



Standard Test Method for Determining Energy Consumption of Copiers and Similar Office Imaging Equipment¹

This standard is issued under the fixed designation F2494; 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 procedure provides a test method by which electro-photographic copiers and similar office imaging equipment may be rated for energy consumption.

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 International Standards:

ISO/IEC 11159 Minimum Information to be Included in Specification Sheets—Copying Machines²

ISO 554 Standard Atmospheres for Conditioning and/or Testing Specifications²

2.2 Federal Energy Management Program (FEMP) website:

http://www.eere.energy.gov/femp/technologies/eep_standby_power.cfm#sleep

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *optional devices*—any device added to improve the functionality of the base unit. They include an automatic document feeder (ADF), sorter, finisher and expansion memory.

3.1.2 *copier speed, first copy (X)*—one of the convenient levels for which the machine's speed is measured. This is calculated based on the amount of time, a_1 (sec), counted in a normal operating mode from the beginning of pressing the print button of the machine to the end of ejecting the first copy, $X = 60/a_1$ (cpm). For copiers with ADF, the amount of time, a_1 shall be used, counted from pressing the print button after

placing an original or originals on the ADF to the end of ejecting the first copy.

3.1.3 *copier speed, multi copy (Y)*—one of the convenient levels for which the machine's speed is measured. This is calculated based on the amount of time, a_2 (sec), counted in a normal operating mode from the end of ejecting the first copy after pressing the print button of the machine to the end of ejecting the remaining copies (b), $Y = (b) \times 60/a_2$ (cpm). Normally, the value declared in the machine's specifications shall be used.

3.1.4 *ready mode*—the condition that exists when the machine is ready for copying, but has not yet started copying, and has not entered an energy-saver mode, either.

3.1.5 *copying cycle*—the condition that exists from the beginning to the end of a nominal job cycle (1 h) to produce a copy or copies. According to the machine's multi copy speed (Y) declared in the specifications, the following are listed in Job Tables: nominal monthly volumes assumed, nominal volumes per day and combinations of the number of jobs as $\frac{1}{8}$ day (1 h) nominal jobs, the number of originals per job and the number of copies per original.

3.1.6 *copying energy*—the amount of energy needed in excess of ready mode energy during a copying cycle.

3.1.7 *copying time*—the amount of time that the nominal jobs are run when testing copying energy during a copying cycle.

3.1.8 *warm-up energy*—the amount of energy needed in excess of ready mode energy when the machine is in a warm-up mode after the machine is turned on in an auto-off mode on a standard work day.

3.1.9 *energy-saver mode*—the condition that exists when the machine is not making copies and is consuming less power than when the machine is in a ready mode. The machine goes into this mode after it completes a copying job and no job is scheduled in a specified time period. Since the International Energy Star Program has been used widely in the world, this has caused copiers to have this mode. This standard particularly designates this condition as an energy-saver mode in operating hours (9 h) of a standard work day.

3.1.9.1 *Discussion*—The International Energy Star Program stipulates that the machine shall be set to enter an energy-saver

¹ This test method 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.

Current edition approved Oct. 1, 2011. Published September 2012. Originally approved in 2005. Last previous edition approved in 2005 as F2494-05. DOI: 10.1520/F2494-05R11.

² Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

mode 15 minutes or less after the end of a copying job. However, considering the fact that shorter passing time has been set than before because recovery time tends to be reduced, this test method stipulates that the machine shall stay in a ready mode for 10 minutes after the end of a copying job up until it starts passing to the energy-saver mode if no job is scheduled. The recovery time from the energy-saver mode to the ready mode shall be set to 30 seconds or less. Energy-saver mode design to fulfill this recovery time is left to the manufacturer's discretion. This test method provides energy calculations on the assumption that the passing time is 10 minutes. If setting of the time shorter than 10 minutes is accepted by users in the future, the procedure of this test method will be reviewed.

3.1.10 *auto-off mode*—the condition with less energy consumption than the energy-saver mode in 3.1.9. The machine enters the energy-saver mode 10 minutes after the end of a copying job if no job is scheduled in the ready mode. Later, the machine enters an auto-off mode, if no additional job is scheduled in a specified time period. Normally, this auto-off mode stays for a whole day of Saturday and Sunday weekends other than standard work days. As for standard work days, the machine stays in this mode at night as a night stand-by condition. It is calculated by subtracting the 9 hours of operation from the 24 hours in a day. The machine comes out of this mode when the user manipulates the machine for a job or switches it on.

3.1.11 *energy-saver recovery time*—the amount of time that the machine takes to enter the ready mode after it comes out of the energy-saver mode in the 9-h operating condition of a standard work day.

3.1.12 *energy-saver mode time*—the amount of time that the machine is in an energy-saver mode in the 9-h operating condition of a standard work day.

3.1.13 *lunch break*—one hour assigned to a lunch break that exists between 4-h morning and 4-h afternoon in the 9-h operating condition of a standard work day. The machine stays in an energy-saver mode during this time period.

3.1.14 *job*—making a copy or copies from one or more originals without interruption or delay between originals.

3.1.15 *machine energy*—the energy obtained by subtracting energy consumed for copying (3.1.6) from total energy consumed in a standard month where the machine is plugged-in 24 h/day including the 9-h operating condition.

3.1.16 *nominal copies per day*—the number of nominal copies produced on a single machine during a nominal standard work day.

3.1.17 *nominal monthly copying volume*—monthly copying volume nominally determined according to the copying speed band category.

3.1.18 *plug-in mode*—the condition that exists when the machine is connected to an appropriate electrical source and is not turned on. (This mode is also referred to as hard-off mode, manual-off mode or plug-in-off mode.) This corresponds to the one specified on the FEMP website.

3.1.19 *recovery energy*—the amount of energy needed in excess of energy-saver mode energy to pass from the energy-saver mode to the ready mode.

3.1.20 *standard copy*—a sheet imaged on one side that measures 210 by 297 mm (A4) or 8½ by 11 in. (letter size).

3.1.21 *standard month*—thirty 24-h days.

3.1.22 *standard work day*—a day having an operating condition (9-h) including a 1-h lunch break. A standard month (30 days) has 22 days.

3.1.23 *warm-up mode*—the condition that exists when the machine is turned on from a plug-in mode or auto-off mode and prior to reaching the ready mode.

3.1.24 *operating condition*—nine hours starting from the day's first warm-up mode on condition that recovery from the plug-in mode or auto-off mode occurs each of 22 standard work days. This consists of 1 h of a lunch break and 8 hours of day's typical job cycles.

4. Summary of Test Method

4.1 The standard energy consumption rating is determined (using a watt-hour meter) for a copier while the machine is in a simulated customer installation performing one eighth (1 h) of a typical day's copying jobs. The typical day's jobs (the number of jobs, originals, and copies per original) are based on the standard monthly copying volume assumed according to its copy speed. In this test method, there is no difference in assumed nominal monthly copying volumes between monochrome copiers and color ones. In other words, since a color copier naturally has two copying speeds (speeds in color and monochrome modes), this test method gives the color copier the nominal standard monthly copying volume of a monochrome copier of which speed equals the color copier's maximum speed (normally, in monochrome mode).

4.1.1 However, since the job conditions depend on whether or not a copier has a color mode, separate Job Tables have been provided for color copiers and monochrome copiers.

4.1.2 Moreover, note should be taken that two types of Job Tables have been provided for color copiers according to the structure (1 drum: serial type, and 4 drum: parallel type). (Refer to the Job Tables in Annex A1.)

4.2 The energy consumption may be calculated based on the following assumptions, that the copier will typically:

4.2.1 Be connected to a live power line for thirty 24 h days (720 h) per month.

4.2.2 Be in the operating condition each of 22 work days per month and be in an operating condition for an average of 9 h each of the 22 days. The operating condition of 9 h includes a lunch break of 1 h.

4.2.3 As a result of 4.2.2 and 3.1.23, come out of the auto-off mode to enter the warm-up mode each of 22 work days, since the copier normally has the auto-off mode where the machine automatically enters after a period of time of non-use or no job scheduled.

4.2.4 As a result of Discussion in 3.1.9.1, do not enter the energy-saver mode during a copy cycle, if the number of nominal jobs per hour (1/8 of a day's job cycle) is 6 or more in the Job Table and this leads to job interval of 10 minutes or

less; and as a result of 3.1.13, be in the energy-saver mode during the 1-h lunch break each of 22 work days. To facilitate the tests, the upper limit of the number of jobs shall be 6.

4.2.4.1 *Discussion*—In actual use, the higher the monthly copying volume is, the larger the number of jobs is. Besides, it is less likely for the machine to go into the energy-saver mode. Considering these, the numbers of jobs are provided according to the nominal monthly volume in the Job Table and the machine behavior as follows:

(1) The nominal monthly copying volume of 23 000 or less leads to the number of nominal jobs of 5 or less ($\frac{1}{8}$ day) and the machine enters the energy-saver mode during the copying cycle; and

(2) The nominal monthly copying volume of 28 000 or more leads to the number of nominal jobs of 6 ($\frac{1}{8}$ day) and the machine does not enter the energy-saver mode during the copying cycle.

4.2.5 Perform a typical day's copying jobs each of the 22 work days each month.

4.3 The rating of energy consumption per hour in a typical month (kWh/h) is determined using calculations based on the test data.

5. Significance and Use

5.1 This test method provides a procedure for measuring the energy consumption of the product and optional devices in various operating modes. It is intended to permit rating the energy requirements of products by a method that will permit accurate energy efficiency comparisons of each product with all other similar products.

6. Apparatus and Supplies

6.1 *Watt-Hour Meter*, shall be calibrated properly and have a crest factor of 3 or more.

6.2 *Timer*, a timing device accurate to 1 s.

6.3 *Test Target*, 210 by 297 mm (A4) or $8\frac{1}{2}$ by 11 in. (letter) with 4 to 8 % coverage.

6.4 *Paper*, 210 by 297 mm (A4), 60 to 80 g/m², $8\frac{1}{2}$ by 11 in. (letter), 20-lb bond or where not applicable, use machine manufacturer's recommended paper size and weight, depending on the machine sales area.

7. Sampling

7.1 The energy rating should be that for a device representative of the commercially available equipment. Any modification of the product or additional configurations that significantly alter energy consumption will require re-ratings or additional ratings.

7.2 Those copiers configured with automatic duplex option should be rated twice for each job, once at 100 % single-sided copy and once at 100 % of two-sided copies (making two-sided copies from single-sided originals, each side counted as one copy).

7.3 The copier(s) to be evaluated should be set to within the manufacturer's operating specifications.

8. Preparation of Apparatus

8.1 Test Conditions:

8.1.1 The room ambient shall be within a range of $23 \pm 3^\circ\text{C}$; $50 \pm 10\%$ relative humidity in compliance with ISO 554.

8.1.2 The working voltage shall be machine-rated voltage $\pm 2\%$. Stabilized power supply shall be used.

8.1.3 The machine shall be at least 500 mm from any wall or obstacle.

8.1.4 All supplies used shall be those specified by the copier manufacturer and preconditioned for a minimum of 12 h in the room ambient environment (see 8.1.1) prior to evaluating the copier energy rating.

8.1.5 The power supply voltage shall be supplied as a true sine wave with no more than 3 % harmonic distortion.

8.1.6 The power frequency must be rated frequency ± 0.1 Hz.

8.1.7 The manufacturer will define the configuration (including optional devices) of the machine to be tested, the nominal monthly copying volume at which it will be rated (see Job Tables), and both the first copy speed and multi copy speed.

8.1.8 The test should be discontinued if an unusually high number of machine problems occur. Excess machine stoppages may distort the overall energy rating. A reasonable number of paper jams that can be readily cleared by the operator should not be considered reason to discontinue the test.

9. Procedure

9.1 Steps 9.1.1-9.1.10 of this procedure should be completed once for each test machine. The data from 9.1.5 will only apply to one configuration and, if the machine has configuration variations, the rating must be repeated for each configuration for which the machine is being rated. Prior to the start of this test, the machine should be plugged in to a live power line but turned off and stabilized at specified room ambient conditions (indoors) for at least 12 h. An appropriate watt-hour meter should be in line with the machine, ready to give an accurate indication of machine energy. This test should be run at the machine setting that, in the opinion of the evaluator, is the one yielding an appropriate copy.

9.1.1 *Copying Time*—Choose the appropriate formula from Job Tables (see Annex A1) that matches the monthly volume for which the machine is being rated, according to the machine type, monochrome or color (serial or parallel). In accordance with 3.1.2 and 3.1.3, using the manufacturer's values for copier speeds, where X is the first copy speed, and Y is the multi copy speed per minute, follow the appropriate formulas. Record the copying time in Fig. 1 (in minutes).

9.1.2 *Plug-In Mode Energy*—Read the indication (W) of the watt-hour meter connected to the test machine. This mode corresponds to the one addressed in FEMP. If no change is observed in energy in the plug-in mode, record the indication (W) in Fig. 1 for plug-in mode energy use (Wh).

9.1.3 *Warm-Up Plus Ready Mode Energy*— While the machine is in the stabilized plug-in mode, read and record the indication (Wh) of the watt-hour meter connected to the test machine and the time (or start the stopwatch or timer). Turn the machine on and allow the machine to warm up and stabilize in

EUT	Single-sided Copy	Duplex Copy
Monthly volume, N	_____	
Number of copies, n , in test (from Table)	_____	
Copying time, C_c (from Table)	_____ min	
Warm-up time, T_w	_____ min	
Number of Jobs, j , in test (from Table)	_____	
Plug in mode energy	_____ Wh	
Test Results (1-h test):		
A. Warm-up plus ready mode energy	_____ Wh	
B. Ready mode energy	_____ Wh	
C. Copying energy plus ready mode energy	_____ Wh	_____ Wh
D. Energy-saver mode energy	_____ Wh	
E. Energy-saver recovery time	_____ sec	
F. Recovery energy plus energy-saver mode energy	_____ Wh	
G. Auto-off mode energy	_____ Wh	
Calculations, All copiers:		
(1) Warm-up energy, E_r [A — B]	_____ Wh	
(2) Copying energy, E_c [C — B]	_____ Wh	_____ Wh
(3) Copying energy per copy, E_c/n	_____ Wh	_____ Wh
(4) Recovery energy, E_{rc} [F — D]	_____ Wh	
(5) Recovery energy, E_{rc} [F — D] per month	_____ Wh	
No. of jobs ≤ 5 : $(F - D) \times \{22 + (j) \times 176\}$		
No. of jobs ≥ 6 : $(F - D) \times 22$		
(6) Ready mode energy time per month	_____ h	
No. of jobs ≤ 5 : $\{[(T_w) \times 22 + (C_c/n) \times N + 10 \times (j) \times 176] \div 60\}$		
No. of job ≥ 6 : [176 h]		
(7) Energy-saver time per month [198 — (6)]	_____	
(8) Auto-off mode energy per standard month [G \times 522]	_____ Wh	
(9) Warm-up energy per standard month [(A — B) \times 22]	_____ Wh	
(10) Ready mode energy per standard month [B \times (6)]	_____ Wh	
No. of jobs (j) ≤ 5 : $[B \times \{(T_w) \times 22 + (C_c/n) \times N + 10 \times (j) \times 176\} \div 60]$		
No. of jobs (j) ≥ 6 : [B \times 176]		
(11) Energy-saver mode energy per standard month (D \times (7))	_____ Wh	
No. of jobs (j) ≤ 5 : $D \times [198 - \{(T_w) \times 22 + (C_c/n) \times N + 10 \times (j) \times 176\} \div 60]$		
No. of jobs (j) ≥ 6 : [D \times 22]		
(12) Machine energy per standard month	_____ Wh	
$E_m = [(8) + (9) + (10) + (11) + (5)]$		
(13) Total energy per month $E_t = E_m + (E_c/n) \times N$	_____ Wh	_____ Wh
(14) Average total energy per hour	_____ Wh/h	_____ Wh/h
$E_{tave} = \{E_m + (E_c/n) \times N\} \div 720$		

FIG. 1 Sample Data Sheet

a ready mode until it is ready for copying. Record the warm-up time until the ready mode in minutes in Fig. 1. Normally, the warm-up time from the plug-in mode equals the recovery time from the auto-off mode. After 1 h, read and record the watt-hour indication (Wh) again. The difference between the two readings of the watt-hour meter is the observed data for warm-up plus ready mode energy use. Record the result in Fig. 1, Test Results Part A. Since the machine has an energy-saver mode, change the machine setting in advance to prevent the machine from entering the energy-saver mode from the ready mode.

9.1.4 Ready Mode Energy—During the previous step (9.1.3), read and record the watt-hour meter indication (Wh) and the time after the test machine has warmed up and entered the ready mode showing that it is ready for copying. The test machine must have been left in the ready mode after the end of the previous step (9.1.3). 1 h after the watt-hour meter indication (Wh) and the time are recorded as stated above in this step, read and record the watt-hour indication (Wh) again. The difference between the watt-hour reading at the start and finish of the hour is the observed data for ready mode energy use. Record the result in Fig. 1, Test Results Part B.

9.1.5 Copying Energy Plus Ready Mode Energy—After the measurement has been completed in the previous step (9.1.4), read and record the indication (Wh) of the watt-hour meter connected to the test machine in the ready mode and the time (or start the stopwatch or timer). Using a nominal original or originals (see 6.3) refer to Job Table for the nominal standard monthly copying volume for which the machine is being rated and perform the nominal jobs. Equally space the jobs throughout the 1 h allocated for this part of the test (see Job Table for the job time interval). For machines without ADF, the operator should change the original or originals in such a manner as to have a minimal impact on job time and energy use (see 8.1.8 for exceptions). For color machines, refer to the Job Table according to the type (serial or parallel) and repeat the jobs starting from the color mode and then the monochrome mode, in turn. The number of jobs can vary between color and monochrome modes. In this case, repeat the monochrome mode at the end. 1 h after all the jobs have been performed, read and record the watt-hour meter indication again. The difference between the two readings of the watt-hour meter is the observed data for copying energy plus ready mode energy use. Record the result in Fig. 1, Test Results Part C.

9.1.6 *Energy-Saver Mode Energy*—Change the machine setting so that the machine can enter the energy-saver mode. When the machine has automatically entered the energy-saver mode, read and record the watt-hour meter indication (Wh) and the time. After 1 h, record the watt-hour reading again. The difference between the watt-hour reading at the start and finish of the hour is the observed data for energy-saver mode energy. Record the result in Fig. 1, Test Results Part D. If the machine reaches an auto-off mode within 1 h after the start point of the energy-saver mode measurement, change the setting of the time to pass to the auto-off mode to prevent the auto-off mode function from working during the measurement.

9.1.7 *Energy-Saver Recovery Time*—Using the stopwatch, record the amount of time (in seconds) it takes the machine to come out of the energy-saver mode when the appropriate button (copy, or energy saver) is pressed. Record this in Fig. 1, Part E.

9.1.8 *Recovery Energy Plus Energy-Saver Mode Energy*—Repeat the steps in 9.1.6, when the machine enters the energy-saver mode, read and record the watt-hour meter indication (Wh) and the time (or start the stopwatch or timer). At one hour minus the time needed for the machine to come out of the energy-saver mode (9.1.7), bring the machine out of the energy-saver mode. When the machine reaches the ready mode, the time should show one hour. Record the watt-hour meter reading (Wh). The difference between these two readings is the observed data for recovery energy plus energy-saver mode energy. Record this in Fig. 1, Part F.

9.1.9 *Auto-Off Mode Energy*—Change the machine setting so that the machine can enter the auto-off mode. When the machine has automatically entered the auto-off mode, read and record the watt-hour meter indication (Wh) and the time. After 1 h, record the watt-hour reading (Wh) again. The difference between the watt-hour reading at the start and finish of the hour is the observed data for auto-off mode energy. Record the result in Fig. 1, Test Results Part G.

9.1.10 For machines configured with automatic duplex option, repeat the steps in 9.1.5 in a mode where two-sided copies are made from single-sided originals. Record the result in the appropriate section in Fig. 1. The copying time in the duplex mode is obtained in a different manner from the calculation in 9.1.1. Actual copying time of at least one job should be measured separately within a copy cycle of 1 h allocated for this part of the test. For efficiency measurements in the duplex mode in step 9.1.10 should be made after step 9.1.5, because the machine has been set not to enter the energy-saver mode in 9.1.5. However, since copies are made 100 % in the duplex mode in 9.1.5 without considering a single-to-duplex copying ratio, the value obtained should be used as reference only.

10. Calculation

10.1 Refer to the appropriate Job Table according to the machine type, color copier (1 drum – serial type or 4 drum – parallel type) or monochrome copier. Enter the following into Fig. 1: the nominal monthly copying volume (N) assumed based on the machine speed, the nominal number of jobs per

hour of the machine (j), the number of copies (n), copying time (C_c) obtained in 9.1.1 and plug in mode energy obtained in 9.1.2.

10.2 Calculate the data for 100 % single sided copies obtained from steps 9.1.3-9.1.9 and list in the appropriately designated sections in Fig. 1.

10.2.1 Enter the data obtained from steps 9.1.3-9.1.9 under Test Results, Parts A, B, C, D, E, F and G, respectively.

10.2.2 Calculate warm-up energy ($A - B$) and record under (1).

10.2.3 Calculate copying energy (E_c) using ($C - B$) and record under (2). Calculate copying energy per copy (E_c/n) and record under (3).

10.2.4 Calculate recovery energy from the energy-saver mode (E_{rc}) from ($F - D$) and record under (4). Calculate recovery energy per standard month.

10.2.4.1 If the number of jobs (j) is 6 or more, the job interval will be 10 minutes or less and the machine does not go into the energy-saver mode during the copying cycle (see 3.1.9.1, Discussion). This means the energy-saver mode time per month is only the time of 22 lunch breaks per month. The recovery energy per standard month is obtained from:

$$(F - D) \times 22 \quad (1)$$

10.2.4.2 If the number of jobs (j) is 5 or less, the machine goes into the energy-saver mode and recovers “the number of jobs” times, that is, “the number of jobs (j) \times 8 h” times in the copying cycle of each day or “the number of jobs (j) \times 176 h” times per standard month, in addition to times of the lunch break energy-saver mode. In this case, the recovery energy per standard month is obtained from:

$$(F - D) \times \{(j) \times 176 + 22\} \quad (2)$$

10.2.4.3 Record this result in Fig. 1, (5).

10.2.5 Calculate ready mode energy time per standard month.

10.2.5.1 If the number of jobs (j) is 5 or less, the ready mode energy exists in (i) warm-up time (T_w), (ii) copying time (C_c) and (iii) $\{10 \times (j)\}$, multiplying 10 minutes designated as passing time to the energy-saver mode by the number of jobs (j). The ready mode energy time per standard month (in hours) is obtained from:

$$\{(T_w \times 22 + (C_c/n) \times N + 10 \times (j) \times 176)\} \div 60 \quad (3)$$

10.2.5.2 If the number of jobs (j) is 6 or more, the machine does not go into the energy-saver mode during the copying cycle. Eight hours of the copying cycle of each of 22 work days per month is regarded as ready mode energy time. The ready mode energy time per standard month is obtained from:

$$8 \times 22 = 176 \quad (4)$$

10.2.5.3 Record the result in Fig. 1, (6).

10.2.6 Calculate energy-saver mode energy time per standard month.

10.2.6.1 Operating hours per standard month is 198 hours as a result of calculation, 9 h \times 22 days.

10.2.6.2 Energy-saver mode time per standard month is obtained by subtracting the ready mode energy time per standard month calculated in 10.2.5 from 198 hours; that is, $198 - (6)$.

10.2.6.3 If the number of jobs (j) is 5 or less, the energy-saver mode time per standard month is obtained from:

$$198 - \{(T_w) \times 22 + (C/n) \times N + 10 \times (j) \times 176\} \div 60 \quad (5)$$

10.2.6.4 If the number of jobs (j) is 6 or more, the energy-saver mode energy time is 22 hours as a result of calculation, $198 - 176$, since the ready mode energy time per standard month is 176 hours.

10.2.6.5 This corresponds to 22 hours of lunch breaks per standard month (1 h \times 22 days).

10.2.6.6 Record the result (in hours) in Fig. 1, (7).

10.2.7 Calculate auto-off mode energy per standard month.

10.2.7.1 Auto-off mode time per standard month is 522 hours, which is obtained by subtracting operating hours ($9 \times 22 = 198$ hours) from total hours in a standard month ($24 \times 30 = 720$ hours). The energy is obtained from:

$$G \times 522 \quad (6)$$

10.2.7.2 Record the result in Fig. 1, (8).

10.2.8 Calculate warm-up energy per standard month from:

$$(A - B) \times 22 \quad (7)$$

10.2.8.1 Record the result in Fig. 1, (9).

10.2.9 Calculate ready mode energy per standard month ($B \times (6)$).

10.2.9.1 If the number of jobs is 5 or less:

$$B \times \{(T_w) \times 22 + (C/n) \times N + 10 \times (j) \times 176\} \div 60 \quad (8)$$

10.2.9.2 If the number of jobs is 6 or more:

$$B \times 176 \quad (9)$$

10.2.9.3 Record the result in Fig. 1, (10).

10.2.10 Calculate energy-saver mode energy per standard month ($D \times (7)$).

10.2.10.1 If the number of jobs is 5 or less:

$$D \times [198 - \{(T_w) \times 22 + (C/n) \times N + 10 \times (j) \times 176\} \div 60] \quad (10)$$

10.2.10.2 If the number of jobs is 6 or more:

$$D \times 22 \quad (11)$$

10.2.10.3 Record the result in Fig. 1, (11).

10.2.11 Calculate machine energy per standard month from:

$$E_m = [(8) + (9) + (10) + (11) + (5)] \quad (12)$$

10.2.11.1 Record the result in Fig. 1, (12).

10.2.12 Calculate the total energy per standard month (E_t).

10.2.12.1 Total energy equals machine energy plus copying energy, as follows:

$$E_t = (E_m) + (E_c/n)N \quad (13)$$

10.2.12.2 Record the result in Fig. 1, (13).

10.2.13 Calculate the average total energy per hour, as follows:

$$\{E_m + (E_c/n)N\} \div 720 \quad (14)$$

10.2.13.1 Record the result in Fig. 1, (14).

10.3 Obtain data from 9.1.5 for 100 % duplex copies (making two-sided copies from single sided originals) and calculate the data from 10.2.1-10.2.13. List in the appropriately designated sections in Fig. 1.

11. Report

11.1 If several identical machines of the same model are rated, the average energy rating should be reported. If the results for each machine differ by more than 10 %, the test should be repeated.

11.2 All data recorded should be reported to a minimum of three significant figures.

12. Keywords

12.1 copier-duplicating equipment; copy materials; copy products; electrostatic copier; energy-consumption; office equipment; UDC; upgradable digital copier

ANNEX
(Mandatory Information)
A1. JOB TABLES
TABLE A1.1 Mono Copier Table (1)

Speed	Nominal Monthly Copying Volume, N	Nominal Copies/Day	Nominal Jobs ($\frac{1}{8}$ day)				Job Interval	Copying Time C_t (min)
			Number of Jobs	Number of Originals	Number of Copies/Originals	n		
$0 < \text{cpm} \leq 5$	100	8	1	1	1	1	60 min	1/X
$5 < \text{cpm} \leq 10$	600	24	1	1	3	3	60 min	1/X + 2/Y
$10 < \text{cpm} \leq 15$	1800	80	2	1	5	10	30 min	2/X + 8/Y
$15 < \text{cpm} \leq 20$	3000	128	2	2	4	16	30 min	2/X + 14/Y
$20 < \text{cpm} \leq 25$	5000	240	3	2	5	30	20 min	3/X + 27/Y
$25 < \text{cpm} \leq 30$	8000	360	3	3	5	45	20 min	3/X + 42/Y
$30 < \text{cpm} \leq 35$	11000	480	4	3	5	60	15 min	4/X + 56/Y
$35 < \text{cpm} \leq 40$	14000	640	4	4	5	80	15 min	4/X + 76/Y
$40 < \text{cpm} \leq 45$	18000	800	5	4	5	100	12 min	5/X + 95/Y
$45 < \text{cpm} \leq 50$	23000	1000	5	5	5	125	12 min	5/X + 120/Y
$50 < \text{cpm} \leq 55$	28000	1200	6	5	5	150	10 min	6/X + 144/Y
$55 < \text{cpm} \leq 60$	34000	1440	6	5	6	180	10 min	6/X + 174/Y
$60 < \text{cpm} \leq 65$	40000	1728	6	6	6	216	10 min	6/X + 210/Y
$65 < \text{cpm} \leq 70$	46000	2016	6	6	7	252	10 min	6/X + 246/Y
$70 < \text{cpm} \leq 75$	53000	2304	6	6	8	288	10 min	6/X + 282/Y
$75 < \text{cpm} \leq 80$	60000	2688	6	8	7	336	10 min	6/X + 330/Y
$80 < \text{cpm} \leq 85$	68000	3072	6	8	8	384	10 min	6/X + 378/Y
$85 < \text{cpm} \leq 90$	77000	3456	6	8	9	432	10 min	6/X + 426/Y
$90 < \text{cpm} \leq 95$	86000	3840	6	8	10	480	10 min	6/X + 474/Y
$95 < \text{cpm} \leq 100$	96000	4320	6	10	9	540	10 min	6/X + 534/Y
$100 < \text{cpm}$	116000	5280	6	10	11	660	10 min	6/X + 654/Y

TABLE A1.2 Color Copier Table (2) (Serial: 1 Drum)

Speed (B/W Mode)	Nominal Monthly Copying Volume, N	Upper: Color Lower: B/W	Nominal Copies/Day	Nominal Jobs (1/8 Day)				Total Number of Jobs	Job Interval	Copying Time C _i (min)
				Number of Jobs	Number of Originals Copies/Originals	Number of Originals	n			
0 < cpm ≤ 5	100	100	8	1	1	1	1	1	60 min	1/X
5 < cpm ≤ 10	600	n/a	n/a	1	n/a	1	1	2	30 min	n/a
		120	8							1/X
10 < cpm ≤ 15	1800	480	24	1	1	3	3	2	30 min	1/X + 2/Y
		360	16	1	1	2	2			1/X + 1/Y
15 < cpm ≤ 20	3000	1440	64	1	2	4	8	2	30 min	1/X + 7/Y
		600	24	1	1	3	3			1/X + 2/Y
20 < cpm ≤ 25	5000	2400	112	1	2	7	14	3	20 min	1/X + 6/Y
		1000	48	1	2	3	6			1/X + 5/Y
25 < cpm ≤ 30	8000	4000	160	2	2	5	20	3	20 min	2/X + 18/Y
		1600	64	1	2	4	8			1/X + 7/Y
30 < cpm ≤ 35	11000	6400	288	2	3	6	36	4	15 min	2/X + 34/Y
		2200	96	1	3	4	12			1/X + 11/Y
35 < cpm ≤ 40	14000	8800	384	3	4	4	48	4	15 min	3/X + 45/Y
		2800	128	1	4	4	16			1/X + 15/Y
40 < cpm ≤ 45	18000	11200	504	3	3	7	63	5	12 min	3/X + 60/Y
		3600	160	2	2	5	20			2/X + 18/Y
45 < cpm ≤ 50	23000	14400	672	3	4	7	84	5	12 min	3/X + 81/Y
		4600	224	2	2	7	28			2/X + 26/Y
50 < cpm ≤ 55	28000	18400	864	3	4	9	108	6	10 min	3/X + 105/Y
		5600	256	2	2	8	32			2/X + 30/Y
55 < cpm ≤ 60	34000	22400	1024	4	4	8	128	6	10 min	4/X + 124/Y
		6800	288	2	3	6	36			2/X + 34/Y
60 < cpm ≤ 65	40000	27200	1280	4	5	8	160	6	10 min	4/X + 156/Y
		8000	336	2	3	7	42			2/X + 40/Y
65 < cpm ≤ 70	46000	32000	1440	4	5	9	180	6	10 min	4/X + 176/Y
		9200	432	2	3	9	54			2/X + 52/Y
70 < cpm ≤ 75	53000	36800	1600	4	6	9	200	6	10 min	4/X + 196/Y
		10600	480	2	3	10	60			2/X + 58/Y
75 < cpm ≤ 80	60000	42400	1920	4	6	10	240	6	10 min	4/X + 236/Y
		12000	528	2	3	11	66			2/X + 64/Y
80 < cpm ≤ 85	68000	48000	2240	4	7	10	280	6	10 min	4/X + 276/Y
		13600	640	2	4	10	80			2/X + 78/Y
85 < cpm ≤ 90	77000	54400	2464	4	7	11	308	6	10 min	4/X + 304/Y
		15400	704	2	4	11	88			2/X + 86/Y
90 < cpm ≤ 95	86000	61600	2688	4	7	12	336	6	10 min	4/X + 332/Y
		17200	768	2	4	12	96			2/X + 94/Y
95 < cpm ≤ 100	96000	68800	3072	4	8	12	384	6	10 min	4/X + 380/Y
		19200	864	2	6	9	108			2/X + 106/Y
100 < cpm	116000	76800	3584	4	8	14	448	6	10 min	4/X + 444/Y
		23200	1056	2	6	11	132			2/X + 130/Y
		92800	4096	4	8	16	512			4/X + 508/Y

TABLE A1.3 Color Copier Table (3) (Parallel: 4 Drums)

Speed (B/W Mode)	Nominal Monthly Copying Volume, N	Upper: Color Lower: B/W	Nominal Copies/Day	Nominal Jobs (1/8 Day)				Total Number of Jobs	Job Interval	Copying Time C _i (min)
				Number of Jobs	Number of Originals Copies/Originals	Number of n	n			
0 < cpm ≤ 5	100	100	8	1	1	1	1	1	60	1/X
5 < cpm ≤ 10	600	n/a	n/a							n/a
		300	16	1	1	2	2	2	30 min	1/X + 1/Y
10 < cpm ≤ 15	1800	↑	↑	1	1	2	2	2	30 min	1/X + 1/Y
		900	40	1	1	5	5	2	30 min	1/X + 4/Y
15 < cpm ≤ 20	3000	↑	↑	1	1	5	5	2	30 min	1/X + 4/Y
		1500	64	1	2	4	8	2	30 min	1/X + 7/Y
20 < cpm ≤ 25	5000	↑	↑	1	2	4	8	3	20 min	1/X + 7/Y
		2500	112	2	1	7	14	3	20 min	2/X + 12/Y
25 < cpm ≤ 30	8000	↑	↑	1	2	7	14	3	20 min	1/X + 13/Y
		4000	192	2	2	6	24	3	20 min	2/X + 22/Y
30 < cpm ≤ 35	11000	↑	168	1	3	7	21	4	15 min	1/X + 20/Y
		5500	240	2	3	5	30	4	15 min	2/X + 28/Y
35 < cpm ≤ 40	14000	↑	↑	2	3	5	30	4	15 min	2/X + 28/Y
		7000	320	2	4	5	40	4	15 min	2/X + 38/Y
40 < cpm ≤ 45	18000	↑	↑	2	4	5	40	5	12 min	2/X + 38/Y
		9000	384	3	4	4	48	5	12 min	3/X + 45/Y
45 < cpm ≤ 50	23000	↑	400	2	5	5	50	5	12 min	2/X + 48/Y
		11500	504	3	3	7	63	5	12 min	3/X + 60/Y
50 < cpm ≤ 55	28000	↑	512	2	4	8	64	6	10 min	2/X + 62/Y
		14000	648	3	3	9	81	6	10 min	3/X + 78/Y
55 < cpm ≤ 60	34000	↑	↑	3	3	9	81	6	10 min	3/X + 78/Y
		17000	768	3	4	8	96	6	10 min	3/X + 93/Y
60 < cpm ≤ 65	40000	↑	↑	3	4	8	96	6	10 min	3/X + 93/Y
		20000	864	3	4	9	108	6	10 min	3/X + 105/Y
65 < cpm ≤ 70	46000	↑	↑	3	4	9	108	6	10 min	3/X + 105/Y
		23000	1056	3	4	11	132	6	10 min	3/X + 129/Y
70 < cpm ≤ 75	53000	↑	↑	3	4	11	132	6	10 min	3/X + 129/Y
		26500	1200	3	5	10	150	6	10 min	3/X + 147/Y
75 < cpm ≤ 80	60000	↑	↑	3	5	10	150	6	10 min	3/X + 147/Y
		30000	1320	3	5	11	165	6	10 min	3/X + 162/Y
80 < cpm ≤ 85	68000	↑	↑	3	5	11	165	6	10 min	3/X + 162/Y
		34000	1560	3	5	13	195	6	10 min	3/X + 192/Y
85 < cpm ≤ 90	77000	↑	↑	3	5	13	195	6	10 min	3/X + 192/Y
		38500	1728	3	6	12	216	6	10 min	3/X + 213/Y
90 < cpm ≤ 95	86000	↑	↑	3	6	12	216	6	10 min	3/X + 213/Y
		43000	1872	3	6	13	234	6	10 min	3/X + 231/Y
95 < cpm ≤ 100	96000	↑	↑	3	6	13	234	6	10 min	3/X + 231/Y
		48000	2112	3	8	11	264	6	10 min	3/X + 261/Y
100 < cpm	116000	↑	↑	3	8	11	264	6	10 min	3/X + 261/Y
		53000	2304	3	8	12	288	6	10 min	3/X + 285/Y
		↑	↑	3	8	12	288	6	10 min	3/X + 285/Y

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