Designation: F685 – 96 (Reapproved 2011)

Standard Practice for Determining Toner Usage, Efficiency, and Dusting Nonheat Fixing Copiers Using Single-Component Toner Systems[1]

This standard is issued under the fixed designation F685; 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 practice covers the determination of toner usage, efficiency of toner deposition on an imaged copy, and dusting in those nonheat fixing copiers utilizing a single-component toner.

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.* See Section 8 and 10.19.2 for specific precautions and warnings.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F335 Terminology Relating to Electrostatic Imaging

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

2.2 *ASTM Adjuncts:*

Density Target Test Sheets[3]

3. Descriptions of Terms Specific to this Standard

3.1 *single-component toner*—also described commercially as single-component developer.

3.2 *toner usage*—amount of toner (milligrams per copy) removed from the toner hopper during the copying process.

3.3 *efficiency*—the ratio of the weight of toner developed on the image copy to the weight of the toner used.

3.4 *toner dusting*—loss of toner other than to the imaged copies and therefore the difference between toner usage and the weight of the toner developed on the imaged copy. Dusting is usually found deposited either inside the copier components such as cleaning subsystems and filters or surrounding the copier externally, specifically the table top, wall, and so forth.

4. Summary of Practice

4.1 A full roll or quantity of sheets together with a sample of toner are both weighed and placed into a copier. Copies are imaged to a predetermined end point and weighed. Toner usage, dusting, and copier efficiency are subsequently calculated from values obtained from the imaged copy weights and initial toner weights.

5. Significance and Use

5.1 Many dry electrostatic developers consist of toners and carriers and only the toner portion of which forms the visible image on the copy. Single-component toner (or developer) does not contain a carrier, and in theory, when properly used, is consumed at a rate proportional to the image area and density. As with all dry developers, single-component toners (or developers) are not 100 % efficient. Some toner is lost to the surroundings (inside or outside of the copiers). This loss is also dependent on copier adjustments and may be significant enough to affect the total number of copies capable of being produced by a specific amount of toner.

6. Apparatus

6.1 *Balance,* [4] capable of a precision of ±0.1 g and readable to 0.1 g.

6.2 *Model Copier,* operated in accordance with the manufacturers instructions.

7. Reagents and Materials

7.1 A supply of specified type or lot of appropriate paper sufficient to complete the test.

7.2 A supply of recommended type or lot of dry single-component toner sufficient to complete the test.

7.3 A black target larger than the size of the test target the user elects to use.

[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] Available from ASTM International Headquarters. Order Adjunct No. ADJF0875.

[4] A Mettler P5N balance (or equivalent alternative) has been found acceptable and has a reported precision of ±0.05 g.

8. Precautions

8.1 This procedure is not applicable to those single component toner copiers utilizing either heat or a combination of pressure and heat fixing methods because of the possible weight loss of the paper due to the heat fixing.

8.2 If any jams or paper roll splices are encountered during this procedure, the test should be discontinued and repeated.

8.3 During this procedure, all copier conditions, specifically line voltage, should be held constant.

8.4 The user should be aware that variables such as relative humidity, supplies (between lots, within lots, or manufacturers of), copiers, or the interaction of the variables can alter the final results.

9. Calibration and Standardization

9.1 All supplies to be utilized should be preconditioned to the Technical Association of the Pulp and Paper Industry (TAPPI) conditions of 23.0 ± 1.0°C and 50.0 ± 2.0 % relative humidity for 24 h prior to evaluation. Evaluate this test under those same conditions.

10. Procedure

10.1 Clean the copier and empty the toner from the toner hopper by any suitable means.

10.2 Remove any residual toner within the copier, load the copier with the appropriate paper, and copy the black test target until the imaged copies are substantially free of toner.

10.3 Distribute a weighed sample of toner (40 to 50 ± 0.1 g) in the hopper. If the mechanics of the copier permit, cover the hopper with an appropriately cut sheet (or equivalent). Record the weight of the toner. Note the amount (height) of toner in the hopper as this influences the results.

10.4 Place or insert a suitable test target (configuration is left to the discretion of the evaluator, refer to Note 1) into the copier and image several copies. Set the exposure dial for the optimum copy (the best possible contrast between the background and image). The area of image coverage must be constant for comparable results.

NOTE 1—The Test Method F875 adjunct/Test Target for Office Copiers is available.[3]

10.5 Image a number of copies until the copies start to show copy image deterioration due to the initial exhaustion of the toner (the images will start to be broken up or incompletely reproduced). Record the number of copies. All copies should be of the same length and width throughout this test.

10.6 Image the black test target until the imaged copies are substantially free of toner. In some copiers this may appear as a background-free area in the center of the imaged copy with toner deposits along the edge of the copy running in the machine direction. (This end point requires some judgment and may vary from one copier type to another.)

10.7 Remove the paper supply from the copier and weigh to ±0.1 g the TAPPI conditioned paper. Record this weight as W_1.

NOTE 2—A variance of ±0.1 g is based on the paper supply weighing at least 1000 g. The weight limit of the Mettler P5N balance is 6000 g maximum.

10.8 Weigh a sample of dry single-component toner to ±0.1 g approximately equal to the amount weighed in 10.3 and distribute this weighed sample equally in the hopper. Record this weight as W_2.

NOTE 3—The user may wish to alter the recommended toner weight sample to suit his test requirements.

10.9 Set the exposure dial for the optimum copy (as found in 10.4) and insert or place the *same* test target as used in 10.4 into the copier.

10.10 Load the conditioned paper supply into the copier.

10.11 Image a number N of copies. N should approach but not exceed the number of copies required to show copy defects due to the exhaustion of toner (refer to 10.5). Remove the paper supply from the copier.

10.12 Weigh all N copies plus the remainder of the paper supply just removed from the copier. Record the weight as W_3.

10.13 Calculate the weight of toner W_4 on N copies by:

$$W_4 = W_3 - W_1 \quad (1)$$

10.14 Remove N copies from the balance and weigh the remainder of the paper and record as W_5. Count the number of N copies and record.

10.15 Return the paper to the copier and image the black test target until the same endpoint is reached as found in 10.6. Record the copies required to do this as N'. Remove the remaining paper from the copier.

10.16 Weigh the copies from 10.15 plus the remaining paper. Record as weight W_6.

10.17 Calculate the weight of toner W_7 on the copies obtained from 10.15 by:

$$W_7 = W_6 - W_5 \quad (2)$$

10.18 Calculate the total weight of toner W_8 put on all imaged copies by:

$$W_8 = W_7 + W_4 \quad (3)$$

10.19 Since passage of the paper through the copier may cause a weight change due to a gain or loss of moisture, a blank determination should be carried out as described in the following:

10.19.1 Weigh the unimaged paper from 10.16 and record the weight as W_{10} . This paper supply should contain enough paper to yield approximately 200 copies.

10.19.2 Empty the toner hopper and disconnect the corona. (**Warning—**Unplug the machine first.)

10.19.3 Using an all-white original, process approximately 200 copies through the completely clean copier. Count the number of copies made and record as n.

10.19.4 Weigh the copies and the remainder of the unimaged paper and record this weight as W_{11} .

10.19.5 Calculate the paper weight change per copy (W_{12}) by the following:

$$W_{12} = (W_{10} - W_{11})/n \quad (4)$$

11. Calculation

11.1 *Efficiency:*

$$E = (W_8 + (N + N')W_{12})/W_2 \quad (5)$$

Refer to 10.15 for N'.

11.2 *Toner Usage or Consumption :*

$$U = (W_4 + NW_{12})/NE \quad (6)$$

Refer to 10.14 for N.

11.3 *Toner Dusting:*

$$D = U(1 \geq E) \quad (7)$$

12. Report

12.1 Report all test conditions (temperature and humidity), toner and paper lot number designations if available, and all measured and calculated weights. The report must include the target used.

13. Keywords

13.1 development efficiency; non-heat fixing; single-component toner; toner dusting; toner usage