

Final Report by Copying Machine, etc.
Evaluation Standards Subcommittee,
Energy Efficiency Standards Subcommittee of the Advisory
Committee for Natural Resources and Energy

As regards copying machines, current evaluation standards for manufacturers, etc. of copying machines were presented in the “Final Report by Copying Machine, etc. Evaluation Standards Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee for Natural Resources and Energy (dated December 17, 1998)” and entered the target fiscal year in FY2006.

Therefore, for the purpose of studying new target standard values, etc. for copying machines and studying target standard values, etc. for printers and multifunction devices for which measurement methods had not been defined yet when the current standards were made, the “Copying Machine, etc. Evaluation Standards Subcommittee” was established to conduct deliberation on evaluation standards for manufacturers or importers (hereinafter referred to as “manufacturers”) of copying machines, printers and multifunction devices (hereinafter referred to as “copying machines, etc.”), and the report was made as follows.

1. Evaluation of current standards

As for copying machines which entered the target fiscal year in FY 2006, the weighted average of energy consumption efficiency was 42.7 Wh/h, improved by 72.5% from 155 Wh/h which was the value of those (shipped in FY 1997) before the Top Runner standards were introduced. It is noted that they are much better than originally assumed efficiency (107 Wh/h) and assumed improvement ratio (31.0%), which are the estimates in the case the Top Runner standards are achieved.

In the light of the above, energy saving of copying machines is making progress as a result of the manufacturers’ efforts, and it can be recognized that the current standards based on the Top Runner method are working effectively.

2. Target scope [See Attachment 1]

Copying machines, etc. to be covered this time are dry type indirect electrostatic products with supply voltage of 100V and using digital electro-photographic method.

Multifunction devices referred to here means those which have two or more functions from copying, printing, scanning and facsimile.

In addition, a convenience copying function of products having no platen is not included in the above mentioned function of copier.

Following products shall be excluded from the target scope.

- 1) Those whose copying or printing speed is 86 images per minute or above and which are used exclusively for monochrome copying or printing.
- 2) Those whose monochrome copying or printing speed is 61 images per or above and which are capable of copy or print in color.
- 3) Those whose monochrome copying or printing speed is 12 images per minute or below.
- 4) Those which are capable of copy or print on A2 size media defined by Japanese Industrial Standards (hereinafter referred to as “A2”) or larger.
- 5) Those which are copying machines and are capable of copy in color.
- 6) Those which have a facsimile function and do not have a platen.
- 7) Those which have a scanner function and a facsimile function only.
- 8) Those which have digital front end (DFE) function.

3. Items, etc. to be evaluation standards for manufacturers

(1) Target fiscal year (See Attachment 2)

The target fiscal year for copying machines, etc. shall be FY2017. However, that for copying machines shall remain the same as it is now (i.e. FY2006 and each fiscal year after that) because of the reasons described in Attachment 4 “4. Specific concept of target standard values”.

(2) Target standard values [See Attachment 3 and 4]

As regards copying machines, etc. shipped by each manufacturer/importer for the domestic market in the target fiscal year, the values which are calculated by weight-averaging the energy consumption per hour (Wh/h) or annual energy consumption (kWh/year) measured using the method described in paragraph (3) below with the quantity shipped by each manufacturer/importer for each category shown in the following table shall not exceed the target standard values.

○ Copying Machines

Category	Type of Copying Machine	Copying Speed	Target Standard Value (Wh/h)
1	A4 machine	13 images or more to 20 images or less per minute	17
2		21 images or more to 30 images or less per minute	69
3		31 images or more to 40 images or less per minute	88
4		41 images or more to 50 images or less per minute	123
5		51 images or more to 60 images or less per minute	144
6		61 images or more to 70 images or less per minute	180
7		71 images or more to 80 images or less per minute	200
8		81 images or more to 85 images or less per minute	258
9	B4 machine	13 images or more to 20 images or less per minute	20
10		21 images or more to 30 images or less per minute	85
11		31 images or more to 40 images or less per minute	108
12		41 images or more to 50 images or less per minute	151
13		51 images or more to 60 images or less per minute	176
14		61 images or more to 70 images or less per minute	221
15		71 images or more to 80 images or less per minute	246
16		81 images or more to 85 images or less per minute	317
17	A3 machine	13 images or more to 20 images or less per minute	55
18		21 images or more to 30 images or less per minute	99
19		31 images or more to 40 images or less per minute	125
20		41 images or more to 50 images or less per minute	176
21		51 images or more to 60 images or less per minute	205
22		61 images or more to 70 images or less per minute	257
23		71 images or more to 80 images or less per minute	286
24		81 images or more to 85 images or less per minute	369
25	A3Y machine	13 images or more to 20 images or less per minute	77
26		21 images or more to 30 images or less per minute	139

27		31 images or more to 40 images or less per minute	175
28		41 images or more to 50 images or less per minute	246
29		51 images or more to 60 images or less per minute	287
30		61 images or more to 70 images or less per minute	383
31		71 images or more to 80 images or less per minute	433
32		81 images or more to 85 images or less per minute	483

Note 1. “A4 machine”, “B4 machine”, “A3 machine” and “A3Y machine” above mean copying machines whose maximum supporting paper width is the short side of A4 size defined by the Japanese Industrial Standards (hereinafter referred to as “A4”), the short side of B4 size defined by the Japanese Industrial Standards (hereinafter referred to as “B4”), the short side of A3 size defined by the Japanese Industrial Standards (hereinafter referred to as “A3”) and the long side of A3 respectively.

2. “Copying speed” is expressed by the number of images copied per minute when conducting continuous copying on A4 standard papers.

○ Multifunction Devices

Category	Availability of Color Copying or Printing Capability	Copying or Printing Speed	Target Standard Value (kWh/year)
a	Available	Less than 43 images per minute	$E_k = 2.17X + 125$
b		43 images per minute or more	$E_k = 8.48X - 140$
c	Not available	Less than 50 images per minute	$E_k = 4.86X - 30$
d		50 images per minute or more	$E_k = 8.72X - 223$

Note 1. “Copying or printing speed” is expressed by the number of images copied or printed per minute when conducting continuous monochrome copying or printing on A4 standard paper.

2. “ E_k ” and “X” express the following values respectively.

E_k : Standard energy consumption efficiency (Unit: kWh/year)

X: Copying or printing speed

In case of machines whose copying or printing speed is at the lower limit value or lower, the lower limit value shall be used.

[Lower limit value]

Category c: 22 ipm

3. Target standard value is calculated by using the formula listed in the right column of the table, which shall be rounded off to the closest whole number.

○ Printers

Category	Availability of Color Printing Capability	Printing Speed	Target Standard Value (kWh/year)
A	Available	Less than 43 images per minute	$E_k = 5.34X - 14$
B		43 images per minute or more	$E_k = 8.48X - 146$
C	Not available	Less than 50 images per minute	$E_k = 4.07X - 15$
D		50 images per minute or more	$E_k = 8.72X - 247$

Note 1. “Printing speed” is expressed by the number of images printed per minute when conducting continuous monochrome printing on A4 standard paper.

2. “ E_k ” and “X” express the following values respectively.

E_k : Standard energy consumption efficiency (Unit: kWh/year)

X: Printing speed

In case of machines whose printing speed is the lower limit value or lower, the lower limit value shall be used.

[Lower limit value]

Category A: 22 ipm

Category C: 16 ipm

3. Target standard value is calculated by using the formula listed in the right column of the table, which shall be rounded off to the closest whole number.

(3) Measurement method of energy consumption efficiency [See Attachment 5]

Energy consumption efficiency of copying machines, etc. shall be the value calculated with the following formula (annual energy consumption (kWh/year)).

However, in case of copying machines, it shall be the same as it is now for the reason stated in Attachment 4 “4. Specific concept of target standard values”.

$$E = W_{TEC} * 52/1000$$

E: Annual energy consumption (kWh/year)

W_{TEC} : Energy consumption per week (Wh/week)

On the premise of having 5 working days a week, it contains energy consumption of the working days (5 days) and energy consumption in Auto-off (Sleep) mode on nonworking days (2 days)

(4) Indication items and related matters

Matters related to indication are as follows.

1) Indication items

Manufacturers must indicate the following items.

- i) Product name and model name
- ii) Category name
- iii) Copying or printing speed
- iv) Energy consumption efficiency
- v) Name of manufacturers

2) Compliance items

- i) As regards energy consumption efficiency, it shall be expressed by whole number in “Wh/h” for copying machines and in “kWh/year” for multifunction devices and printers.
- ii) Indication items listed in the foregoing paragraph 1) shall be indicated on conspicuous places in catalogues and operation manuals describing performance of the product.

4. Proposals for energy conservation

(1) Actions of manufacturers

- 1) Efforts shall be made to promote technological development toward energy saving of copying machines, etc. and to develop products with excellent energy consumption efficiency.
- 2) From the viewpoint of promoting the spread of copying machines, etc. with excellent energy consumption efficiency, efforts shall be made to provide appropriate information so that users can select copying machines, etc. with excellent energy consumption efficiency by means of, for example, indicating energy consumption efficiency not only on catalogues and operation manuals but also on easily noticeable places in materials which manufacturers will present to users at the point of product selection.
- 3) Efforts shall be made to develop energy saving technologies which are not only suiting for the measurement method of energy consumption efficiency but also reflecting the actual usage of users.
- 4) Efforts shall be made to provide users with appropriate information so that they can actively use energy saving setting when using copying machines, etc.

(2) Actions of retailers

- 1) Efforts shall be made to sell copying machines, etc. with excellent energy consumption efficiency as well as to provide appropriate information to users so that they can select copying machines, etc. with excellent energy consumption efficiency.
- 2) Efforts shall be made to provide users with appropriate information so that, when selecting copying machines, etc., users can select ones with functions and copying/printing speed suitable for the size of the place, where they are used.
- 3) Efforts shall be made to provide users with appropriate information so that they can actively use energy saving setting when using copying machines, etc.

(3) Actions of users

- 1) Efforts shall be made not only to select copying machines, etc. with excellent energy consumption efficiency, but also to promote energy conservation by actively utilizing energy saving setting for example when using copying machines, etc.
- 2) If there is a demand to use multiple functions such as copying, printing and more, efforts shall be made to select multifunction devices whose overall energy consumption is considered to be relatively less.

(4) Actions of Government

- 1) From the viewpoint of promoting the spread of copying machines, etc. with excellent energy consumption efficiency, efforts shall be made to take necessary actions such as the spread enlightenment activities, in order to promote actions of users and manufacturers.
- 2) Efforts shall be made to conduct appropriate operation of the law through periodical and continuous checking of the indication of information by manufacturers so that correct and comprehensible information on energy consumption efficiency can be provided to users.
- 3) Energy efficiency standards based on the Top Runner method is a very effective means to promote energy saving of products; therefore, efforts shall be made to disseminate it internationally by taking appropriate opportunities.

Target Scope of Copying Machines, etc.

Copying machines, etc. to be covered this time are dry type indirect electrostatic products¹ with supply voltage of 100V and using digital electro-photographic method².

Multifunction devices referred to here means those which have two or more of main functions of copier, printer, scanner and facsimile.

In addition, a convenience copying function of products having no platen is not included in the above mentioned function of copier.

Following products shall be excluded from the target scope.

- 1) Those whose copying or printing speed is 86 images per minute or above and which are used exclusively for monochrome copying or printing

The shipment volume is small and they are used for special usage mainly by printing business operators. Most of them cannot be used with ordinary power supply; thus they are excluded from the scope.

* Quantity shipped (FY2007): Approximately 2,040 units (Ratio of the quantity shipped to the total: 0.1%)

Note) The quantity mentioned above is the total of copying machines, multifunction devices and printers.

- 2) Those whose monochrome copying or printing speed is 61 images per minute or above and which are capable of copy or print in color

The shipment volume is small and they are used for special usage mainly by printing business operators; thus, they are excluded from the scope.

* Quantity shipped (FY2007): Approximately 6,320 units (Ratio of the quantity shipped to the total: 0.4%)

Note) The quantity mentioned above is the total of copying machines, multifunction devices and printers.

- 3) Those whose monochrome copying or printing speed is 12 images per minute or below

The shipment volume is small, and they are used mainly in general households but the frequency of use is low. It is often the case that they are turned on only when to be used, and they do not consume much energy. Thus they are excluded from the scope.

* Quantity shipped (FY2007): Approximately 23,200 units (Ratio of the quantity shipped to the total: 1.3%)

Note) The quantity mentioned above is the total of copying machines, multifunction devices and printers.

¹ A system in which electrostatic images formed by exposing image information on the surface of an electrical-charged photoreceptor are developed with powder toner and transferred to the paper.

² A system in which electrostatic images are formed on the surface of a photoreceptor using images which are converted to electric signals or images which have already been translated to electronic information,.

- 4) Those which are capable of copy or print on A2 size media or larger
The shipment volume is small and they are used for special usage mainly by printing and designing business operators. Many of them are difficult to be used with ordinary power supply. Thus they are excluded from the scope.
* Quantity shipped (FY2007): Approximately 16,000 units (Ratio of the quantity shipped to the total: 0.9%)
Note) The quantity mentioned above is the total of copying machines, multifunction devices and printers.
- 5) Those which are copying machines and are capable of copy in color.
The shipment volume is decreasing and ratio of the quantity shipped to the market is extremely small. Thus, they are excluded from the scope.
* Quantity shipped (FY2007): Approximately 5,050 units (Ratio of the quantity shipped to the total: 0.3%)
- 6) Those which have a facsimile function and do not have a platen
Since they do not have a platen, there is freedom in attachment position of a document reader and the structure becomes compact. As a result, the type and positioning of parts used in them are very different from those in general multifunction devices. Besides, ratio of the quantity shipped to the market is small. Thus they are excluded from the scope.
* Quantity shipped (FY2007): Approximately 39,000 units (Ratio of the quantity shipped to the total: 2.3%)
- 7) Those which have a scanner function and a facsimile function only
There is no shipment to the market and the likelihood of them being produced in the future is very low. Thus, they are excluded from the scope.
* Quantity shipped (FY2007): None
- 8) Those which have digital front end (DFE) function³
The shipment volume is small and they are used for special usage mainly by printing business operators; thus, they are excluded from the scope.
* Quantity shipped (FY2007): Approximately 2,000 units (Ratio of the quantity shipped to the total: 0.1%)
Note) The quantity mentioned above is the total of copying machines, multifunction devices and printers.

Note that after excluding above mentioned products, approximately 94.4% of shipment is still covered.

³ Servers with high image processing capability and being capable to centrally process (i.e. edit, manage, etc.) printing jobs requested from other computers or applications.

Target Fiscal Year for Copying Machines, etc.

1. A considerable improvement in energy consumption efficiency of copying machines, etc. is, in many cases, made when a model change takes place. Taking into consideration that in general minor changes of copying machines, etc. take place approximately every 4 to 6 years, it may be necessary to give at least once or twice opportunity(s) of improving energy consumption efficiency of copying machines, etc. in order to achieve greater improvement.

Meanwhile, it takes approximately 10 years to complete a major model change which is accompanied by changes in the fixing system protected by patents or changes in Sleep power control system, etc.

Therefore, it is appropriate to set the target fiscal year for copying machines, etc. to be FY2017 which is 10 years after FY2007 which is to be the standard fiscal year.

As regards copying machines which have conventionally been included in the target scope, the target fiscal year remains the same "FY2006 and each fiscal year after that" as it is now, for the reasons stated in Attachment 4 "4. Specific concept of target standard values".

2. It is expected that the improvement rate of annual energy consumption (kWh/year) in the target fiscal year will be approximately 44.5%, based on the assumption that there will be no change in shipment quantity and categorical composition from results in the standard fiscal year (result of FY2007) (approximately 46.8% for multifunction devices and approximately 41.6% for printers).

<Overview of Estimation>

- (1) Annual energy consumption calculated from the values of actual achievements of multifunction devices and printers shipped in FY2007:

Approximately 227 kWh/year

- (2) Annual energy consumption estimated from the target standard values of multifunction devices and printers to be shipped in the target fiscal year:

Approximately 126 kWh/year

- (3) Improvement rate of energy consumption efficiency:

$(227 - 126) / 227 * 100 = \text{Approximately } 44.5\%$

<Overview of Estimation: Multifunction Devices>

- (1) Annual energy consumption calculated from the values of actual achievements of multifunction devices shipped in FY2007:

Approximately 280 kWh/year

- (2) Annual energy consumption estimated from the target standard values of multifunction devices to be shipped in the target fiscal year:

Approximately 149 kWh/year

- (3) Improvement rate of annual energy consumption:

$(280 - 149) / 280 * 100 = \text{Approximately } 46.8\%$

<Overview of Estimation: Printers>

- (1) Annual energy consumption calculated from the values of actual achievements of printers shipped in FY2007:

Approximately 178 kWh/year

- (2) Annual energy consumption estimated from the target standard values of printers to be shipped in the target fiscal year:

Approximately 104 kWh/year

- (3) Improvement rate of annual energy consumption efficiency:

$(178 - 104)/178 * 100 = \text{Approximately } 41.6\%$

Classification of Copying Machines, etc.

I. Basic idea

Copying machines, etc. are classified based on the principles referred to as “the basic idea concerning the development and revision of evaluation standards for manufacturers, etc. to be considered in relation to the improvement in performance of specific equipment” (the 10th Energy Efficiency Standards Subcommittee of the Advisory Committee for Natural Resources and Energy, revised on June 18, 2007) (hereinafter referred to as “the principles”).

In case of copying machines, etc., they are mainly used for business usage, and while energy consumption per single unit is large, the market size as well as the shipment volume are small. If they are classified into too small groups, the number of products or shipping quantity for some groups may become overly decreased. In light of the above, while using functional formulae, they are classified with as few indices as possible based on the principles.

“The basic idea concerning the development and revision of evaluation standards for manufacturers, etc. to be considered in relation to the improvement in performance of specific equipment”

- Extract -

Principle 2: Specific equipment is classified based on certain indices. The indices (basic indices) are those which are deeply related to energy consumption efficiency such as physical amount and functions, and they are determined considering factors which consumers use as standards when choosing products (factors representing consumers’ needs).

Principle 3: Target standard value is determined by one value or functional formula for each category based on the basic indices, where it is feasible and appropriate to target at the same energy consumption efficiency.

Principle 4: When setting categories, additional functions are disregarded in principle. However, if the energy consumption efficiency of a product without a certain additional function is set as a target standard value, other products with additional functions may withdraw from the market, despite that market needs for the latter products are thought to be high, because they cannot comply with the target standard value. If the probability of such case is high, then it is acceptable to make another category (sheet) for those products.

Principle 5: As regards products which are expensive but excellent in energy consumption efficiency because they use advanced energy saving technologies, although it is possible to classify them into separate categories, it is desirable to treat them in the same category with others wherever possible so that manufacturers can actively sell the products with excellent energy consumption efficiency.

Principle 6: When setting a target standard value for a category, special products shall be excluded. However, availability of technologies employed in such special products shall be also reviewed when studying the future efficiency improvement possibly realized by technology development, etc.

II. Specific classification method

II-1 Copying machines

As regards copying machines, the conventional classification shall be used for the reason stated in Attachment 4 “4. Specific concept of target standard values”.

Table 1. Categories of Copying Machines

Category	Type of Copying Machine	Copying Speed
1	A4 machine	13 images or more to 20 images or less per minute
2		21 images or more to 30 images or less per minute
3		31 images or more to 40 images or less per minute
4		41 images or more to 50 images or less per minute
5		51 images or more to 60 images or less per minute
6		61 images or more to 70 images or less per minute
7		71 images or more to 80 images or less per minute
8		81 images or more to 85 images or less per minute
9	B4 machine	13 images or more to 20 images or less per minute
10		21 images or more to 30 images or less per minute
11		31 images or more to 40 images or less per minute
12		41 images or more to 50 images or less per minute
13		51 images or more to 60 images or less per minute
14		61 images or more to 70 images or less per minute
15		71 images or more to 80 images or less per minute
16		81 images or more to 85 images or less per minute
17	A3 machine	13 images or more to 20 images or less per minute
18		21 images or more to 30 images or less per minute
19		31 images or more to 40 images or less per minute
20		41 images or more to 50 images or less per minute
21		51 images or more to 60 images or less per minute
22		61 images or more to 70 images or less per minute
23		71 images or more to 80 images or less per minute
24		81 images or more to 85 images or less per minute
25	A3Y machine	13 images or more to 20 images or less per minute
26		21 images or more to 30 images or less per minute
27		31 images or more to 40 images or less per minute
28		41 images or more to 50 images or less per minute
29		51 images or more to 60 images or less per minute
30		61 images or more to 70 images or less per minute
31		71 images or more to 80 images or less per minute
32		81 images or more to 85 images or less per minute

II-2 Multifunction devices and printers

Multifunction devices and printers are classified according to the following 2 points based on the characteristics of the products.

- (1) Classification according to the availability of a color copying or printing capability
- (2) Classification according to copying or printing speed

Although the measuring method for multifunction devices are different according to the availability of a print-capability, both types of multifunction devices are classified into one category, because the shipment volume of those without print-capability is small and even decreasing.

- (1) Classification according to the availability of color copying or printing capability

To cope with consumer needs, there are products with color copying or printing capability and products without said function. Because the availability of color copying or printing capability is a factor that affects energy consumption of the products, they shall be classified as follows.

- 1) Those with color copying or printing capability
- 2) Those without color copying or printing capability

- (2) Classification according to copying or printing speed

In case of multifunction devices and printers, energy consumption tends to increase as their copying or printing speed increases; thus, a certain correlation can be observed between copying or printing speed and energy consumption. Meanwhile, products with color copying or printing capability are classified into “low speed machines” whose copying or printing speed is below 43 images per minute and “high speed machines” whose speed is 43 images per minute or above according to the difference in the fixing system, characteristics of toner, etc., while products without color copying or printing capability are classified into “low speed machines” whose copying or printing speed is below 50 images per minute and “high speed machines” whose speed is 50 images per minute or above. A correlation between copying or printing speed and energy consumption is different among these types of products.

In light of the above the classification according to copying or printing speed shall be adopted, and they are classified as follows taking into account the correlation between copying or printing speed and energy consumption.

- Those with color copying or printing capability
 - 1) Those whose speed is below 43 images per minute
 - 2) Those whose speed is 43 images per minute or above
- Those without color copying or printing capability
 - 1) Those whose speed is below 50 images per minute
 - 2) Those whose speed is 50 images per minute or above

Table 2. Categories of Multifunction Devices

Category	Availability of Color Copying or Printing capability	Copying or Printing Speed
a	Available	Those whose speed is below 43 images per minute
b		Those whose speed is 43 images per minute or above
c	Not available	Those whose speed is below 50 images per minute

d		Those whose speed is 50 images per minute or above
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Table 3. Categories of Printers

Category	Availability of Color Printing Capability	Printing Speed
A	Available	Those whose speed is below 43 images per minute
B		Those whose speed is 43 images per minute or above
C	Not available	Those whose speed is below 50 images per minute
D		Those whose speed is 50 images per minute or above

Target Standard Values for Copying Machines, etc.

1. Basic concept

Target standard values are set based on the Top Runner Method. Specific concepts are as follows.

- 1) Target standard values are set for each category which is determined appropriately.
- 2) As regards products whose efficiency is expected to be improved due to advancement of technologies in the future, target standard values are set taking such improvement into consideration as much as possible.
- 3) Target standard values should be consistent among categories.

2. Possible improvement of energy consumption efficiency due to advancement of technologies in the future

Technologies for copying machines, etc. are being developed focusing on the enhancement of convenience of users and improvement of energy consumption efficiency and the efficiency of each elemental technology has already been enhanced almost to its upper limit. Therefore, any innovative technological development cannot be expected at this moment.

[Examples of major efficiency improvement technologies for copying machines, etc.]

- 1) Low thermal capacity of fixing units
Improvement of efficiency resulting from thinner-walled or material improvement of the fixing unit.
- 2) Low melting point of toner
Improvement of efficiency by lowering the fixing temperature resulting from finer and polymerized particles of toner.
- 3) Improvement of photoreceptor's sensitivity
Improvement of efficiency by reforming photoreceptor materials, etc.
- 4) Reduction of torque of the driving system
Improvement of efficiency by reducing torque resulting from a smaller and lighter driving system.
- 5) Improved efficiency of motors and power supplies
Improvement of efficiency resulting from the improvement of magnetic materials or semiconductor devices
- 6) Reduction of electric power of illumination light sources
Improvement of efficiency by improving luminance efficiency of illumination lighting sources or introducing LED light sources, etc.
- 7) Shortening of warming-up time
Improvement of efficiency by making the smaller thermal capacity of fixing unit and the lowering melting point of toner.
- 8) Shortening of transition time to Sleep
Improvement of efficiency resulting from the shortening of transition time to Sleep realized in association with "7) Shortening of warming-up time"

It is supposed to be difficult to further improve the efficiency of these technologies because doing so may make the convenience or reliability of the equipment worse. Meanwhile, these technologies have already been incorporated into current top runner equipment and it is hard to expect that the energy consumption efficiency will be drastically improved. Nonetheless, there are still many machines which have not incorporated some of these technologies, so, considering the energy consumption of copying machines, etc. shipped in Japan as a whole, it can be expected that the efficiency would be considerably improved by expanding the introduction of these technologies.

3. Products to be considered as special products

When setting target standard values, products 1) which use special technologies, 2) the market share of which is currently very low in general, and 3) which are considered to have high uncertainty now as well as in the future are considered to be special products and excluded from the study of top runner values, if they are associated with a considerably high possibility that products with widespread technologies become less able to exist, leading to an extreme level of market distortion, and that they interfere with other technological improvement and innovation, when setting their energy consumption efficiency as target standard values.

In this study, the following products in each product category are considered to be special products and, therefore, they are excluded from the determination of top runner values.

(1) Multifunction devices

1) Those which have color copying or printing capability and meet all of the following conditions (10 product models, ratio of the quantity shipped: 2.9%)

- Surf fixing method or free belt nip fixing method
 - Warm-up time: 30 seconds or less
 - Sleep power: 5 W or less
 - Transition time to Sleep: 1 minute or less

2) Those which do not have color copying or printing capability and meet all of the following conditions (16 product models, ratio of the quantity shipped: 8.6%)

- Surf fixing method
 - Warm-up time: 10 seconds or less (in case of A4 exclusive machines, 5 seconds or less)
 - Sleep power: 6.5 W or less
 - Transition time to Sleep: 1 minute or less

(2) Printers

1) Those which have color printing capability and meet all of the following conditions (2 product models, ratio of the quantity shipped: 0.9%)

- Free belt nip fixing method
 - Warm-up time: 30 seconds or less
 - Sleep power: 7.5 W or less
 - Transition time to Sleep: 5 minute or less

2) Those which do not have color printing capability and meet all of the following conditions (3 product models, ratio of the quantity shipped: 8.1%)

- Surf fixing system (limited to A4 exclusive machines)
 - Warm-up time: 10 seconds or less
 - Sleep power: 5 W or less
 - Transition time to Sleep: 1 minute or less

<Reason of exclusion>

Currently, top runner products have already incorporated latest energy saving technologies and, as for other technologies, there is hardly any room left for improvement. Especially, when it comes to above mentioned multifunction devices and printers, the fixing method and its peripheral technologies which are main factors for the improvement of energy consumption efficiency are protected by patents and, therefore, it is almost impossible for manufacturers who do not have the patents to produce models meeting the above mentioned conditions. Therefore, in categories where products meeting the above mentioned conditions are being shipped, it is possible that products of manufacturers without the patent are less able to become available, leading to an extreme market distortion due to monopolization of the category by a few companies, if those special products should be included in the determination of target standard values.

4. Specific concept of target standard values

(1) Copying machines

Copying machines became designated products for the Top Runner standard in FY1999 and entered the target fiscal year in FY2006.

During this period, many energy saving technologies were developed and improvement rate of 72.5%, which was far beyond the originally anticipated improvement (31.0%), was achieved in the target fiscal year.

In recent years, however, as multifunction devices which are products with multiple functions rapidly spread, the shipment quantity of copying machines was drastically decreasing, and companies are focusing on the development of technologies for multifunction devices. At the same time, the development of technologies for copying machines has almost come to the limit as said in section 3; therefore, further improvement of efficiency cannot be expected.

Meanwhile, the whole energy consumption is likely to become smaller when using multifunction devices rather than using multiple machines with single function. Thus, this further encourages manufacturers to make efforts to develop technologies which may support shifting to multifunction devices, resulting in further decrease in the shipment volume of copying machines (from 116,870 units in FY2003 to 44,076 units in FY2009).

Considering these factors, it was decided that measuring methods and target standard values for copying machines be kept unchanged.

Lastly, since a copying machine is in other words a product resulting from removing all functions except copying from a multifunction device, it is assumed to be inevitable that the technological development for multifunction devices will also be adopted in copying machines. Thus, it is expected that the level of energy consumption efficiency of copying machines will be raised.

<Specific target standard values>

Target Standard Values for Copying Machines

Category	Type of Copying Machine	Copying Speed	Target Standard Value (Wh/h)
1	A4 machine	13 images or more to 20 images or less per minute	17
2		21 images or more to 30 images or less per minute	69
3		31 images or more to 40 images or less per minute	88
4		41 images or more to 50 images or less per minute	123
5		51 images or more to 60 images or less per minute	144
6		61 images or more to 70 images or less per minute	180
7		71 images or more to 80 images or less per minute	200
8		81 images or more to 85 images or less per minute	258
9	B4 machine	13 images or more to 20 images or less per minute	20
10		21 images or more to 30 images or less per minute	85
11		31 images or more to 40 images or less per minute	108
12		41 images or more to 50 images or less per minute	151
13		51 images or more to 60 images or less per minute	176
14		61 images or more to 70 images or less per minute	221
15		71 images or more to 80 images or less per minute	246
16		81 images or more to 85 images or less per minute	317
17	A3 machine	13 images or more to 20 images or less per minute	55
18		21 images or more to 30 images or less per minute	99
19		31 images or more to 40 images or less per minute	125
20		41 images or more to 50 images or less per minute	176
21		51 images or more to 60 images or less per minute	205
22		61 images or more to 70 images or less per minute	257
23		71 images or more to 80 images or less per minute	286
24		81 images or more to 85 images or less per minute	369
25	A3Y machine	13 images or more to 20 images or less per minute	77
26		21 images or more to 30 images or less per minute	139
27		31 images or more to 40 images or less per minute	175
28		41 images or more to 50 images or less per minute	246
29		51 images or more to 60 images or less per minute	287
30		61 images or more to 70 images or less per minute	383
31		71 images or more to 80 images or less per minute	433
32		81 images or more to 85 images or less per minute	483

Note 1. “A4 machine”, “B4 machine”, “A3 machine” and “A3Y machine” above mean copying machines whose maximum supporting paper width is respectively the short side of A4, the short side of B4, the short side of A3 and the long side of A3.

2. “Copying speed” is expressed by the number of images copied per minute when conducting continuous copying on A4 standard papers.

(2) Multifunction devices

For each category of multifunction devices, the Top Runner values were taken from actual measurements of annual energy consumption (FY2007) which is an index of energy consumption efficiency, and then a study on target standard values was carried out.

It was decided that a calculation formula for a target standard value shall be expressed by a linear function formula with a variable of printing speed, because there is a correlation between annual energy consumption and printing speed.

When developing a calculation formula, the following procedures were conducted.

- 1) In the low speed categories, an approximate line is calculated from the distribution of products incorporating new technologies such as lowered thermal capacity of fixing unit and reduction of Sleep power. Then, while maintaining the slope of the approximate line, it is shifted in parallel down to the Top Runner value (Figure 1).
- 2) Likewise in the high speed categories, an approximate line is calculated from the distribution of products incorporating new technologies. Then, while maintaining the slope of the line and considering tie points with the low speed categories and the top runner value of the high speed categories, it is shifted in parallel down to the top runner value to develop a standard line (Figure 2).
- 3) At the point where the sufficient correlation between annual energy consumption and printing speed disappears, a lower limit value is set for printing speed as necessary and then a lower limit line is set to develop a standard line.

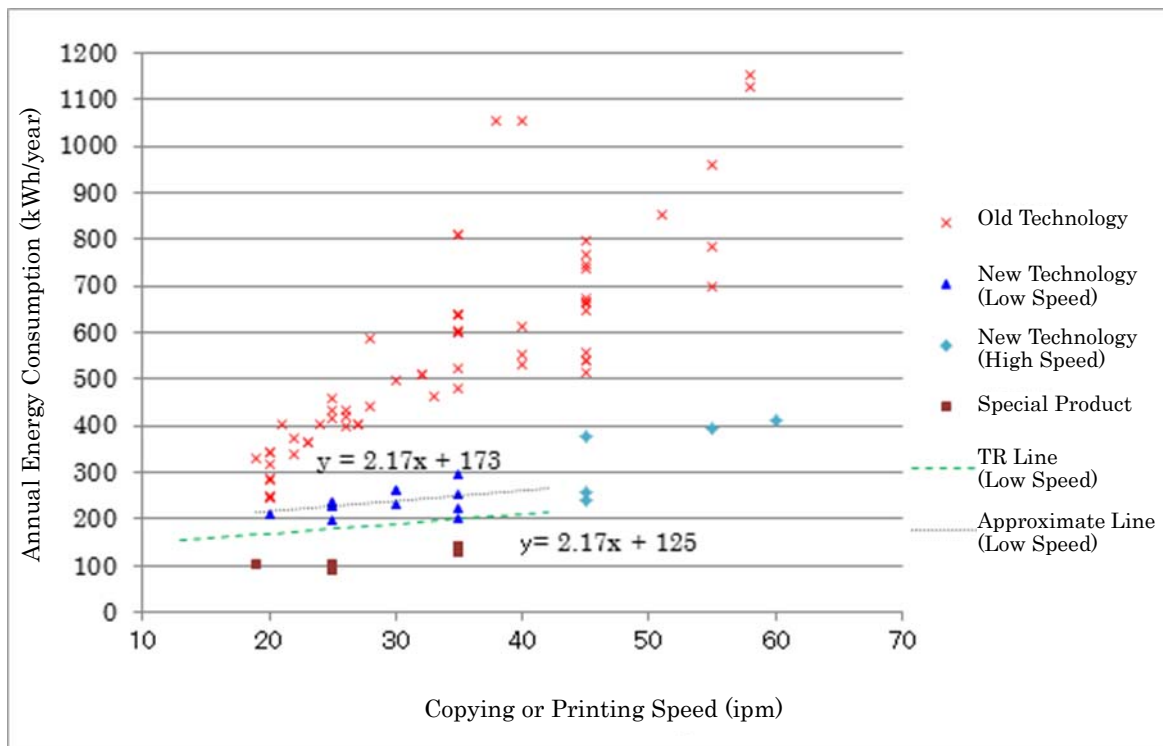


Figure 1 Parallel Shift of Approximate Line in Low Speed Category

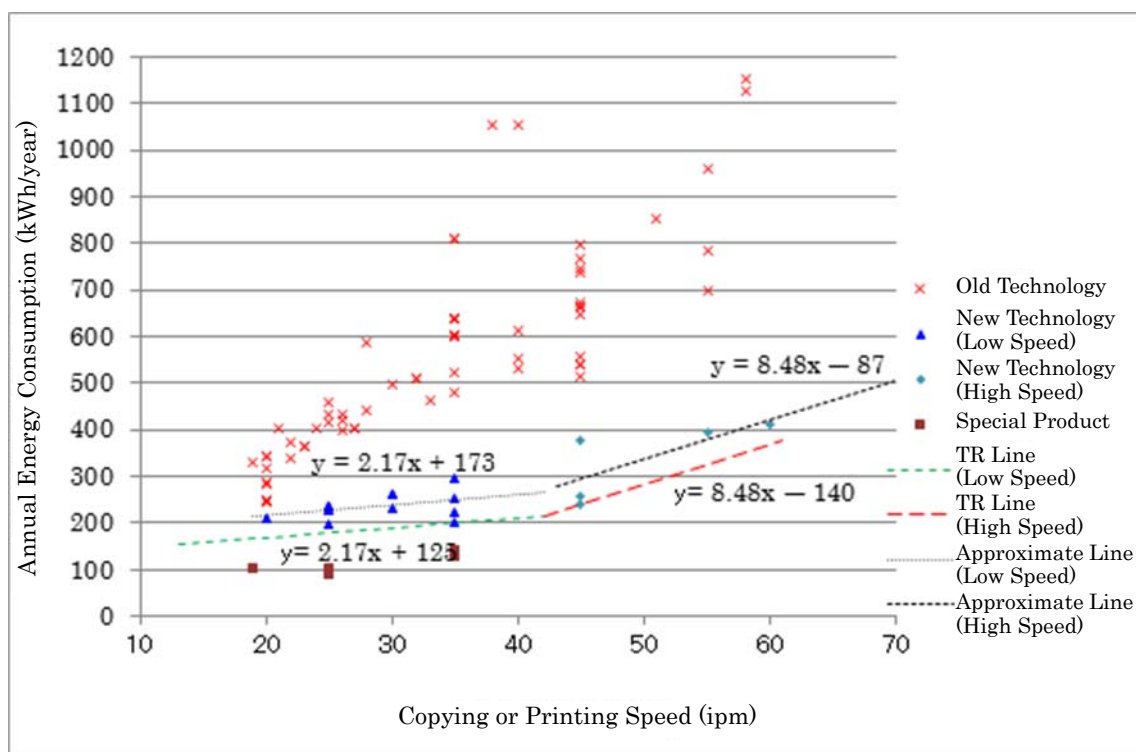


Figure 2 Parallel Shift of Approximate Line and Development of Standard Line in High Speed Category

<Specific target standard values>

As mentioned above, the top runner value was calculated for each category by functions and copying or printing speeds.

As a result, the target standard values for multifunction devices are determined as follows.

Meanwhile, in case of “machines without print-capability”, the energy consumption efficiency is measured using their copying function, so their energy consumption become greater than that of “machines with print-capability” measured using their print-capabilities. However, since the number of models of the “machines without print-capability” is few, it is difficult to determine standard values individually. Besides, their shipping quantity is decreasing. It was decided to set the same target standard values as those for the “machines with print-capability”.

Target Standard Values of Multifunction Devices

Category	Availability of Color Copying or Printing Capability	Copying or Printing Speed	Target Standard Values (kWh/year)
a	Available	Below 43 images per minute	$E_k = 2.17X + 125$
b		43 images per minute or above	$E_k = 8.48X - 140$
c	Not available	Below 50 images per minute	$E_k = 4.86X - 30$
d		50 images per minute or above	$E_k = 8.72X - 223$

Note 1. “Copying or printing speed” is expressed by the number of images copied or printed per minute when conducting continuous monochrome copying or printing on A4 standard paper.

2. “ E_k ” and “ X ” express the following values respectively.

E_k : Standard energy consumption efficiency (Unit: kWh/year)

X : Copying or printing speed

However, in case of machines whose copying or printing speed is the lower limit value or lower, the following lower limit value shall be used.

[Lower limit value]

Category c: 22 ipm

- The target standard value is calculated using the formula listed in the right column of the table, which shall be rounded off to the closest whole number.

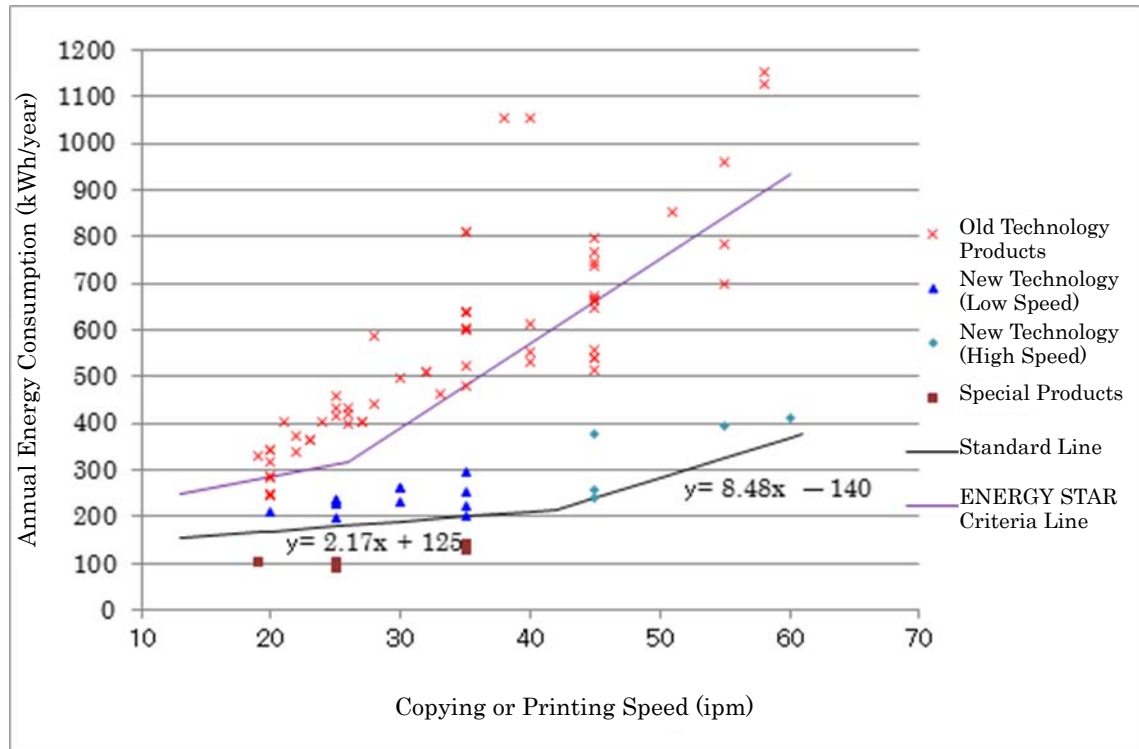


Figure 3 Target Standard Line of Color Multifunction Device (Category a, b)

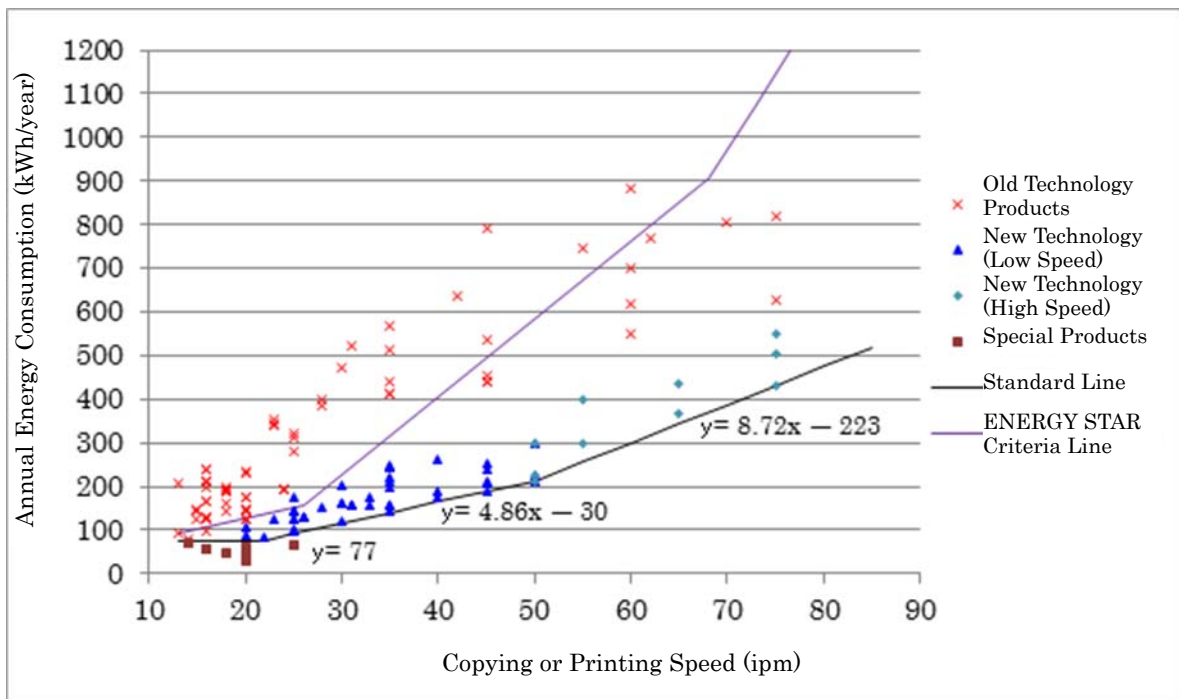


Figure 4 Target Standard Line of Monochrome Multifunction Device (Category c, d)

The improvement rate of each category is as follows.

Improvement Rate of Multifunction Devices in Target Fiscal Year

Category	Availability of Color Copying or Printing Capability	Copying or Printing Speed	Improvement Rate in Target Fiscal Year	
a	Available	Below 43 images per minute	Approx. 48.5%	Approx. 49.1%
b		43 images per minute or above	Approx. 50.9%	
c	Not available	Below 50 images per minute	Approx. 43.0%	Approx. 41.8%
d		50 images per minute or above	Approx. 34.1%	

* The improvement rate of multifunction devices as a whole is approximately 46.8%.

(3) Printers

For each category of printers, the Top Runner values were taken from actual measurements of annual energy consumption (FY2007) which is an index of energy consumption efficiency, and then a study on target standard values was carried out.

It was decided that a calculation formula for a target standard value shall be expressed by a linear function formula with a variable of printing speed, because there is a correlation between energy consumption efficiency and printing speed.

When developing a calculation formula, the following procedures were conducted.

- 1) In the low speed categories, an approximate line is calculated from the distribution of products incorporating new technologies such as lowered thermal capacity of fixing units and reduction of Sleep power.
- 2) While maintaining the slope of the approximate line, it is shifted in parallel down to the Top Runner value (Figure 5).
- 3) Likewise in the high speed categories, since there are no data concerning products incorporating new technologies, the slopes of the approximation lines of multifunction devices in high speed categories are adopted, and then it is shifted in parallel down to a tie point with the low speed categories.
- 4) At the point where the sufficient correlation between annual energy consumption and printing speed disappears, a lower limit value is set for printing speed as necessary and then a lower limit line is set to develop a standard line (Figure 6).

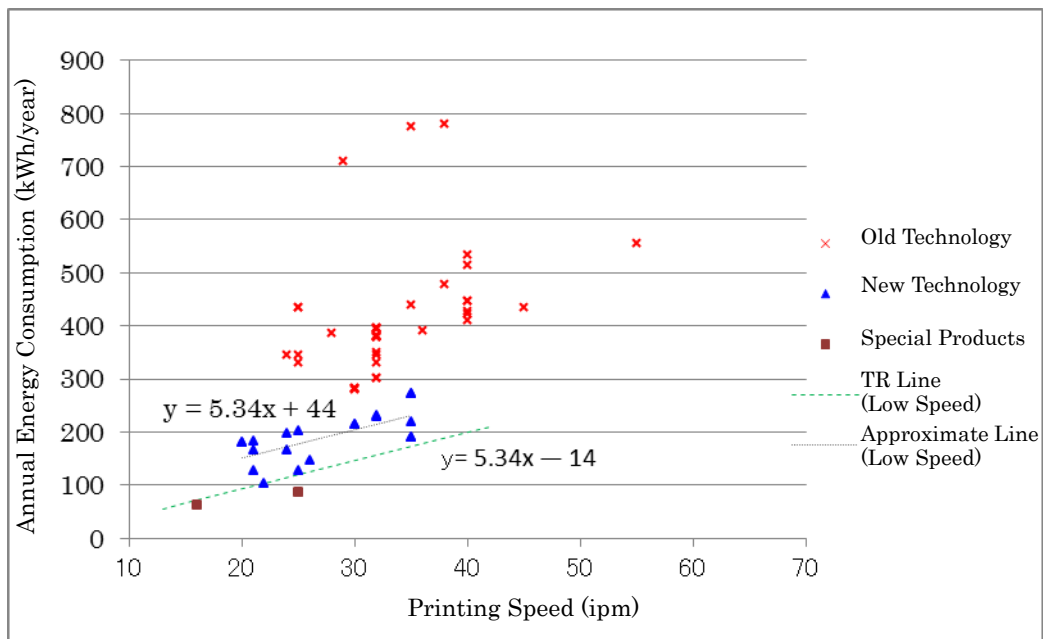


Figure 5 Parallel Shift of Approximate Line

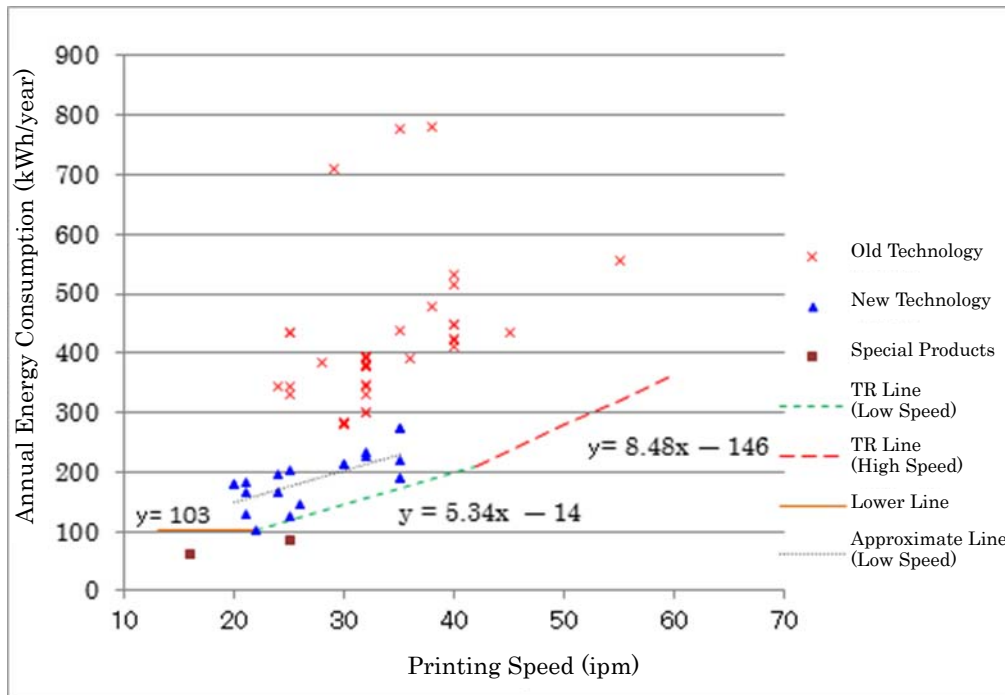


Figure 6 Development of Standard Line and Lower Limit Line

<Specific target standard values>

As mentioned above, the top runner value was calculated for each category by functions and printing speed.

As a result, the target standard values for printers are determined as follows.

Target Standard Values for Printers

Category	Availability of Color Printing Capability	Printing Speed	Target Standard Value (kWh/year)
A	Available	Below 43 images per minute	$E_k = 5.34X - 14$
B		43 images per minute or above	$E_k = 8.48X - 146$
C	Not available	Below 50 images per minute	$E_k = 4.07X - 15$
D		50 images per minute or above	$E_k = 8.72X - 247$

Note 1. "Printing speed" is expressed by the number of images printed per minute when conducting continuous monochrome printing on A4 standard paper.

2. "E_k" and "X" express the following values respectively.

E_k: Standard energy consumption efficiency (Unit: kWh/year)

X: Copying or printing speed

However, in case of machines whose printing speed is the lower limit value or lower, the following lower limit value shall be used.

[Lower limit value]

Category A: 22 ipm

Category C: 16 ipm

3. Target standard value is calculated using the formula listed in the right column of the table, which shall be rounded off to the closest whole number.

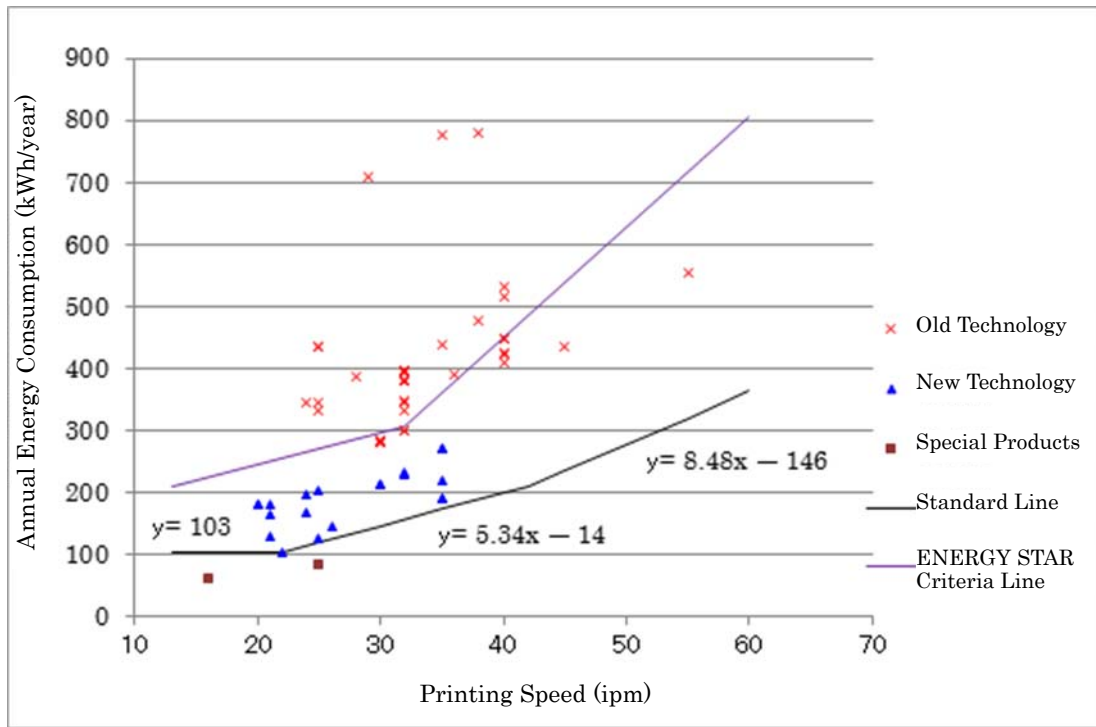


Figure 7 Target Standard Line for Color Printers (Category A, B)

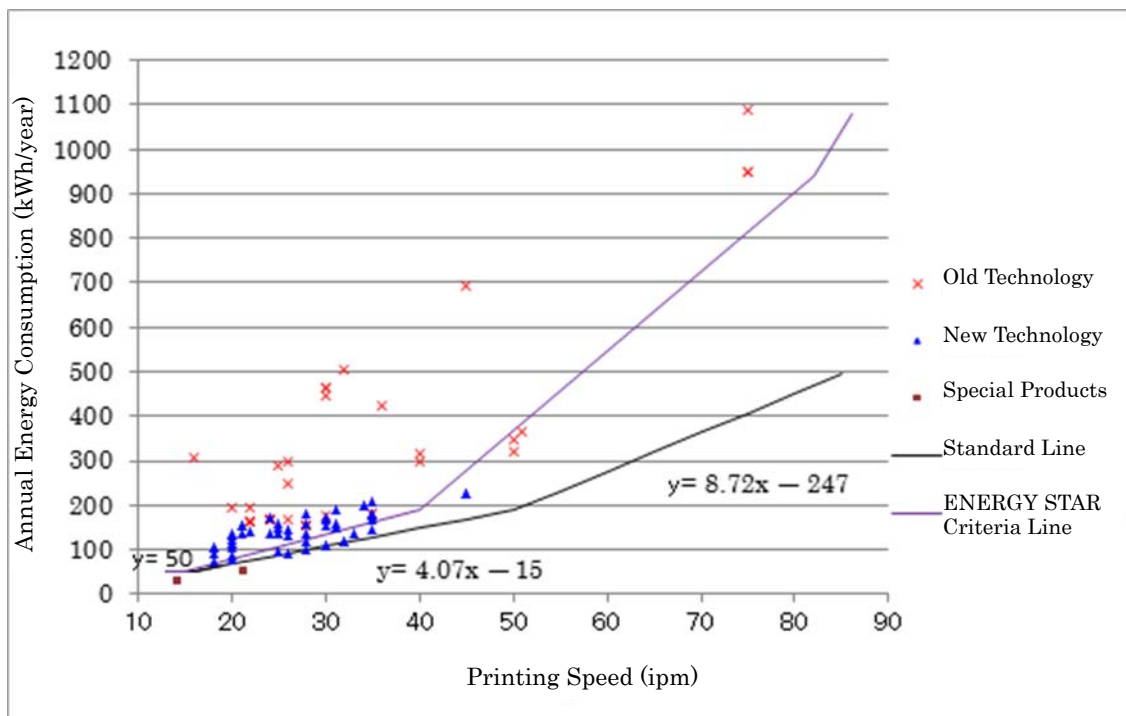


Figure 8 Target Standard Line for Monochrome Printers (Category C, D)

The improvement rate of each category is as follows.

Improvement Rate of Printers in Target Fiscal Year

Category	Availability of Color Printing Capability	Printing Speed	Improvement Rate in Target Fiscal Year	
A	Available	Below 43 images per minute	Approx. 46.8%	Approx. 46.8%
B		43 images per minute or above	Approx. 45.4%	
C	Not available	Below 50 images per minute	Approx. 37.2%	Approx. 37.6%
D		50 images per minute or above	Approx. 51.6%	

* The improvement rate of printers as a whole is approximately 41.6%.

The improvement rate of multifunction devices and printers in total is approximately 44.5%.

Energy Consumption Efficiency of Copying Machines, etc. and Measuring Method

1. Basic concept

Energy consumption efficiency of current copying machines prescribed by the Act on the Rational Use of Energy is energy consumption per hour (Wh/h), which is obtained based on the energy consumption of the first one hour after starting work and other active hours by modes.

Meanwhile, concerning a measuring method for multifunction devices and printers which are newly added to the target scope, the International ENERGY STAR Program has provided the measuring method for energy consumption per week (TEC) based on a usage pattern. Therefore, they shall be measured according to the test procedure for ENERGY STAR qualifying imaging equipment typical electricity consumption (TEC: Typical Electricity Consumption).

As for copying machines, since the shipping quantity is decreasing and anticipated to stay in a low level even in the future, the conventional measuring method is kept unchanged.

2. Specific energy consumption efficiency and its measuring method

Energy consumption efficiency shall be annual energy consumption, and it is calculated with the following calculation formula.

$$E = W_{\text{TEC}} * 52/1000$$

Where, E and W_{TEC} express the following values respectively.

E: Annual energy consumption (kWh/year)

W_{TEC} : Energy consumption per week (Wh/week)

I. Multifunction devices without print-capability

(1) W_{TEC} : Energy consumption per week (Wh/week)

Presuming 5 working days a week, energy consumption of working days (5 days) and energy consumption in Auto-off on nonworking days (2 days).

$$W_{\text{TEC}} = (W_{\text{D}} * 5) + (W_{\text{AO}} * 48)$$

W_{D} : Energy consumption per day (Wh/day)

W_{AO} : Energy consumption per hour in Auto-off (Wh/h)

Note 1. Printing means to print original images in form of electronic data such as electronic files, etc. onto the surface of print media such as papers.

Note 2. Auto-off means a power state which a product enters when it is switched off by automatic or preset stimuli (e.g., a delay time or clock) but is still plugged in and connected to a power source. Auto-off ends when the product is stimulated by an input such as turning on a manual power switch or clock timer to bring it into Ready state.

(2) W_D : Energy consumption per day (Wh/day)

Energy consumption calculated based on daily hours of use, usage pattern and low power modes (Sleep mode or Auto-off). It is the total of energy consumption in copying and Ready mode, in transitioning to Auto-off and in Auto-off. The transition to Auto-off is executed twice a day, simulating a lunch break between the morning and afternoon hours.

$$W_D = W_J + (W_T * 2) + W_{DAO}$$

W_J : Energy consumption needed for copying per day (Wh/day)

W_T : Energy consumption in transitioning to Auto-off (Wh)

W_{DAO} : Energy consumption in Auto-off per day (Wh/day)

Note 3. Sleep means a reduced power state that a product enters automatically after a period of inactivity without being physically switched off. In addition to automatically entering Sleep, the product may also enter this mode via 1) time setting by users, 2) immediate response to manual operation by users and 3) automatically achieved ways based on user action.

During this mode, all of the product's functions can be enabled and the product must enter active mode in response to any designed potential input signals. The potential input signals include external electrical stimuli (e.g. network stimuli, remote control) and direct physical operation (e.g. activation of physical switches or buttons). The product must maintain network connection while in Sleep and wakes up only when necessary. If a product has multiple Sleep modes, it shall be the one with the least energy consumption (final Sleep).

Note 4. Ready means a power state in which a product is not producing output, has reached operating conditions, has not yet entered into any lower-power modes, enables all functions, and can enter active state with minimal delay in response to designed potential input signals. The potential input signals include external electrical stimuli (e.g. network stimuli, remote control) and direct physical operation (e.g. activation of physical switches or buttons).

Note 5. Copying means to print an original image on paper, etc. onto the surface of print media such as papers.

(3) W_{AO} : Energy consumption per hour in Auto-off (Wh/h)

Energy consumption per hour after entering Auto-off from Ready. In case of multifunction devices without print-capability but with facsimile function, this is energy consumption after entering Sleep from Ready.

(4) W_J : Energy consumption needed for copying per day (Wh/day)

Energy consumption needed to execute prescribed number of copying according to copying speed given in paragraph 14) of Section 3. Measurement conditions. Presuming lunch break, copying immediately after returning from Sleep mode is executed twice, i.e. in the morning and the afternoon, and other copying are executed from Ready mode.

$$W_J = (W_{J1} * 2) + \{W_{AJ} * (J - 2)\}$$

W_{J1} : Energy consumption needed for Copying Test 1 (Wh)

W_{AJ} : Average energy consumption of Copying Test 2, Copying Test 3 and Copying Test 4 (Wh)

J : The number of copying times per day (the number of times)

(5) W_T : Energy consumption in transitioning to Auto-off (Wh)

Energy consumption during the period from the time when measurement of Copying Test 4 ends till the product enters Auto-off. In case of multifunction devices without print-capability but with facsimile function, this is energy consumption during the period from the time when measurement of Copying Test 4 ends till the product enters Sleep.

(6) W_{DAO} : Energy consumption in Auto-off per day (Wh/day)

Energy consumption in Auto-off per day.

The value comprised of time needed for copying plus two sets of time for transitioning to Auto-off because of product's entering Auto-off in the morning and in the afternoon is subtracted from 24 hours, then the calculated value is multiplied by energy consumption in Auto-off to obtain W_{DAO} .

$$W_{DAO} = [24 - \{(J/4) + (T * 2)\}] * W_{AO}$$

J : The number of copying times per day (the number of times)

T : Time for transitioning to Auto-off (h)

W_{AO} : Energy consumption in Auto-off (Wh/h)

(7) W_{J1} : Energy consumption needed for Copying Test 1 (Wh)

After one hour Sleep mode, energy consumption during the period from the time when the unit starts one copying, which consists of copying a set of images per copying test prescribed according to copying speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed.

(8) W_{AJ} : Average energy consumption of Copying Test 2, Copying Test 3 and Copying Test 4 (Wh)

Energy consumption needed for copying from Ready mode (Wh).

From Ready mode, energy consumption during the period from the time when the unit starts one copying, which consists of copying a set of images per copying test prescribed according to copying speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed. It is measured for three times, and W_{AJ} is obtained by averaging these three measurements.

$$W_{AJ} = (W_{J2} + W_{J3} + W_{J4})/3$$

(9) J : The number of copying times per day (the number of times).

The number of copying times per day prescribed according to copying speed in paragraph 14) of Section 3. Measurement conditions.

(10) T : Time for transitioning to Auto-off (h)

Time from the end of measurement of Copying Test 4 until the unit enters Auto-off. In

case of multifunction devices without print-capability but with facsimile function, this is the time from the end of measurement of Copying Test 4 until the product enters Sleep.

(11) W_{J2} : Energy consumption needed for Copying Test 2 (Wh)

After measuring W_{J1} , from Ready mode, energy consumption during the period from the time when the unit starts one copying, which consists of copying a set of images per copying test prescribed according to copying speed in paragraph 14) of Section 3. Measurement Conditions, until 15 minutes has elapsed. If a product enters low power modes from Ready before 15 minutes elapses from the start of copying, it can be started from Sleep or Auto-off mode.

(12) W_{J3} : Energy consumption needed for Copying Test 3 (Wh)

After measuring W_{J2} , from Ready mode, energy consumption during the period from the time when the unit starts one copying, which consists of copying a set of images per copying test prescribed according to copying speed in paragraph 14) of Section 3. Measurement Conditions, until 15 minutes has elapsed. If a product enters low power modes from Ready before 15 minutes elapses from the start of copying, it can be started from Sleep or Auto-off mode.

(13) W_{J4} : Energy consumption needed for Copying Test 4 (Wh)

After measuring W_{J3} , from Ready mode, energy consumption during the period from the time when the unit starts one Copying Test, which consists of copying a set of images per copying test prescribed according to copying speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed. If a product enters low power modes from Ready before 15 minutes elapses from the start of copying, it can be started from Sleep or Auto-off mode.

(14) Measurement of energy consumption and time described in (3), (5), (7) and (10) to (13) shall be conducted according to the following procedures.

Procedure		Initial State of Step	Record (at the end of step)	State to be Measured
<1>	Connect the unit under the test to a meter. Zero the meter. Wait for the start of test (5 minutes or more).	Off	Energy consumption in Off, and time until the unit is switched on	Off
<2>	Switch on the unit. Wait until the unit indicates that it is in Ready mode.	Off	-	-
<3>	Execute one copying job which consists of copying the number of images prescribed in paragraph 14) of Section 3. Measurement Conditions. Wait until the meter indicates that the unit has entered Sleep mode.	Ready	Time until the first sheet is exiting the unit	-
<4>	Zero the meter and wait one hour. If the unit enters Off state before one hour elapses, record the time and energy consumption Sleep mode. In this case, also wait one hour before going to step <5>.	Sleep	Energy consumption and time in Sleep mode	Sleep

<5>	Zero the meter and timer. Execute one copying job which consists of copying the number of images prescribed in paragraph 14) of Section 3. Measurement Conditions. Wait until the timer indicates that 15 minutes have elapsed. * Energy consumption in (7)	Sleep	Energy consumption needed for copying test 1 (W_{J1}), and the time until the first sheet is exiting the unit	Recovery, Active, Ready, Sleep, Auto-off
<6>	Repeat Step <5>. * Energy consumption in (11)	Ready	Energy consumption needed for copying test 2 (W_{J2}), and the time until the first sheet is exiting the unit	The same as above.
<7>	Repeat Step <5> (no measurement of Active time). * Energy consumption in (12)	Ready	Energy consumption needed for copying test 3 (W_{J3})	The same as above.
<8>	Repeat Step <5> (no measurement of Active time). * Energy consumption in (13)	Ready	Energy consumption needed for copying test 4 (W_{J4})	The same as above.
<9>	Zero the meter and timer. Wait until the meter or the unit indicates that it has entered Auto-off (or Sleep mode in case of multifunction devices without print-capability but with facsimile function). * Energy consumption in (5) and time in (10).	Ready	Time for transitioning to Auto-off (a period from the time when 15 minutes has elapsed from the start of copying test 4 till the unit enters Auto-off (or Sleep in case of multifunction devices without print-capability but with facsimile function)) (T), and energy consumption in transitioning to Auto-off (W_T)	Ready, Sleep
<10>	Zero the meter and wait until test time ends (5 minutes of more). * Energy consumption in (3)	Auto-off (or Sleep in case of multifunction devices without print-capability but with facsimile function)	Energy consumption in Auto-off (W_{AO})	Auto-off (or Sleep in case of multifunction devices without print-capability but with facsimile function)

Note 6. In step <2>, if the unit is not equipped with a Ready indicator, wait until the power stabilizes at Ready level.

Note 7. In step <3>, after recording the time until the first sheet is exiting from the unit, the remainder of copying can be cancelled.

Note 8. In step <4>, if the unit is switched off during this time, record energy consumption and time of Sleep mode at that time. Before starting step <5>, wait until one hour has elapsed after the unit enters Sleep mode.

Note 9. In step <5>, the 15 minutes is from the start of copying. In order to be evaluated by this test procedure, products must be able to complete copying jobs prescribed in paragraph 14) of Section 3. Measurement Conditions within the 15-minute copying test interval.

Note 10. If the unit enters low power modes from Ready before 15 minutes elapses from the start of copying jobs, it is acceptable to start Setp <6>, <7> and <8> from Sleep or Auto-off.

Note 11. If the unit has already entered Auto-off (or Sleep in case of multifunction devices without print-capability but with facsimile function) prior to the start of step <9>, the values of energy consumption and time when transitioning to Auto-off are zero.

Note 12. Regarding images for measurement, originals may be placed in the document feeder prior to the test. If the unit is not equipped with a document feeder, images are copied from one original placed on the platen.

II. Printers and multifunction devices with print-capability

(1) W_{TEC} : Energy consumption per week (Wh/week)

Presuming 5 working days a week, energy consumption of working days (5 days) and energy consumption in Sleep mode on nonworking days (2 days).

$$W_{TEC} = (W_D * 5) + (W_S * 48)$$

W_D : Energy consumption per day (Wh/day)

W_S : Energy consumption per hour in Sleep mode (Wh/h)

(2) W_D : Energy consumption per day (Wh/day)

Energy consumption calculated based on daily hours of use, usage pattern and Sleep mode. It is the total of energy consumption in printing and Ready, transitioning to Sleep mode and in Sleep mode. The transition to Sleep mode is executed twice a day, simulating a lunch break between the morning and afternoon hours.

$$W_D = W_J + (W_T * 2) + W_{DS}$$

W_J : Energy consumption needed for printing per day (Wh/day)

W_T : Energy consumption in transitioning to Sleep mode (Wh)

W_{DS} : Energy consumption in Sleep mode per day (Wh/day)

(3) W_S : Energy consumption per hour in Sleep mode (Wh/h)

Energy consumption per hour after entering Sleep mode from Ready.

(4) W_J : Energy consumption needed for printing per day (Wh/day)

Energy consumption needed to execute prescribed number of printing according to printing speed given in paragraph 14) of Section 3. Measurement conditions. Presuming lunch break, printing immediately after returning from Sleep mode is executed twice, i.e. in the morning and the afternoon, and other printing are executed from Ready mode.

$$W_J = (W_{J1} * 2) + \{W_{AJ} * (J - 2)\}$$

W_{J1} : Energy consumption needed for Printing Test 1 (Wh)

W_{AJ} : Average energy consumption of Printing Test 2, Printing Test 3 and Printing Test 4 (Wh)

J : The number of printing times per day (the number of times)

(5) W_T : Energy consumption in transitioning to Sleep mode (Wh)

Energy consumption during the period from the time when measurement of Printing Test 4

ends till the unit enters Sleep mode.

(6) W_{DS} : Energy consumption in Sleep mode per day (Wh/day)

Energy consumption in Sleep mode per day.

The value comprised of time needed for printing plus two sets of time for transitioning to Sleep mode because of product's entering Sleep mode in the morning and in the afternoon is subtracted from 24 hours, then the calculated value is multiplied by energy consumption in Sleep mode to obtain W_{DS} .

$$W_{DS} = [24 - \{(J/4) + (T * 2)\}] * W_S$$

J: The number of printing times per day (the number of times)

T: Time for transitioning to Sleep mode (h)

W_S : Energy consumption in Sleep mode per hour (Wh/h)

(7) W_{J1} : Energy consumption needed for Printing Test 1 (Wh)

After one hour Sleep mode, energy consumption during the period from the time when the unit starts one printing, which consists of printing a set of images per printing test prescribed according to printing speed in paragraph 14) of Section 3. Measurement Conditions, until 15 minutes has elapsed.

(8) W_{AJ} : Average energy consumption of Printing Test 2, Printing Test 3 and Printing Test 4 (Wh)

Energy consumption needed for printing from Ready mode (Wh).

From Ready mode, energy consumption during the period from the time when the unit starts one printing, which consists of printing a set of images per printing test prescribed according to printing speed in paragraph 14) of Section 3. Measurement Conditions, until 15 minutes has elapsed. It is measured for three times, and W_{AJ} is obtained by averaging these three measurements.

$$W_{AJ} = (W_{J2} + W_{J3} + W_{J4})/3$$

(9) J: The number of printing times per day (times)

The number of printing times per day prescribed according to printing speed prescribed in paragraph 14) of Section 3. Measurement conditions.

(10) T: Time for transitioning to Sleep mode (h)

Time from the end of measurement of Printing Test 4 until the unit enters Sleep mode.

(11) W_{J2} : Energy consumption needed for Printing Test 2 (Wh)

After measuring W_{J1} , from Ready mode, energy consumption during the period from the time when the unit starts one printing, which consists of printing a set of images per printing test prescribed according to printing speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed. If a product enters Sleep mode from Ready before 15 minutes elapse from the start of printing, it can be started from Sleep mode.

(12) W_{J3} : Energy consumption needed for Printing Test 3 (Wh)

After measuring W_{J2} , from Ready mode, energy consumption during the period from the time when the unit starts one printing, which consists of printing a set of images per printing

test prescribed according to printing speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed. If a product enters Sleep mode from Ready before 15 minutes elapses from the start of printing, it can be started from Sleep mode.

(13) W_{J4} : Energy consumption needed for Printing Test 4 (W_h)

After measuring W_{J3} , from Ready mode, energy consumption during the period from the time when the unit starts one printing, which consists of printing a set of images per printing test prescribed according to printing speed in paragraph 14) of Section 3. Measurement conditions, until 15 minutes has elapsed. If a product enters Sleep mode from Ready before 15 minutes elapses from the start of printing, it can be started from Sleep mode.

(14) Measurement of energy consumption and time described in (3), (5), (7) and (10) to (13) shall be conducted according to the following procedures.

Procedure		Initial State of Each Step	Record (at the end of each step)	State to be Measured
<1>	Connect the unit under the test to a meter. Zero the meter. Wait for the start of Step <2> (5 minutes or more).	Off	Energy consumption in Off, and time until the unit is switched on	Off
<2>	Switch on the unit. Wait until the unit indicates that it is in Ready mode.	Off	-	-
<3>	Execute one printing job which consists of printing the number of images prescribed in paragraph 14) of Section 3. Measurement Conditions. Wait until the meter indicates that the unit has entered Sleep mode.	Ready	Time until the first sheet is exiting the unit	-
<4>	Zero the meter. Wait for one hour. * Energy consumption in (3)	Sleep	Energy consumption in Sleep mode	Sleep
<5>	Zero the meter and timer. Execute one printing job which consists of printing the number of images prescribed in paragraph 14) of Section 3. Measurement Conditions. Wait until the timer indicates that 15 minutes have elapsed. * Energy consumption in (7)	Sleep	Energy consumption needed for printing test 1 (W_{J1}), and the time until the first sheet is exiting the unit	Recovery, Active, Ready, Sleep,
<6>	Repeat Step <5>. * Energy consumption in (11)	Ready	Energy consumption needed for printing test 2 (W_{J2}), and the time until the first sheet is exiting the unit	The same as above.
<7>	Repeat Step <5> (no measurement of Active time). * Energy consumption in (12)	Ready	Energy consumption needed for printing test 3 (W_{J3})	The same as above.
<8>	Repeat Step <5> (no measurement of Active time). * Energy consumption in (13)	Ready	Energy consumption needed for printing test 4 (W_{J4})	The same as above.
<9>	Zero the meter and timer. Wait until	Ready	Time for transitioning to	-

	<p>the meter or the unit indicates that it has entered Sleep mode. * Energy consumption in (5) and time in (10).</p>		<p>Sleep (a period from the time when 15 minutes has elapsed from the start of printing test 4 till the unit enters Sleep mode) (T), and energy consumption in transitioning to Sleep (W_T)</p>	
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Note 13. In step <2>, if the unit is not equipped with a Ready indicator, wait until the power stabilizes at Ready level.

Note 14. In step <3>, after recording the time until the first sheet is exiting from the unit, the remainder of printing can be cancelled.

Note 15. In step <5>, the 15 minutes is from the start of printing. The unit must indicate increased power consumption within 5 seconds of zeroing the meter and timer. To ensure this, it may start printing before zeroing.

Note 16. If the unit enters Sleep mode from Ready before 15 minutes elapses from the start of printing jobs, it is acceptable to start Step <6>, <7> and <8> from Sleep mode.

Note 17. If the unit has multiple sleep modes, all of the sleep modes except for the last one are taken into account in the time for transitioning to Sleep mode; whereas, if it has only one Sleep mode, the Sleep mode is not included in the time for transitioning to Sleep mode.

Note 18. When executing printing, each image shall be sent separately. They may be part of the same document, but multiple copying of a single image is not allowed.

3. Measurement conditions

Measurement of energy consumption and time described in 2. I (1) to (8) and (10) to (13), and 2. II (1) to (8) and (10) to (13) shall be conducted under the following conditions.

1) Power supply voltage shall be AC power supply of 100 +/- 1 V, and power supply frequency shall be 50 Hz (+/- 1%) or 60 Hz (+/- 1%). In case of units whose maximum power consumption exceeds 1.5 kW, it shall be AC power supply of 100 +/- 4 V.

2) Total harmonic distortion shall be less than 2%. In case of units whose maximum power consumption exceeds 1.5 kW, it shall be less than 5%.

3) Ambient temperature shall be 23 +/- 2°C and relative humidity shall be 65 +/-10%.

* Although the typical electricity consumption testing procedure for ENERGY STAR qualifying image equipment specifies the ambient temperature as 23 +/- 5°C and the relative humidity as 10 to 80%, the tolerance of current measuring method is adopted here because the ones in ENERGY STAR procedure are likely to cause variability.

4) Paper for testing shall be A4 and 64 g/m² +/- 5%.

5) As for power measurement instrument, meters satisfying the following conditions shall be used.

a) Frequency response is 3 kHz or more.

b) Resolution is set as follows according to wattage of power measurements.

i) 0.01 W or better for power measurements of 10 W or less.

ii) 0.1 W or better for power measurements of greater than 10 W up to 100 W.

iii) 1 W or better for power measurements of greater than 100 W up to 1.5 kW.

iv) 10 W or better for power measurements of greater than 1.5 kW.

c) Accuracy of measurements shall be 5% or better. For measurements of 0.5 W or less, it

shall be 0.02 W.

- d) Meters must have been calibrated within the last 12 months from the day of measurement.
- 6) Timer shall be the one able to measure in units of seconds.
 - 7) Originals with an image on one side shall be printed or copied in a monochrome simplex mode.
 - 8) Test images shall be Test Pattern A of ISO/IEC standard 10561:1999 and use 10 point size in a fixed-width Courier font or nearest equivalent. The test image shall be rendered on A4 sheet of paper and sent in a page description language (PDL) for printers or multifunction devices which are supporting PDL.
 - 9) Delay time of power management and resolution shall be the same as shipped and configured as the manufacturers' recommendations in its operation manual or website. In case that printers and multifunction devices with print-capability have Auto-off enabled as shipped, measurement shall be conducted after disabling that feature. In case that printers and multifunction devices with print-capability have network connection enabled as shipped, measurement shall be conducted while maintaining a connection allowing them to communicate with one or more externally-powered device(s) on the network. Print jobs for testing may be sent over non-network connections (e.g., USB), even on those units that are network-connected.
 - 10) Paper feeders and finishing devices shall be the same as shipped and configured as the manufacturers' recommendations. All of the hardware included as standard as shipped shall be attached to the unit for testing.
 - 11) All of power consumption shall be recorded in watt-hour (Wh); and time shall be measured by a timer with resolution of units of seconds and recorded by seconds or minutes.
 - 12) Service/maintenance modes and color calibration shall not be included in measurements. If they occur during a copying or printing test other than the first one, which is conducted 4 times, that copying or printing test shall be considered as invalid, and an substitute test shall be conducted immediately after Copying or Printing Test 4. The 15-minute test interval shall be maintained including the test deemed invalid.
 - 13) Anti-humidity feature shall be configured as shipped for testing.
 - 14) The number of copying or printing times per day and the number of images per copying or printing test described in 2. I (4), (7) to (9), (11) to (13) and 2. II (4), (7) to (9), (11) to (13) shall be as per the numbers listed in the table below.

Copying or Printing Speed (images/minute)	Number of Copying or Printing Times per Day (times)	Number of Images per Copying or Printing Test (images)	Copying or Printing Speed (images/minute)	Number of Copying or Printing Times per Day (times)	Number of Images per Copying or Printing Test (images)
13	13	6	50	32	39
14	14	7	51	32	40
15	15	7	52	32	42
16	16	8	53	32	43
17	17	8	54	32	45
18	18	9	55	32	47
19	19	9	56	32	49
20	20	10	57	32	50

21	21	10	58	32	52
22	22	11	59	32	54
23	23	11	60	32	56
24	24	12	61	32	58
25	25	12	62	32	60
26	26	13	63	32	62
27	27	13	64	32	64
28	28	14	65	32	66
29	29	14	66	32	68
30	30	15	67	32	70
31	31	15	68	32	72
32	32	16	69	32	74
33	32	17	70	32	76
34	32	18	71	32	78
35	32	19	72	32	81
36	32	20	73	32	83
37	32	21	74	32	85
38	32	22	75	32	87
39	32	23	76	32	90
40	32	25	77	32	92
41	32	26	78	32	95
42	32	27	79	32	97
43	32	28	80	32	100
44	32	30	81	32	102
45	32	31	82	32	105
46	32	33	83	32	107
47	32	34	84	32	110
48	32	36	85	32	112
49	32	37			

Note 19. For the number of copying or printing times per day and the number of images per copying or printing test, use the numbers listed in the table above according to the copying or printing speed. Note that the number of copying or printing times per day and the number of images per copying or printing test are obtained from using maximum claimed simplex printing or copying speed for making monochrome images on A4 paper, rounded to the nearest integer, rather than using output speed configured as default for the unit.

Note 20. As for testing images for multifunction devices without print-capability, an original shall be used for each of the number of images per copying test above. In case of multifunction devices without print-capability whose copying speed is 20 images per minute or above, it is acceptable to make multiple copies of each original as long as the number of originals is at least ten, instead of using the number of images per copying test shown above.

(Reference) Energy consumption measurement procedures

Figure 1 TEC Measurement Procedures

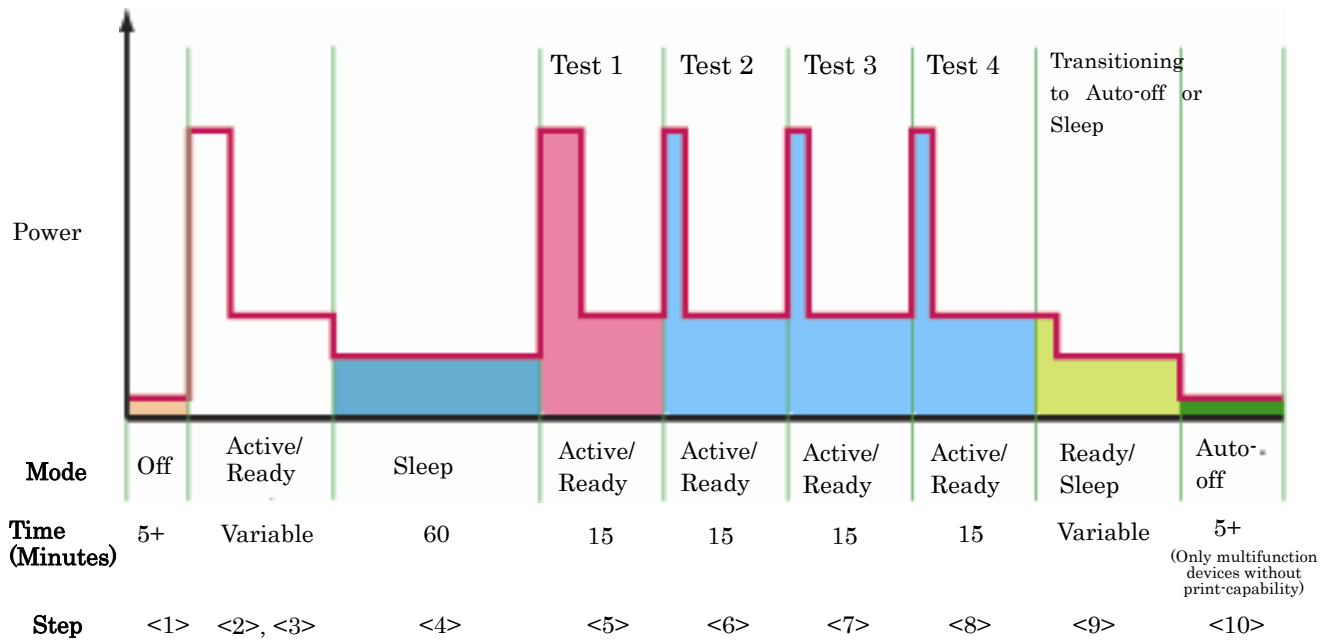


Figure 1 shows a graph of the measurement procedure. Note that in case of products whose delay time is short, Sleep time may be included in the measurement of 4 copying or printing tests, and Auto-off may be included in the measurement of Sleep in Step <4>. Meanwhile, in case of products with print-capability having only one Sleep mode, Sleep mode is not included in the time for transitioning to Sleep mode. Step <10> only applies to multifunction devices without print-capability (in case of multifunction devices without print-capability but with fax-capability, it shall be Sleep mode).

Figure 2 Typical Day

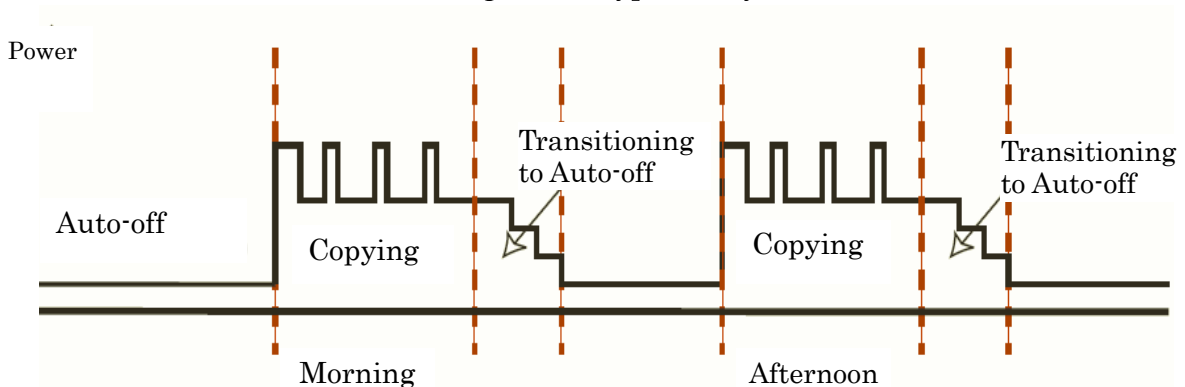


Figure 2 illustrates an example of a multifunction device without print-capability whose copying speed is 8 images/minute which performs copying 4 times each in the morning and in the afternoon and transitions to Auto-off mode twice in a working day, but stays in Auto-off for the remainder of the workday and all the weekend. Lunch time is assumed but not indicated explicitly. This figure is not made for the purpose of measurement. As Figure 1 shows, copying is always performed at 15 minute interval and making two big clusters. Meanwhile, regardless of the length of time, there are always two sets of full "time for transitionig to Auto-off". Printers, multifunction devices with print-capability and multifunction devices without print-capability but with fax-capability may use Sleep rather than Auto-off as the base mode.

Copying Machine, etc. Evaluation Standards Subcommittee
Energy Efficiency Standards Subcommittee
of the Advisory Committee for Natural Resources and Energy
Meeting History

1st Subcommittee (May 8, 2008)

- Regarding disclosure of the Copying Machine, etc. Evaluation Standards Subcommittee
- Regarding current status of copying machines, etc.
- Regarding target scope of copying machines, etc.
- Regarding energy consumption efficiency of copying machines, etc. and its measurement method

2nd Subcommittee (April 26, 2011)

- Regarding proposal for revising the target scope and measurement method of/for copying machines, etc.
- Regarding classification of copying machines, etc. for setting target
- Regarding target fiscal year and target standard values for copying machines, etc.
- Regarding interim report

Copying Machine, etc. Evaluation Standards Subcommittee
 Energy Efficiency Standards Subcommittee
 of the Advisory Committee for Natural Resources and Energy
 List of Members

Chairman	Kenichi AIKA	Director of Setagaya Study Center, the Open University of Japan
Members	Hitoshi AIDA	Professor, School of Engineering, University of Tokyo
	Atsushi AKISAWA	Professor, Graduate School of Engineering, Tokyo University of Agriculture and Technology
	Shoji IZAWA	Chairman of Image Data Communications & Facsimile Committee, Communications and Information Network Association of Japan (replaced by Kawamura subcommittee member from 2nd meeting)
	Kiyoshi KAWAMURA	Vice Chairman of Image Data Communications & Facsimile Committee, Communications and Information Network Association of Japan (joined from 2nd meeting)
	Minako OHISHI	Vice Chairperson of Environment Committee, Nippon Association of Consumer Specialists
	Minoru SAITO	Chairman of Copying Machine & Complex Machine Committee, Japan Business Machine and Information System Industries Association
	Koichi TANIGAWA	Vice Chairman of Technical Subcommittee of Printer Specific Committee, Japan Electronics and Information Technology Industries Association
	Keidai TSURUSAKI	Manager of Research Department, Environmental Planning Laboratory Inc.
	Yasuo HASAGAWA	Manager of Energy Technology Research Institute, National Institute of Advanced Industrial Science and Technology
	Yoichi HANJI	General Manager of Energy Conservation Technology Division, the Energy Conservation Center, Japan

(In Japanese alphabetical order)