



Standard Practice for Estimating Toner and Dispersant Usage in Copiers Utilizing Liquid Developers¹

This standard is issued under the fixed designation F 1042; 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 describes a procedure for estimating the number of copies that can be produced for a given unit of toner, and a given unit of dispersant in a copier utilizing liquid developer.

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.*

2. Referenced Documents

2.1 ASTM Standards:²

- F 335 Terminology Relating to Electrostatic Copying
- F 596 Practice for Comparative Evaluation of the Imaging Properties of Dry Electrostatic Toners
- F 875 Test Method for Evaluation of Large Area Density and Background on Office Copiers
- F 995 Test Method for Estimating Toner Usage in Copiers Utilizing Dry Two-Component Developer

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

- 3.1.1 *dispersant*—an organic liquid in a liquid developer system that conveys toner particles. (See Terminology F 335.)
- 3.1.2 *dispersant usage*—amount of dispersant (milligrams per copy) removed from the system during the copying process.
- 3.1.3 *liquid toner*—a toner dispersed in an organic liquid carrier used for developing electrostatic images in copiers.
- 3.1.4 *toner usage*—amount of toner (milligrams per copy) removed from the system during the copying process.

¹ This practice is under the jurisdiction of ASTM Committee F05 on Business Copy Products and is the direct responsibility of Subcommittee F05.04 on Electrostatic Copy 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.

4. Summary of Practice

4.1 A copier is set up to standard operating parameters and operated under a controlled job stream and environment for a length of time sufficient for stable performance. A known or estimated quantity of toner and dispersant used to replenish the toner bath over the length of the test, along with the total number of copies generated, is used to estimate the number of copies produced per unit of toner and per unit of dispersant.

5. Significance and Use

5.1 This practice can be used to evaluate the performance of different lots of toner in a common machine. It can also be used to evaluate the economics of toner and dispersant usage when making machine-to-machine comparisons.

5.2 This practice provides only a point estimate that is subject to a significant number of variables that are not easily measured. Those making decisions based on the results of this practice should carefully consider the accuracy of the results and other pertinent data.

5.3 Actual use of the copier in normal operating conditions will most likely result in toner and dispersant usage values different from those generated using this practice.

6. Interferences

6.1 Variations in toner usage can occur for many of the following reasons: machine adjustments, operating environment, varying use of special copy controls, number of copies on photoconductor and toner bath, variations in copy paper, operator variability, batch-to-batch toner variability, machine-to-machine variability, and use of different area of coverage of original documents.

6.2 Machine-to-machine comparisons should be made, if possible, with the same manufacturing lot of toner and dispersant.

6.3 The test conditions used when making comparisons between machines or toners should be carefully considered and well documented.

6.4 The test must be controlled as described in this practice. A casual use of the copier during the test may affect the results.

6.5 The toner and dispersant usage estimated with this practice may not accurately predict actual field results. Actual results will depend not only on those listed in 6.1 but on a number of additional variables: type of originals used (percent area of coverage), machine and service variability, users image quality requirements, and number of copies per original.

7. Apparatus

- 7.1 Refer to Test Method F 875 for required instruments.
- 7.2 *Balance*, reading to the nearest tenth of a gram.

8. Reagents and Materials

- 8.1 Sufficient quantities of paper, toner, dispersant and photoconductor, to run the evaluation. (See 10.7.)
- 8.2 *Test Targets*:
 - 8.2.1 *Chart for 4 % Coverage*—As shown in Fig. 1 of Test Method F 995.³
 - 8.2.2 *Chart for 8 % Coverage*—As shown in Fig. 2 of Test Method F 995.³
 - 8.2.3 *Density and Background Test Sheet*—As shown in Fig. 1 of Test Method F 875.⁴

9. Conditioning

9.1 Condition the paper, toner, dispersant, photoconductor, and copier in the test environment for 24 h prior to initiating the test.

10. Procedure

10.1 Control the environment in which the following procedure is carried out to reduce variation. Control the temperature $\pm 5^\circ\text{F}$ ($\pm 2.75^\circ\text{C}$) around the mean temperature selected for the test. Control the relative humidity (RH) $\pm 10\%$ around the mean RH selected for this test. Measure and record the actual temperature and RH periodically during the test.

10.2 The machine, in which toner and dispersant usage will be measured, should be thoroughly cleaned by an authorized service representative and any prescribed preventative maintenance performed prior to loading the test materials. It is also recommended that major replaceable components in the fusing and cleaning subsystems be replaced in accordance with the manufacturer’s PM schedule.

10.3 Design a log sheet (see Fig. 1) on which to record significant events during the running of this test.

10.4 Record the initial machine copy count from the appropriate indicator before test materials are loaded into the machine.

10.5 The copy paper used should be all of the same size and type. Paper should remain in the original packaging until just before it is added to the copier. Manufacturer’s directions should be followed in placing the paper in the machine.

10.6 The procedure requires that the machine and toner be used sufficiently long enough to provide stable performance. This is defined as one preventative maintenance cycle number of copies (PM). Add toner and dispersant being evaluated as required throughout the test. (See 10.7.2.)

10.7 For liquid development machines, toner, and dispersant usages are estimated over some steady-state period of operation. The test is considered to begin with the addition of the second unit of test toner or dispersant (NT_2, ND_2 , respectively). The first unit of test toner and dispersant (NT_1, ND_1) is used to set the copier into a steady test state.

10.7.1 Record the machine copy count at machine set up (CT_1, CD_1) and at the beginning of the test period when test toner or dispersant is installed in the machine (CT_2 and CD_2).

10.7.2 Record the machine copy count as each additional unit of toner or dispersant is installed to replenish the bath. Add toner or dispersant only when the replenishment sensor indicates an “add toner” or “add dispersant” condition.

10.7.3 Calculate the net weight of each unit of toner or dispersant added to the nearest tenth of a gram. This can be done by directly weighing the toner or dispersant added, or determining the net toner or dispersant added by weighing the container before it is loaded in a machine and after it is

³ Available from ASTM Headquarters. Order PCN 12-609950-11.
⁴ Available from ASTM Headquarters. Order PCN 12-608750-11.

CT_1	Initial copy count at addition of first bottle of toner—machine set up.	
CD_1	Initial copy count at addition of first bottle of dispersant—machine set up.	
CT_2	Copy count at addition of second unit of toner. Test actually begins.	
CD_2	Copy count at addition of second unit of dispersant. Test actually begins.	
NT_1	Net weight of toner added, first bottle of test.	g
NT_2	Net weight of toner added, second bottle of test.	g
NT_n	Net weight of toner added, nth bottle of test.	g
ND_1	Net weight of dispersant added, first bottle of test.	g
ND_2	Net weight of dispersant added, second bottle of test.	g
ND_n	Net weight of dispersant added, nth bottle of test.	g
NT_f	Net weight of toner added from final bottle of test.	g
ND_f	Net weight of dispersant added from the final bottle of test.	g
CF	Final copy count of test.	
Toner usage = $\frac{(NT_2 + NT_3 + \dots + NT_{n-1} + NT_f)}{(CF - CT_2)} \times 1000$		
	= mg/copy toner	
Dispersant usage = $\frac{(ND_2 + ND_3 + \dots + ND_{n-1} + ND_f)}{(CF - CD_2)} \times 1000$		
	= mg/copy dispersant	

FIG. 1 Sample Data Sheet

removed. Record these net weights as NT_1 , NT_2 , NT_n (toner) and ND_1 , ND_2 , ND_n (dispersant).

10.7.4 Compare the copy counts CT_2 and CD_2 . Add the PM number (see 10.6) of copies to the larger of CT_2 or CD_2 . This number will be the copy count at which the test should be stopped, CF .

10.7.5 At the end of the test, the toner and dispersant replenishment containers may not be empty. Weigh them at this point and calculate the net weight of toner and dispersant that has been added to the machine from these final bottles, NT_f and ND_f respectively.

10.7.6 Estimate toner usage, in milligrams per copy, by using the following equation:

$$\text{Toner usage} = \frac{(NT_2 + NT_3 + \dots + NT_{n-1} + NT_f)}{(CF - CT_2)} \times 1000$$

10.7.7 Estimate dispersant usage, in milligrams per copy, by using the following equation:

Dispersant usage

$$= \frac{(ND_2 + ND_3 + \dots + ND_{n-1} + ND_f)}{(CF - CD_2)} \times 1000$$

10.8 Conduct the test using one of two standard toner usage test targets identified in 8.2.1 and 8.2.2. Selection depends on the desired print coverage (4 % or 8 %). One may want to use the target which represents the print coverage closest to that most commonly used by the consumer. This document provides a controlled job stream and eliminates one source of variability.

10.9 Rotate the toner usage test target 180° on the platen every 500 copies to reduce the potential of fatiguing the photoconductor.

10.10 Monitor image quality during the test as a check on copy uniformity and process performance. Use the density and background test target (Test Method F 875) at the beginning of the test and at intervals equal to the number of copies that can be generated in 2 h of machine operation. Record the density data and copy count at each measurement. Readjust the machine if density changes by more than 15 % as measured during Test Method F 875.

11. Interpretation of Results

11.1 The estimated toner usage determined by this practice relates only to the relatively limited and controlled conditions under which the practice was used. It is useful in making comparisons between machines or lots of toner only under these conditions. Variations in the populations of machines, toners, service, and operating conditions may result in toner usage values different from those estimated.

12. Precision

12.1 The precision of the procedure for estimating the toner usage in copiers utilizing liquid toners is being determined. Preliminary data from one laboratory, using a similarly controlled test, gave a range from the mean of 10 %.

13. Keywords

13.1 copier; dispersant; dispersant usage (or yield); liquid toner; toner; toner usage (or yield)

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