

10.1.11 Reproduction of pictorial illustrations.

10.1.12 Freedom from objectionable odor, particularly in those copies employing heat-fusing techniques.

10.1.13 Any black-density variation of imaged letter characteristics or solid black areas during the long-imaged copy run.

10.1.14 Sharpness or freedom from bridging.

10.1.15 Resolution. The user should be aware that resolution is not related solely to toner. Although the copier optical system and photoconductor are vitally important factors, it is possible for the user to measure toner contribution to resolution by holding copier conditions constant.

10.1.16 Toner build-up, deposits, on the various copier components.

10.1.17 Jamming of the copy paper. The user should be aware that this defect may be a result of toner depositing in critical transport pathways or to deposits on feed rollers due to duplexing.

10.1.18 Variations may exist from copier to copier with identical model designations, and from one copier to another due to run lengths, a possible variety of test originals, customer preference in contrast, etc. These parameters, coupled with the difficulty of measurement techniques, make quantification of yield (number of copies per weight of toner system) highly complex and are therefore not included in this practice.

10.1.19 Level of dispersant retained in a finished print. Examine the imaged copy for retained dispersant immediately out of the copier or after a period of time (for example, 1 min) by visually observing a wet appearance either within the sheet or on the surface by one or more of the following recommended procedures:

10.1.19.1 Observe the imaged copy, imaged side up as it exits out of a cold or warm machine, or both, into the receiving tray.

10.1.19.2 Observe an imaged copy in the center of a stack of continuously imaged copies (for example, 20 to 40 copies).

10.1.19.3 Placing copies selected from either or both of the above two categories imaged side up and down on a table top, visually observe any puddling of the dispersant on the table beneath the imaged copy after a period of time.

10.2 The results of a test may be interpreted or expressed in terms of a rating system or scale. A recommended rating scale would include a five-step scale of values or rankings of merit, with 5—good, 3—medium, and 1—bad.

11. Precision

11.1 When this practice is used to compare two or more toners within a laboratory, the rating scale and comparative ranking order is repeatable. Because the interpretation of results is dependent upon the subjectivity of the observations and varying preferences from one consumer to the next, this repeatability is not necessarily anticipated between laboratories.

12. Keywords

12.1 copiers; image quality; liquid toner; toner