



ENERGY STAR® Program Requirements for Imaging Equipment

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for imaging equipment. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. Obtain certification of ENERGY STAR qualification from a Certification Body recognized by EPA for imaging equipment prior to associating the ENERGY STAR name or mark with any product. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform imaging equipment product testing.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale.
5. Provide clear and consistent labeling of ENERGY STAR qualified imaging equipment products.
 - 5.1. Partner shall adhere to the following product-specific commitments regarding use of the ENERGY STAR certification mark on qualified products:
 - 5.1.1. Partner must use the ENERGY STAR mark in one of the following ways:
 - 1) Via permanent or temporary label on the top or front of the product. All temporary labeling must be affixed to the product with an adhesive or cling-type application; or
 - 2) Via electronic labeling that has been pre-approved by EPA.
 - 3) On product packaging/boxes for products sold at retail.
 - 5.1.2. If additional information about the ENERGY STAR program or other products is provided by the Partner on its website, Partner must comply with the ENERGY STAR Web Linking Policy, which can be found at www.energystar.gov/partners;

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for imaging equipment.
7. Comply with tests that EPA/DOE may conduct at its discretion on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

8. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:
 - 8.1. Partner must submit the total number of ENERGY STAR qualified imaging equipment products shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).
 - 8.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.
 - 8.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;
9. Report to EPA any attempts by laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.
10. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Training and Consumer Education

11. Partner shall comply with the following, product-specific requirements concerning training and education:
 - 11.1. Agree to complete steps to educate users of their products about the benefits of power management by including the following information with each ENERGY STAR qualified imaging equipment product in the user manual or as part of a printed box insert:
 - 11.1.1. Energy and cost savings potential;
 - 11.1.2. Environmental benefits; and
 - 11.1.3. The ENERGY STAR logo, plus information on ENERGY STAR and a link to www.energystar.gov.
 - 11.2. Include a link to www.energystar.gov/powermanagement from product web pages, product specifications, and related content pages.
 - 11.3. At the Partner's request, EPA will supply suggested facts and figures related to the above criteria, template elements, or a complete template suitable for use in user guides or box inserts.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for

periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.

- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.
- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.



ENERGY STAR® Program Requirements Product Specification for Imaging Equipment

Eligibility Criteria Draft Version 1.2

1 Following is the Version 1.2 ENERGY STAR Product Specification for Imaging Equipment. A product shall
2 meet all of the identified criteria if it is to earn the ENERGY STAR.

3 **1 DEFINITIONS**

4 A) Product Types:

5 1) Printer: A product whose primary function is to generate hard-copy output from electronic input. A
6 printer is capable of receiving information from single-user or networked computers, or other input
7 devices (e.g., digital cameras). This definition includes products that are marketed as printers,
8 and printers that can be field-upgraded to meet the definition of an MFD.

9 2) Scanner: A product whose primary function is to convert hard copy originals into electronic
10 images that can be stored, edited, converted, or transmitted, primarily in a personal computing
11 environment. This definition includes products that are marketed as scanners.

12 3) Copier: A product whose sole function is to produce hard copy duplicates from hard copy
13 originals. This definition includes products that are marketed as copiers, and upgradeable digital
14 copiers (UDCs).

15 4) Facsimile (Fax) Machine: A product whose primary functions are (1) to scan hard copy originals
16 for electronic transmission to remote units, and (2) to receive electronic transmissions for
17 conversion to hard copy output. A fax machine may also be capable of producing hard copy
18 duplicates. Electronic transmission is primarily over a public telephone system, but may also be
19 via a computer network or the Internet.

20 5) Multifunction Device (MFD): A product that performs two or more of the core functions of a Printer,
21 Scanner, Copier, or Fax Machine. **A MFD may have a physically-integrated form factor, or it may**
22 **consist of a combination of functionally-integrated components.** MFD copy functionality is
23 considered to be distinct from single-sheet convenience copying functionality sometimes offered
24 by fax machines. This definition includes products marketed as MFDs, and “multi-function
25 products” (MFPs).

26 6) Digital Duplicator: A product sold as a fully-automated duplicator system through the method of
27 stencil duplicating with digital reproduction functionality.

28 7) Mailing Machine: A product whose primary function is to print postage onto mail pieces.

29 B) Marking Technologies:

30 1) Direct Thermal (DT): A marking technology characterized by the burning of dots onto coated print
31 media that is passed over a heated print head. DT products do not use ribbons.

32 2) Dye Sublimation (DS): A marking technology characterized by the deposition (sublimation) of dye
33 onto print media as energy is supplied to heating elements.

- 34 3) Electro-photographic (EP): A marking technology characterized by the illumination of a
35 photoconductor in a pattern representing the desired hard copy image via a light source,
36 development of the image with particles of toner using the latent image on the photoconductor to
37 define the presence or absence of toner at a given location, transfer of the toner to the final print
38 media, and fusing to cause the hard copy to become durable. For purposes of this specification,
39 Color EP products simultaneously offer three or more unique toner, while Monochrome EP
40 products simultaneously offer one or two unique toner colors. This definition includes Laser, Light
41 Emitting Diode (LED), and Liquid Crystal Display (LCD) illumination technologies.
- 42 4) Impact: A marking technology characterized by the formation of the desired hard copy image by
43 transferring colorant from a “ribbon” to the print media via an impact process. This definition
44 includes Dot Formed Impact and Fully-formed Impact.
- 45 5) Ink Jet (IJ): A marking technology characterized by the deposition of colorant in small drops
46 directly to the print media in a matrix manner. For purposes of this specification, Color IJ products
47 offer two or more unique colorants at one time, while Monochrome IJ products offer one colorant
48 at a time. This definition includes Piezo-electric (PE) IJ, IJ Sublimation, and Thermal IJ. This
49 definition does not include High Performance IJ.
- 50 6) High Performance IJ: An IJ marking technology that includes nozzle arrays that span the width of
51 a page and/or the ability to dry ink on the print media via supplemental media heating
52 mechanisms. High-performance IJ products are used in business applications usually served by
53 electro-photographic marking products.
- 54 7) Solid Ink (SI): A marking technology characterized by ink that is solid at room temperature and
55 liquid when heated to the jetting temperature. This definition includes both direct transfer and
56 offset transfer via an intermediate drum or belt.
- 57 8) Stencil: A marking technology characterized by the transfer of images onto print media from a
58 stencil that is fitted around an inked drum.
- 59 9) Thermal Transfer (TT): A marking technology characterized by the deposition of small drops of
60 solid colorant (usually colored waxes) in a melted/fluid state directly to print media in a matrix
61 manner. TT is distinguished from IJ in that the ink is solid at room temperature and is made fluid
62 by heat.

63 C) Operational Modes:

64 1) On Mode:

65 a) Active State: The power state in which a product is connected to a power source and is
66 actively producing output, as well as performing any of its other primary functions.

67 b) Ready State: The power state in which a product is not producing output, has reached
68 operating conditions, has not yet entered into any lower-power Modes, and can enter Active
69 State with minimal delay. All product features can be enabled in this state, and the product is
70 able to return to Active State by responding to any potential inputs, including external
71 electrical stimulus (e.g., network stimulus, fax call, or remote control) and direct physical
72 intervention (e.g., activating a physical switch or button).

73 2) Off Mode: The power state that a product enters when it has been manually or automatically
74 switched off but is still plugged in and connected to the mains. Off Mode does not permit
75 operation of all product features but can be exited when the product is stimulated by an input,
76 such as a manual power switch or clock timer to bring the unit into Ready State.

77 a) Auto-off State: An Off Mode entered as a result of an automatic stimulus such as a delay
78 timer.

79 3) Sleep Mode: A reduced power state that a product enters either automatically after a period of
80 inactivity (i.e., Default Delay Time), in response to user manual action (e.g., at a user-set time of
81 day, in response to a user activation of a physical switch or button), or in response to external
82 electrical stimulus (e.g., network stimulus, fax call, remote control). Sleep Mode permits operation
83 of all product features (including maintenance of network connectivity), albeit with a possible delay
84 to transition into Active State.

85 4) Standby: The lowest power consumption state which cannot be switched off (influenced) by the
86 user and that may persist for an indefinite time when the product is connected to the main
87 electricity supply and used in accordance with the manufacturer's instructions¹. Standby is the
88 product's minimum power state. For Imaging Equipment products addressed by this specification,
89 the "Standby" Mode usually corresponds to Off Mode, but may correspond to Ready State or
90 Sleep Mode. A product cannot exit Standby and reach a lower power state unless it is physically
91 disconnected from the main electricity supply as a result of manual manipulation.

92 D) Media Format:

93 1) Large Format: Products designed for A2 media and larger, including those designed to
94 accommodate continuous-form media greater than or equal to 406 mm wide. Large-format
95 products may also be capable of printing on standard-size or small-format media.

96 2) Standard Format: Products designed for standard-sized media (e.g., Letter, Legal, Ledger, A3,
97 A4, B4), including those designed to accommodate continuous-form media between 210 mm and
98 406 mm wide. Standard-size products may also be capable of printing on small-format media.

99 3) Small Format: Products designed for media sizes smaller than those defined as Standard (e.g.,
100 A6, 4"x6", microfilm), including those designed to accommodate continuous-form media less than
101 210 mm wide.

102 4) Continuous Form: Products that do not use a cut-sheet media format, and that are designed for
103 applications such as printing of bar codes, labels, receipts, waybills, invoices, airline tickets, and
104 retail tags.

105 E) Additional Terms:

106 1) Automatic Duplexing: The capability of a copier, fax machine, MFD, or printer to produce images
107 on both sides of an output sheet, without manual manipulation of output as an intermediate step.
108 A product is considered to have automatic duplexing capability only if all accessories needed to
109 produce duplex output are included with the product upon shipment.

110 2) Data Connection: A connection that permits the exchange of information between the imaging
111 product and one external powered device or storage medium.

112 3) Default Delay Time: The time set by the manufacturer prior to shipping that determines when the
113 product will enter a lower-power Mode (e.g., Sleep, Auto-off) following completion of its primary
114 function.

115 4) Digital Front-end (DFE): A functionally-integrated server that acts as an interface to an imaging
116 equipment product and hosts other computers and applications in order to provide additional
117 functionality.

118 a) Type 1 DFE: A DFE that draws dc power from its own ac power supply (internal or external)
119 which is separate from the power supply that powers the imaging equipment product. The
120 DFE's power supply may draw its ac power directly from a wall outlet, or it may draw it from
121 the ac power associated with the imaging product's internal power supply.

1 IEC 62301 Ed. 1.0 – Household electrical appliances – Measurement of standby power.

- 122 b) Type 2 DFE: A DFE that draws dc power from the same power supply as the imaging
123 equipment product with which it operates. Type 2 DFEs have a board or assembly with a
124 separate processing unit that is capable of initiating activity over a network. Type 2 DFEs can
125 be physically removed or isolated using common engineering practices to allow power
126 measurements to be made.
- 127 c) A DFE offers three or more of the following advanced features:
- 128 (1) Network connectivity;
- 129 (2) Mailbox functionality;
- 130 (3) Job queue management;
- 131 (4) Power state management or control (e.g., the ability to wake the imaging equipment
132 product from a reduced power state);
- 133 (5) Advanced graphical user-interface (GUI);
- 134 (6) Ability to initiate communication with other host servers and client computers (e.g.,
135 scanning to email, polling remote mailboxes for jobs); or
- 136 (7) Ability to post-process pages (e.g., reformatting pages prior to printing).
- 137 5) External Power Supply (EPS): A component contained in a separate physical enclosure external
138 to the Imaging Equipment product casing and designed to convert line voltage ac input from the
139 mains to lower dc voltage(s) for the purpose of powering the Imaging Equipment product. An
140 external power supply connects to the Imaging Equipment product via a removable or hard-wired
141 male/female electrical connection, cable, cord or other wiring.
- 142 6) Network Connection: A connection that permits the exchange of information between the imaging
143 product and two or more external powered devices.
- 144 7) Functional Adder: A product feature that adds functionality to the marking engine of an imaging
145 equipment product.
- 146 a) Primary Functional Adder: A Functional Adder, such as a network interface, that remains
147 enabled while the imaging equipment product is in Sleep Mode, and permits the product's
148 transition out of Sleep Mode.
- 149 b) Secondary Functional Adder: A Functional Adder that is disabled while the imaging equipment
150 product is in Sleep Mode.
- 151 8) Operational Mode (OM): A method of comparing product energy performance via an evaluation of
152 power consumption in various operating states.
- 153 9) Typical Electricity Consumption (TEC): A method of comparing product energy performance via
154 an evaluation of typical electricity consumption during normal operation over a specified period of
155 time.
- 156 10) Marking Engine: The fundamental engine of an imaging product that is responsible for image
157 production. A marking engine relies upon functional adders for communication ability and image
158 processing. Without these functional adders, a marking engine cannot acquire image data for
159 processing and is non-functional.
- 160 11) Base Product: The most fundamental configuration of a particular product model, which
161 possesses the minimum number of functional adders available. Optional components and
162 accessories are not considered part of a base product.

163 12) Accessory: A piece of peripheral equipment that is not necessary for the operation of the base
164 product, but that may be added before or after shipment in order to add functionality. An
165 accessory may be sold separately under its own model number, or sold with a base product as
166 part of a package or configuration.

167 13) Product Model: An imaging equipment product that is sold or marketed under a unique model
168 number or marketing name. A product model may be comprised of a base product or a base
169 product plus accessories.

170 14) Product Family: A group of product models that are (1) made by the same manufacturer, (2)
171 subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design.
172 Product models within a family differ from each other according to one or more characteristics or
173 features that either (1) have no impact on product performance with regard to ENERGY STAR
174 qualification criteria, or (2) are specified herein as acceptable variations within a product family.
175 For Imaging Equipment, acceptable variations within a product family include:

176 a) Color,

177 b) Housing, or

178 c) Any of the functional adders specified in Table 9.

179 2 SCOPE

180 2.1 Included Products

181 2.1.1 Products that meet one of the Product Type definitions in Section 1 and are capable of being
182 powered from (1) a wall outlet, (2) a data or network connection, or (3) both a wall outlet and a
183 data or network connection, are eligible for ENERGY STAR qualification, with the exception of
184 products listed in Section 2.2.

185 2.1.2 For purposes of this specification, Imaging Equipment products are classified as either “TEC
186 Products” or “OM Products” depending on the method of ENERGY STAR evaluation. Product
187 classifications are listed in Table 1.

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Table 1: Evaluation Methods for Imaging Equipment

Equipment Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Copier	Standard	DT, DS, EP, SI, TT	TEC
	Large	DT, DS, EP, SI, TT	OM
Digital Duplicator	Standard	Stencil	TEC
Fax Machine	Standard	DT, DS, EP, SI, TT	TEC
		IJ	OM
Mailing Machine	All	DT, EP, IJ, TT	OM
Multifunction Device (MFD)	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ	OM
	Large	DT, DS, EP, IJ, SI, TT	OM
Printer	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ, Impact	OM
	Large or Small	DT, DS, EP, Impact, IJ, SI, TT	OM
Scanner	All	N/A	OM

190 2.2 Excluded Products

191 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for
 192 qualification under this specification. The list of specifications currently in effect can be found at
 193 www.energystar.gov/products.

194 2.2.2 Products that satisfy one or more of the following conditions are not eligible for ENERGY STAR
 195 qualification under this specification:

- 196 i. Products that meet the eligibility requirements for other ENERGY STAR product
 197 specifications,
- 198 ii. Products that are designed to operate directly on three-phase power.

199 3 QUALIFICATION CRITERIA

200 3.1 Significant Digits and Rounding

201 3.1.1 All calculations shall be performed with actual measured or observed values. Only the final result
 202 of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant
 203 digit as expressed in the corresponding specification limit.

204 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact
 205 values without any benefit from further rounding.

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207 **3.2 General Requirements**

208 3.2.1 **External Power Supply (EPS):** If a product is shipped with an EPS, the EPS shall meet the level V
209 performance requirements under the International Efficiency Marking Protocol and include the
210 level V marking. Additional information on the Marking Protocol is available
211 at www.energystar.gov/powersupplies.

212 3.2.2 **Additional Cordless Handset:** Fax machines and MFDs with fax capability that are sold with
213 additional cordless handsets shall use handsets that are qualified per the requirements in the
214 ENERGY STAR Product Specification for Telephony. Additional information on the Telephony
215 program is available at www.energystar.gov/products.

216 3.2.3 **Product Literature:** Printed and electronic product literature shall contain an explanation of default
217 Delay Time to Sleep and its impact on product energy performance.

- 218 i. If the product has no Sleep Mode or does not allow user adjustment of the Default Delay Time
219 to Sleep, Partners shall submit information documenting this fact, and the above requirement
220 shall not apply,
- 221 ii. The actual Default Delay Time to Sleep shall be reported to EPA when a product is submitted
222 for qualification.

223 3.2.4 **Distributed MFD:** If a MFD consists of a set of functionally integrated components (i.e., the MFD is
224 not a single device), the sum of the measured energy or power consumption for all components
225 shall be less than the relevant MFD energy or power consumption requirements for ENERGY
226 STAR qualification.

227 3.2.5 **Digital Front End (DFE) Equipment:**

- 228 i. **Low Power Modes:** The DFE shall not interfere with the ability of the Imaging Equipment
229 product to enter or exit any low power Modes.
- 230 ii. **External DFE Power Supplies:** Any EPS shipped with a DFE shall meet the level V
231 performance requirements under the International Efficiency Marking Protocol and include the
232 level V marking. Additional information on the Marking Protocol is available
233 at www.energystar.gov/powersupplies.
- 234 iii. **Internal DFE Ac-Dc Power Supplies:** Measured efficiency and power factor shall be greater
235 than or equal to the minimum efficiency and minimum power factor at each loading point
236 specified in Table 2.

237 **Table 2: Efficiency and Power Factor**
238 **Requirements for DFE Internal Power Supplies**

Loading Level as a Percentage of Nameplate Output Current	Minimum Efficiency	Minimum Power Factor
20%	0.80	-
50%	0.80	-
100%	0.80	0.9

239 **3.3 Requirements for TEC Products**

240 3.3.1 **Automatic Duplexing Capability:**

- 241 i. For color copiers, color MFDs, and color printers subject to the TEC test method, automatic
242 duplexing capability shall be present at the time of purchase as specified in Table 3.

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Table 3: Automatic Duplexing Requirements for Color Copiers, Color MFDs, and Color Printers

Monochrome Product Speed, s (ipm)	Automatic Duplexing Requirement
$s \leq 19$	None
$19 < s < 40$	Integral to the base product or offered as an optional accessory
$s \geq 40$	Integral to the base product

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- ii. For monochrome copiers, monochrome MFDs, and monochrome printers subject to the TEC test method, automatic duplexing capability shall be present at the time of purchase as specified in Table 4.

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Table 4: Automatic Duplexing Requirements for Monochrome Copiers, Monochrome MFDs, and Monochrome Printers

Monochrome Product Speed, s (ipm)	Automatic Duplexing Requirement
$s \leq 24$	None
$24 < s < 45$	Integral to the base product or offered as an optional accessory
$s \geq 45$	Integral to the base product

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3.3.2 Typical Energy Consumption:

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- i. Calculated Typical Energy Consumption (TEC) per Equation 1 or Equation 2 shall be less than or equal to the Maximum TEC Requirement (TEC_{MAX}) specified in Table 5, to the nearest 0.1 kilowatt-hour.
- ii. For digital duplicators with print capability, fax machines, MFDs with print capability, and printers, TEC shall be calculated per Equation 1.

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Equation 1: TEC Calculation for Digital Duplicators with Print Capability, Fax Machines, MFDs with Print Capability, and Printers

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$$TEC = 5 \times \left[E_{JOB_DAILY} + (2 \times E_{FINAL}) + \left((24 - (N_{JOBS} \times 0.25) - (2 \times t_{FINAL})) \times \frac{E_{SLEEP}}{t_{SLEEP}} \right) \right] + \left(48 \times \frac{E_{SLEEP}}{t_{SLEEP}} \right) - TEC_{DFE}$$

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Where:

- TEC is the typical weekly energy consumption for printers, fax machines, digital duplicators and MFDs with print capability;
- E_{JOB_DAILY} is the daily job energy, as calculated per Equation 3;
- E_{FINAL} is the final energy, as measured in the test procedure;
- t_{FINAL} is the final time to Sleep, as measured in the test procedure;
- N_{JOBS} is the number of jobs per day, as calculated in the test procedure;
- E_{SLEEP} is the sleep energy, as measured in the test procedure;
- t_{SLEEP} is the sleep time, as measured in the test procedure; and
- TEC_{DFE} is the typical energy consumption of the DFE, as calculated per Equation 4.

271 iii. For copiers, digital duplicators without print capability, and MFDs without print capability, TEC
 272 shall be calculated per Equation 2.

273 **Equation 2: TEC Calculation for Copiers, Digital Duplicators without Print Capability,**
 274 **and MFDs without Print Capability**

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$$TEC = 5 \times \left[E_{JOB_DAILY} + (2 \times E_{FINAL}) + \left((24 - (N_{JOBS} \times 0.25) - (2 \times t_{FINAL})) \times \frac{E_{AUTO-OFF}}{t_{AUTO-OFF}} \right) \right]$$

$$+ \left(48 \times \frac{E_{AUTO-OFF}}{t_{AUTO-OFF}} \right) - TEC_{DFE}$$

276 *Where:*

- 277 • *TEC* is the typical weekly energy consumption for printers, fax machines,
- 278 *digital duplicators and MFDs with print capability;*
- 279 • *E_{JOB_DAILY}* is the daily job energy, as calculated per Equation 3;
- 280 • *E_{FINAL}* is the final energy, as measured in the test procedure;
- 281 • *t_{FINAL}* is the final time to Sleep, as measured in the test procedure;
- 282 • *N_{JOBS}* is the number of jobs per day, as calculated in the test procedure;
- 283 • *E_{AUTO-OFF}* is the sleep energy, as measured in the test procedure;
- 284 • *t_{AUTO-OFF}* is the sleep time, as measured in the test procedure; and
- 285 • *TEC_{DFE}* is the typical energy consumption of the DFE, calculated per
- 286 Equation 4.

287 iv. Daily Job Energy shall be calculated per Equation 3.

288 **Equation 3: Daily Job Energy Calculation for TEC Products**

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$$E_{JOB_DAILY} = (2 \times E_{JOB1}) + \left((N_{JOBS} - 2) \times \frac{E_{JOB2} + E_{JOB3} + E_{JOB4}}{3} \right),$$

290 *Where:*

- 291 • *E_{JOB_DAILY}* is the daily job energy;
- 292 • *E_{JOBi}* is the energy of the *ith* job, as measured in the test procedure; and
- 293 • *N_{JOBS}* is the number of jobs per day, as calculated in the test procedure.

294 v. For Type 1 DFEs that draw power directly from the Imaging Equipment product, and for Type
 295 2 DFEs that are shipped with the Imaging Equipment product, TEC shall be calculated per
 296 Equation 4.

297 **Equation 4: TEC Calculation for DFEs**

298

$$TEC_{DFE} = \left(168 \times \frac{E_{DFE}}{(t_{DFE} \times \eta_{PSU})} \right)$$

299 *Where:*

- 300 • *TEC_{DFE}* is the typical energy consumption of the Type 1 DFE;
- 301 • *E_{DFE}* is the energy of the Type 1 DFE, as measured per the test procedure;
- 302 • *t_{DFE}* is the duration of the energy measurement, as measured per the test
- 303 procedure; and
- 304 • *η_{PSU}* is the efficiency of the power supply, measured in the test procedure, for
- 305 Type 2 DFEs or for Type 1 DFEs that draw power via the imaging equipment.

Table 5: Maximum TEC Requirement

Product Type	Color Capability	Marking Technology							Monochrome Product Speed, s (ipm)	TEC _{MAX} (kWh)	
		Direct Thermal	Dye Sublimation	Electro-photographic	Thermal Transfer	High-Performance IJ	Stencil	Solid Ink			
Copier	Mono-chrome	x	x	x	x				$s \leq 15$	1.0	
									$15 < s \leq 40$	$(s \times 0.10) - 0.5$	
	Color		x	x	x			x	$s \leq 32$	$(s \times 0.10) + 2.8$	
Digital Duplicator	Mono-chrome							x	$40 < s \leq 82$	$(s \times 0.35) - 10.3$	
	Color							x	$32 < s \leq 58$	$(s \times 0.35) - 5.2$	
Fax Machine	Mono-chrome	x	x	x	x				$s \leq 15$	1.0	
MFD	Mono-chrome								$s \leq 10$	1.5	
		x	x	x	x	x			$10 < s \leq 26$	$(s \times 0.10) + 0.5$	
									$26 < s \leq 68$	$(s \times 0.35) - 6.0$	
									$s > 68$	$(s \times 0.70) - 30.0$	
	Color								x	$s \leq 26$	$(s \times 0.10) + 3.5$
		x	x	x	x	x				$26 < s \leq 62$	$(s \times 0.35) - 3.0$
									$s > 62$	$(s \times 0.70) - 25.0$	
Printer	Mono-chrome	x	x	x	x	x			$s > 82$	$(s \times 0.70) - 39.0$	
	Color		x	x	x	x		x	$s > 58$	$(s \times 0.70) - 26.0$	

309 **3.4 Requirements for Operational Mode (OM) Products**

310 3.4.1 Multiple Sleep Modes: If a product is capable of automatically entering multiple successive Sleep
 311 Modes, the same Sleep Mode shall be used to determine qualification under the default delay time
 312 to sleep requirements specified in section 3.4.2 and the Sleep Mode power consumption
 313 requirements specified in section 0.

314 3.4.2 Default Delay Time:

- 315 i. Measured Default Delay Time to Sleep (t_{SLEEP}) shall be less than or equal to the Maximum
 316 Default Delay Time to Sleep ($t_{\text{SLEEP_MAX}}$) requirement specified in Table 6 and Table 7.
- 317 ii. Default Delay Time to Sleep settings may be user adjustable up to a maximum of 4 hours.

318 **Table 6: Maximum Default Delay Time to Sleep for OM Products,**
 319 **Except Mailing Machines**

Product Type	Media Format	Monochrome Product Speed, s (ipm)	Default Delay Time to Sleep (minutes)
Copier	Large	$s \leq 30$	30
		$s > 30$	60
Fax Machine	Small or Standard	All	5
MFD	Small or Standard	$s \leq 10$	15
		$10 < s \leq 20$	30
		$s > 20$	60
	Large	$s \leq 30$	30
$s > 30$		60	
Printer	Small or Standard	$s \leq 10$	5
		$10 < s \leq 20$	15
		$20 < s \leq 30$	30
		$s > 30$	60
	Large	$s \leq 30$	30
		$s > 30$	60
Scanner	All	All	15

320 **Table 7: Maximum Default Delay Time to Sleep for Mailing Machines**

Product Type	Media Format	Product Speed, s (mppm)	Default Delay Time to Sleep (minutes)
Mailing Machine	All	$s \leq 50$	20
		$50 < s \leq 100$	30
		$100 < s \leq 150$	40
		$s > 150$	60

321

322

323 3.4.3 Sleep Mode Power Consumption: Measured Sleep Mode power consumption (P_{SLEEP}) shall be
324 less than or equal to the maximum Sleep Mode power consumption requirement (P_{SLEEP_MAX})
325 determined per Equation 5, subject to the following conditions:

- 326 i. Only those product functions that are present and available for use in the “as-shipped” product
327 configuration may be considered functional adders.
- 328 ii. Product functionality offered through a DFE shall not be considered either a Primary or
329 Secondary functional adder.
- 330 iii. No more than three product functions may be selected as Primary functional adders,
331 Additional product functions may only be selected as secondary functional adders.
- 332 iv. The negative Personal Computer (PC)-Based System secondary adder shall be used if
333 applicable.
- 334 v. For products with multiple interfaces, each interface shall be considered separately.
- 335 vi. A single interface that performs multiple functions may be counted only once.
- 336 vii. Any interface that meets more than one interface type definition shall be classified according
337 to its primary functionality
- 338 viii. Products that meet the Sleep Mode power requirement in Ready State, no further automatic
339 power reductions are required to meet Sleep Mode requirements.

340 **Equation 5: Calculation of Maximum Sleep Mode Power**
341 **Consumption Requirement for OM products**

342
$$P_{SLEEP_MAX} = P_{MAX_BASE} + \sum_1^n Adder_{PRIMARY} + \sum_1^n Adder_{SECONDARY} + P_{DFE}$$

343 *Where:*

- 344 • P_{SLEEP_MAX} is the maximum Sleep Mode power consumption requirement;
- 345 • P_{MAX_BASE} is the maximum Sleep Mode power allowance for the base marking
346 engine, as determined per Table 8;
- 347 • $Adder_{PRIMARY}$ is the power allowance for each applicable Primary functional
348 adder, as determined per Table 9;
- 349 • $Adder_{SECONDARY}$ is the power allowance for each applicable Secondary
350 functional adder, as determined per Table 9; and
- 351 • P_{DFE} is the DFE power allowance, as calculated in Equation 6.

352 **Equation 6: Calculation of Maximum Sleep Mode Power Allowance for DFEs**

353
$$P_{DFE} = \frac{E_{DFE}}{(t_{DFE} \times \eta_{PSU})}$$

354 *Where:*

- 355 • P_{DFE} is the DFE power allowance;
- 356 • E_{DFE} is the energy consumption of the Type 2 DFE, as measured in the test
357 procedure;
- 358 • t_{DFE} is the duration of the energy measurement, as measured in the test
359 procedure; and
- 360 • η_{PSU} is the efficiency of the power supply, as measured in the test procedure,
361 for Type 2 DFEs, or for Type 1 DFEs that draw power via the imaging
362 equipment product.

363

Table 8: Sleep Mode Power Allowance for Base Marking Engine

Product Type	Media Format	Marking Technology											P _{MAX_BASE} (watts)
		Monochrome Only				Color Only	Color and Monochrome				Not Applicable		
		Direct Thermal	Electro-photographic	Ink Jet	Thermal Transfer	Solid Ink	Dye Sublimation	Electro-photographic	Impact	Ink Jet		Thermal Transfer	
Copier	Large	x				x	x	x			x		30.0
Fax Machine	Standard										x		1.4
Mailing Machine	N/A	x	x	x	x								7.0
MFD	Standard										x		1.4
	Large										x		15.0
		x				x	x	x			x		30.0
Printer	Small	x				x	x	x	x	x	x		9.0
	Standard									x			4.6
											x		1.4
	Large	x				x	x	x	x		x		14.0
											x		15.0
Scanner	Any										x	4.3	

Table 9: Sleep Mode Power Allowances for Functional Adders

Adder Type	Connection Type	Connection End-point	Maximum Data Rate, r (Mbit per second)	Examples	Primary Functional Adder Allowance (watts)	Secondary Functional Adder Allowance (watts)
Data or Network Connection	Wired	Computer or other Powered Non-Camera Device	$r < 20$	IEEE 488, IEEE 1284/ Parallel/ Centronics, RS232, Fax Modem	0.3	0.2
			$20 \leq r < 500$	USB 2.x, IEEE 1394/ FireWire/ i.LINK, 100Mb Ethernet	0.5	0.2
			$r \geq 500$	1G Ethernet	1.5	0.5
		Removable Flash Storage or Camera	Any	Secure Digital (SD), PictBridge	0.5	0.1
	Wireless, Radio-frequency (RF)	Computer	Any	Bluetooth, 802.11	3.0	0.7
		Cordless Handset	Any	DECT	-	0.8
	Wireless, Infrared (IR)	Computer	Any	IrDA	0.2	0.2
Internal Storage Drive	N/A	N/A	N/A	Hard Disk Drive, DVD drive	-	0.2
Internal Volatile Memory	N/A	N/A	N/A	RAM	-	1.0 W per GB
Scanner	N/A	N/A	N/A	Any scanning ability	-	0.5
Personal Computer (PC)-Based System	N/A	N/A	N/A	Cannot Operate Without Significant PC Resources	-	- 0.5
Power Supply*	N/A	N/A	N/A	External or Internal	-	$0.02 \times (P_{OUT} - 10.0)$

368 * The Power Supply adder only applies to products using Inkjet and Impact marking technologies with
 369 P_{OUT} greater than 10 W.
 370

371 3.4.4 **Standby Mode:** Standby Mode power, which is the lesser of the Ready Mode Power, Sleep Mode
 372 Power, Off Mode Power, and Off Mode Power, as calculated in the test procedure, minus the DFE
 373 power allowance, as calculated per Equation 6, shall be less than or equal to the Maximum
 374 Standby Mode power requirement specified in Table 10.

375 **Table 10: Maximum Standby Power Requirement**

Product Type	Maximum Standby Power (watts)
All OM Products	1.0

376 **4 TESTING**

377 **4.1 Test Methods**

378 4.1.1 When testing Imaging Equipment products, the test methods identified in Table 11 shall be used
 379 to determine ENERGY STAR qualification.

380 **Table 11: Test Methods for ENERGY STAR Qualification**

Product Type	Test Method
All Products	IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power
All Products	ENERGY STAR Imaging Equipment Test Method, Rev. Aug-2010
DFE with Internal Power Supply or Multiple-Voltage External Power Supply	Generalized Internal Power Supply Efficiency Test Protocol Rev. 6.4.2. Available at www.efficientpowersupplies.org .
DFE with Single Voltage External Power Supply	Test Method for Calculating the Energy Efficiency of Single-Voltage External AC-DC and AC-AC Power Supplies, Rev. August 11, 2004. Available at www.efficientpowersupplies.org .

381 **4.2 Number of Units Required for Testing**

382 4.2.1 Representative Models shall be selected for testing per the following requirements:

- 383 i. For qualification of an individual product model, a product configuration equivalent to that
 384 which is intended to be marketed and labeled as ENERGY STAR is considered the
 385 Representative Model;
- 386 ii. For qualification of a product family, any product configuration within the family may be
 387 considered the Representative Model.

388 4.2.2 A single unit of each Representative Model shall be selected for testing. If test results for any
 389 operational mode power measurement are within 10% of ENERGY STAR requirements, two
 390 additional units of the same Representative Model with an identical configuration shall be tested.

391 4.2.3 All tested units shall meet ENERGY STAR qualification requirements.

392 **4.3 International Market Qualification**

393 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for
394 each market in which they will be sold and promoted as ENERGY STAR.

395 **5 USER INTERFACE**

396 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard
397 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices
398 Employed in Office/Consumer Environments. For details, see <http://eetd.LBL.gov/Controls>.

399 **6 EFFECTIVE DATE**

400 6.1.1 Effective Date: The Version 1.2 ENERGY STAR Imaging Equipment specification shall take effect
401 on the date specified in Table 12. To qualify for ENERGY STAR, a product model shall meet the
402 ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is
403 specific to each unit and is the date (e.g., month and year) on which a unit is considered to be
404 completely assembled.

405 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
406 technological and/or market changes affect its usefulness to consumers, industry, or the
407 environment. In keeping with current policy, revisions to the specification are arrived at through
408 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
409 STAR qualification is not automatically granted for the life of a product model.

410 **Table 12: Specification Effective Date**

Effective Date
July 1, 2009

411



ENERGY STAR® Program Requirements Product Specification for Imaging Equipment

Test Method

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Imaging Equipment.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. Table 1 shall be used to determine the applicability of each section of this document:

Table 1: Test Procedure Applicability

Product Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Copier	Standard	DT, DS, EP, SI, TT	TEC
	Large	DT, DS, EP, SI, TT	OM
Digital Duplicator	Standard	Stencil	TEC
Fax Machine	Standard	DT, DS, EP, SI, TT	TEC
		IJ	OM
Mailing Machine	All	DT, EP, IJ, TT	OM
Multifunction Device (MFD)	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ	OM
	Large	DT, DS, EP, IJ, SI, TT	OM
Printer	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ, Impact	OM
	Large or Small	DT, DS, EP, Impact, IJ, SI, TT	OM
Scanner	All	N/A	OM

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Imaging Equipment.

11

12 **4 TEST SETUP**

- 13 A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall
14 be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance
15 Standby Power", Section 4, "General Conditions for Measurements", unless otherwise noted in this
16 document. In the event of conflicting requirements, the ENERGY STAR test method shall take
17 precedence.
- 18 B) AC Input Power: Products intended to be powered from AC mains shall first be connected to an
19 external power supply (if applicable) and then connected to a voltage source appropriate for the
20 intended market, as specified in Table 2.

21 **Table 2: Input Power Requirements**

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 Vac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
China	220 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz and 60 Hz	+/- 1.0 %

- 22 C) Low-voltage DC Input Power:
- 23 1) Products may only be powered with a low-voltage DC source (e.g., via network or data
24 connection) if the DC source is the only available source of power for the product (e.g., no AC
25 plug or EPS is available).
- 26 2) Products powered by low-voltage DC shall be configured with an AC source of the DC power for
27 testing (e.g., an AC-powered USB hub).
- 28 3) Reported UUT power shall be equal to the AC power consumption of the low-voltage DC source
29 with the UUT as the load, minus the AC power consumption of the low-voltage DC source with no
30 load (P_s), as measured per of this procedure.
- 31 D) Ambient Temperature: Ambient temperature shall be from 18 °C to 28 °C.
- 32 E) Relative Humidity: Relative humidity shall be from 10% to 80%.
- 33 F) Power Meter: Power meters shall possess the following attributes:
- 34 1) Crest Factor: Capability to measure the current waveform without clipping.
- 35 i) The peak of the current waveform measured during Sleep Mode and On Mode shall
36 determine the crest factor rating requirement and the appropriate current range setting.

- 37 ii) The full-scale value of the selected current range multiplied by the crest factor for that range
38 shall be at least 15% greater than the peak current.
- 39 2) Bandwidth: Minimum bandwidth as determined by an analysis of current and voltage to determine
40 the highest frequency component (harmonic) with a magnitude greater than 1% of the
41 fundamental frequency under the test conditions.
- 42 3) Minimum Frequency Response: 3.0 kHz
- 43 4) Minimum Sampling Frequency: 60 Hz
- 44 5) Minimum Resolution:
- 45 i) 0.01 W for measurement values less than 10 W;
- 46 ii) 0.1 W for measurement values from 10 W to 100 W; and
- 47 iii) 1.0 W for measurement values greater than 100 W.
- 48 G) Measurement Accuracy:
- 49 1) Power measurements with a value of 0.5 W or greater shall be made with an uncertainty of less
50 than or equal to 2% at the 95% confidence level.
- 51 2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
52 or equal to 0.01 W at the 95% confidence level.
- 53 3) Power measurements shall be reported in Watts and shall be rounded to the second decimal
54 place. For measurements greater than or equal to 10 W, three significant figures shall be reported.
- 55 H) Time Measurements: Time measurements may be performed with an ordinary stopwatch with
56 resolution of at least one second.
- 57 I) Paper Specifications:
- 58 1) Paper with a size and basis weight as specified in Large, small, and continuous format products
59 shall be tested using any compatible paper size.
- 60 2) Table 3 shall be used for all testing of Standard format products.
- 61 3) Large, small, and continuous format products shall be tested using any compatible paper size.

62 **Table 3: Paper Size and Weight Requirements**

Market	Paper Size	Basis Weight (g/m ²)
North America / Taiwan	8.5" x 11"	75
Europe / Australia / New Zealand	A4	80
Japan	A4	64

- 63 J) Test Image: Test Pattern A from ISO/IEC standard 10561:1999 shall be used as the original image for
64 all testing.
- 65 1) Test images shall be rendered in 10 point size in a fixed-width Courier font (or nearest equivalent)

66 2) German-specific characters need not be reproduced if the product is incapable of German
 67 character reproduction.

68 **5 LOW-VOLTAGE DC SOURCE MEASUREMENT**

- 69 1) Connect the DC source to the power meter and relevant AC supply as specified in Table 1.
 70 2) Verify that the DC source is unloaded.
 71 3) Allow the DC source to warm up for a minimum of 30 minutes.
 72 4) Measure and record the unloaded DC source power (P_S) according to IEC 62301 Ed. 1.0.

73 **6 PRE-TEST UUT CONFIGURATION**

74 **6.1 General Configuration**

75 A) Product Speed for Testing: The product shall be tested with speed settings in their default as-shipped
 76 configuration.

77 B) Product Speed for Calculations and Reporting: The product speed, measured in images-per-minute
 78 (ipm) and rounded to the nearest integer, shall be the highest speed calculated per the following
 79 criteria for all calculations performed in this test method:

- 80 1) For all products, the product speed shall be equal to:
 81 i) The print speed, unless the product cannot print, in which case,
 82 ii) The copy speed, unless the product print or copy, in which case,
 83 iii) The scan speed.
 84 2) For standard, small, and large format products, with the exception of mailing machines, the
 85 product speed shall be calculated per Table 4.

86 **Table 4: Calculation of Product Speed for**
 87 **Standard, Small, and Large Format Products**
 88 **with the Exception of Mailing Machines**

Media Format	Media Size	Product Speed, s (ipm)
		<i>Where: s_P is the maximum claimed monochrome simplex speed in pages-per-minute when processing the given media</i>
Standard	8.5" x 11"	s_P
	A4	s_P
Small	4" x 6"	$0.25 \times s_P$
	A6	$0.25 \times s_P$
Large	A2	$4 \times s_P$
	A0	$16 \times s_P$

89 3) For continuous-form products, product speed shall be calculated per Equation 1

90 **Equation 1: Calculation of Product Speed**

91
$$s = 16ws_L$$

92 *Where:*

- 93 • *s is the product speed, in images per minute (ipm),*
- 94 • *w is the width of the media, in meters (m),*
- 95 • *s_L is the maximum claimed monochrome simplex speed, in*
- 96 *length-meters-per-minute.*

97 4) For Mailing Machines, product speed shall be reported in units of mail-pieces-per-minute (mppm).

98 C) Duplexing: Products shall be tested in simplex Mode. Originals for copying shall be simplex images.

99 D) Color: Color-capable products shall be tested making monochrome images unless incapable of doing
100 so.

101 E) Network Connections: Printers, Faxes, and MFDs with networking capability shall be connected to a
102 network. The type of network connection (or other data connection if not capable of being networked)
103 is at the discretion of the manufacturer, and the type used shall be reported.

104 1) Fax machines need not be connected to a telephone line unless the telephone line is necessary
105 for performing the test.

106 F) Sending Jobs: Print jobs for the test may be sent over non-network connections (e.g., USB), even on
107 those units that are network-connected.

108 1) For jobs sent over network connections, each image shall be sent separately, i.e., all images may
109 be part of the same document, but shall not be specified in the document as multiple copies of a
110 single original image.

111 2) For printers and MFDs that can interpret a page description language (PDL) (e.g., PCL,
112 Postscript), images shall be sent to the product in a PDL.

113 3) Originals may be placed in the document feeder before the test begins. Products without a
114 document feeder may make all images off of a single original placed on the platen.

115 **6.2 Configuration for Digital Duplicators**

116 A) Except as noted, digital duplicators shall be configured and tested as printers, copiers, or MFDs,
117 depending on their capabilities as shipped.

118 B) Digital duplicators shall be tested at maximum claimed speed, which is also the speed that should be
119 used to determine the job size for performing the test, not at the default speed as-shipped, if different.

120 **7 PRE-TEST UUT INITIALIZATION**

121 C) Prior to the start of testing, the UUT shall be initialized as follows:

- 122 1) Set up the UUT per the instructions in the supplied operating manual. Install accessories such as
 123 paper source and finishing hardware that are intended to be installed or attached by the end-user.
- 124 2) Connect the UUT to its power source.
- 125 3) Power on the UUT and perform initial system configuration, as applicable. Verify that default delay
 126 times are configured according to product specifications and/or manufacturer recommendations.
- 127 4) User-accessible anti-humidity features may be turned off or disabled for the duration of testing.
- 128 5) Let the UUT sit for at least 15 minutes, or until it has completed initialization and is ready for use.
- 129 6) For products designed to operate on battery power when not connected to the mains, the battery
 130 shall be either:
- 131 i) Removed from the product; or
- 132 ii) Fully charged for at least 24 hours before beginning the test and left in place for the test.
- 133 7) Measure and record the AC mains input voltage and frequency.
- 134 8) Measure and record the test room ambient temperature.

135 **8 TYPICAL ELECTRICITY CONSUMPTION (TEC) TEST PROCEDURE**

136 **8.1 Job Structure**

137 A) Jobs per Day: The number of jobs per day (N_{JOBS}) shall be calculated according to Table 5.

138 **Table 5: Number of Jobs per Day (N_{JOBS})**

Monochrome Product Speed, s (ipm)	Jobs per Day (N_{JOBS})
$s \leq 8$	8
$8 < s < 32$	s
$s \geq 32$	32

139 B) Images per Job:

- 140 1) Fax machines shall be tested with one image per job.
- 141 2) The number of images per job for all other TEC products shall be computed according to Equation
 142 2, below.
- 143

144

Equation 2: Calculation of Number of Images per Job

145

$$N_{IMAGES} = \frac{(0.5 \times s^2)}{N_{JOBS}}$$

146

Where:

147

• N_{IMAGES} is the number of images per job, rounded down to the nearest integer

148

149

• s is the (monochrome) maximum reported speed in images per minute (ipm), and

150

151

• N_{JOBS} is the number of jobs per day, as calculated per Table 5.

152

C) Number of Originals:

153

1) For copiers with speed less than or equal to 20 ipm, there shall be one original per required image.

154

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2) For copiers with speed greater than 20 ipm, it may not be possible to match the number of required original images (e.g., due to limits on document feeder capacity). In this case, it is permissible to make multiple copies of each original, and the number of originals shall be greater than or equal to ten.

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Example: For a 50 ipm unit that requires 39 images per job, the test may be performed with four copies of 10 originals or three copies of 13 originals.

160

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3) For digital duplicators, there shall be only one original image.

162

8.2 Test Procedure

163

A) Measurement of TEC shall be conducted according to Table 6 for printers, fax machines, and digital duplicators and MFDs with print capability, and Table 7 for copiers, and digital duplicators and MFDs without print capability, subject to the following criteria:

164

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1) Auto-Off: If a printer, digital duplicator or MFD with print-capability, or fax machine has an Auto-off capability and it is enabled as shipped, it shall be disabled prior to the test.

167

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2) Paper: There shall sufficient paper in the device.

169

3) Service/Maintenance Modes: Service/maintenance modes (including color calibration) should generally not be included in TEC measurements.

170

171

i) Any service/maintenance modes that occur during the test shall be noted.

172

ii) If a service/maintenance mode occurs during a job other than the first job, the results from the job with the service/maintenance mode may be replaced with results from a substitute job. In this case, the substitute job shall be inserted into the test procedure immediately following Job 4. The 15-minute job interval shall be maintained at all times.

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4) Energy Measurement Method: All measurements shall be recorded as accumulated energy over time.

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i) "Zero meter" references may be accomplished by recording the accumulated energy consumption at that time rather than literally zeroing the meter.

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Note: The TEC test procedure presented in Table 6 and Table 7 contains the requirement that the tester wait until the “final Sleep Mode”. EPA recognizes that it may be unclear to independent testers which Sleep Mode is the final one and is therefore proposing to include a time limit of 4 hours. EPA welcomes comment on this proposal.

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Table 6: TEC Test Procedure for Printers, Fax Machines, and Digital Duplicators, and MFDs with Print Capability

Step	Initial State	Action	Record (at end of step)	Unit of Measure	Possible States Measured
1	Off	Connect the unit under test to the meter. Ensure the unit is powered and in Off Mode. Zero the meter; measure energy over 5 minutes or more. Record both energy and time.	Off energy	Watt-hours (Wh)	Off
			Testing Interval time	Hours (h)	
2	Off	Turn on unit. Wait until unit indicates it is in Ready Mode.	–	–	–
3	Ready	Print a job of at least one output image but no more than a single job per Job Table. Measure and record time to first sheet exiting unit.	Active0 time	Hours (h)	–
4	Ready (or other)	Wait until the meter shows that the unit has entered its final Sleep Mode or 4 hours.	–	–	–
5	Sleep	Zero meter; measure energy and time over 1 hour or until unit enters Auto-Off. Record the energy and time.	Sleep energy, E_{SLEEP}	Watt-hours (Wh)	Sleep
			Sleep time, t_{SLEEP} (≤ 1 hour)	Hours (h)	
6	Sleep	Zero meter and timer. Print one job (calculated above). Measure energy and time. Record time to first sheet exiting unit. Measure energy over 15 minutes from job initiation. The job must finish within the 15 minutes.	Job1 energy, E_{JOB1}	Watt-hours (Wh)	Recovery, Active, Ready, Sleep, Auto-off
			Active1 time	Hours (h)	
7	Ready (or other)	Repeat Step 6.	Job2 energy, E_{JOB2}	Watt-hours (Wh)	Same as above
			Active2 time	Hours (h)	
8	Ready (or other)	Repeat Step 6 (without Active time measurement).	Job3 energy, E_{JOB3}	Watt-hours (Wh)	Same as above
9	Ready (or other)	Repeat Step 6 (without Active time measurement).	Job4 energy, E_{JOB4}	Watt-hours (Wh)	Same as above
10	Ready	Zero meter and timer. Measure energy and time until meter and/or unit shows that unit has entered Sleep Mode, or the final Sleep Mode for units with multiple Sleep modes or 4 hours.	Final energy, E_{FINAL}	Watt-hours (Wh)	Ready, Sleep
			Final time, t_{FINAL}	Hours (h)	

186

Table 7: TEC Test Procedure for Copiers and Digital Duplicators and MFDs without Print Capability

Step	Initial State	Action	Record	Unit of Measure	Possible States Measured
1	Off	Connect the unit under test to the meter. Ensure the unit is powered and in Off Mode. Zero the meter; measure energy over 5 minutes or more. Record both energy and time.	Off energy	Watt-hours (Wh)	Off
			Testing Interval time	Hours (h)	
2	Off	Turn on unit. Wait until unit has entered Ready Mode.	–	–	–
3	Ready	Copy a job of at least one image but no more than a single job per Job Table. Measure and record time to first sheet exiting unit	Active0 time	Hours (h)	–
4	Ready (or other)	Wait until the meter shows that the unit has entered its final Sleep Mode or 4 hours.	–	–	–
5	Sleep	Zero meter; measure energy and time over 1 hour or until unit enters Auto-Off. Record the energy and time.	Sleep energy	Watt-hours (Wh)	Sleep
			Sleep time	Hours (h)	
6	Sleep	Zero meter and timer. Copy one job (calculated above). Measure and record energy and time to first sheet exiting unit. Measure energy over 15 minutes from job initiation. The job must finish within the 15 minutes.	Job1 energy, E_{JOB1}	Watt-hours (Wh)	Recovery, Active, Ready, Sleep, Auto-off
			Active1 time	Hours (h)	
7	Ready (or other)	Repeat Step 6.	Job2 energy, E_{JOB2}	Hours (h)	Same as above
			Active2 time	Watt-hours (Wh)	
8	Ready (or other)	Repeat Step 6 (without Active time measurement).	Job3 energy, E_{JOB3}	Watt-hours (Wh)	Same as above
9	Ready (or other)	Repeat Step 6 (without Active time measurement).	Job4 energy, E_{JOB4}	Watt-hours (Wh)	Same as above
10	Ready (or other)	Zero meter and timer. Measure energy and time until meter and/or unit shows that unit has entered its Auto-off Mode or 4 hours. Record energy and time; if unit began this step already in Auto-off Mode, report both energy and time values as zero.	Final energy, E_{FINAL}	Watt-hours (Wh)	Ready, Sleep
			Final time, t_{FINAL}	Hours (h)	
11	Auto-off	Zero the meter; measure energy and time over 5 minutes or more. Record both energy and time.	Auto-off energy, $E_{AUTO-OFF}$	Watt-hours (Wh)	Auto-off
			Auto-off time, $t_{AUTO-OFF}$	Hours (h)	

190 **8.3 References**

191 ISO/IEC 10561:1999. Information technology — Office equipment — Printing devices — Method for
 192 measuring throughput — Class 1 and Class 2 printers.

193 **9 OPERATIONAL MODE (OM) TEST PROCEDURE**

194 **9.1 Test Procedure**

195 A) Measurement of OM power and delay times shall be conducted according to Table 8, subject to the
 196 following constraints:

- 197 1) Auto-off: If a product has an Auto-off Mode enabled as shipped, it shall be enabled prior to
 198 performing the test.
- 199 2) Service/Maintenance Modes: Service/maintenance modes (including color calibration) generally
 200 should not be included in measurements. Any adaptation of the procedure needed to exclude
 201 such modes that occur during the test shall be noted.

202 **Table 8: Operational Mode (OM) Test Procedure**

Step	Initial State	Action(s)	Record	Unit of Measure
1	Off	Plug the unit into meter. Turn on unit. Wait until unit indicates it is in Ready Mode.*	–	
2	Ready	Print, copy, or scan a single image.	–	
3	Ready	Measure Ready power.	Ready power, P_{READY}	Watts (W)
4	Ready	Wait and measure default delay-time to Sleep.	Sleep default-delay time, t_{SLEEP}	Minutes (min)
5	Sleep	Measure Sleep power.	Sleep power, P_{SLEEP}	Watts (W)
6	Sleep	Wait and measure default delay time to Auto-off. (Disregard if no Auto-off Mode)	Auto-off default-delay time	Minutes (min)
7	Auto-off	Measure Auto-off power. (Disregard if no Auto-off Mode)	Auto-off power $P_{AUTO-OFF}$	Watts (W)
8	Auto-off	Manually turn device off and wait until unit is off. (If no manual on-off switch, note and wait for lowest-power Sleep state).	–	–
9	Off	Measure Off power. (If no manual on-off switch, note and Sleep Mode power).	Off power P_{OFF}	Watts (W)

203 **Notes:**

- 204 • *Step 1 – If the unit has no Ready indicator, use the time at which the power consumption level*
 205 *stabilizes to the Ready level, and note this detail when reporting the product test data.*

- 206 • *Steps 4 and 5 – For products with more than one Sleep level, repeat these steps as many times*
207 *as necessary to capture all successive Sleep levels and report this data. Two Sleep levels are*
208 *typically used in large-format copiers and MFDs that use high-heat marking technologies. For*
209 *products lacking this Mode, disregard Steps 4 and 5.*
- 210 • *Steps 4 and 6 – Default-delay time measurements are to be measured in parallel fashion,*
211 *cumulative from the start of Step 4. For example, a product set to enter a Sleep level in 15*
212 *minutes and enter a second Sleep level 30 minutes after entering the first Sleep level will have a*
213 *15-minute default-delay time to the first level and a 45minute default-delay time to the second*
214 *level.*

215 **10 TEST PROCEDURES FOR PRODUCTS WITH A DIGITAL FRONT** 216 **END (DFE)**

217 **Note:** The following test procedure is being proposed to standardize the estimation of power supply losses
218 due to the DFE, by explicitly referring to established power supply test procedures and assuming that the
219 power supply is operating at 20 percent of nameplate output current when the unit under test is in Ready
220 Mode. EPA welcomes comment on this proposal.

- 221 A) Type 1 DFEs: If the Type 1 DFE draws AC power via the imaging equipment, such that its energy
222 consumption was included in the above measurement, its energy consumption shall be measured
223 using the following procedure.
- 224 1) Ensure that the imaging equipment (including the DFE) is configured per section 5 above.
 - 225 2) Connect the power input to the DFE to the meter. Ensure that all components of the unit under
226 test (including the DFE) are powered and in Off Mode.
 - 227 3) Turn on unit and wait until unit has entered Ready Mode.
 - 228 4) Zero the meter; measure accumulated energy over a period greater than or equal to 5 minutes.
229 Record both energy (E_{DFE}) and time (t_{DFE}).
- 230 B) Type 2 DFEs: Measure the energy consumption of the Type 2 DFE and the Imaging Equipment power
231 supply using the following procedure.
- 232 1) Measure the energy consumption of the DFE while the product is in Ready Mode, per
233 section 10.A), above. Note that Type 2 DFEs consume DC power.
 - 234 2) Measure and record the efficiency of the imaging product's power supply (η) at 20 percent of
235 nameplate output current.
 - 236 i) For internal power supplies and multiple-voltage external power supplies, use the Generalized
237 Internal Power Supply Efficiency Test Protocol Rev. 6.4.2. Available at
238 www.efficientpowersupplies.org.
 - 239 ii) For single-voltage external power supplies, use the Test Method for Calculating the Energy
240 Efficiency of Single-Voltage External AC-DC and AC-AC Power Supplies, Rev. August 11,
241 2004. Available at www.efficientpowersupplies.org.