



ENERGY STAR® Product Specification for Imaging Equipment

Eligibility Criteria Draft 1 Version 2.0

1 Following is the Version 2.0 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 paper 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 is intended to cover products that are marketed as
8 printers, 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 paper originals into electronic images
10 that can be stored, edited, converted, or transmitted, primarily in a personal computing
11 environment. This definition is intended to cover products that are marketed as scanners.

12 3) Copier: A product whose sole function is to produce paper duplicates from paper originals. This
13 definition is intended to cover 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 paper originals for
16 electronic transmission to remote units, and (2) to receive electronic transmissions for conversion
17 to paper output. A fax machine may also be capable of producing paper duplicates. Electronic
18 transmission is primarily over a public telephone system, but may also be via a computer network
19 or the Internet. This definition is intended to cover products that are marketed as fax machines.

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. An 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. This definition is intended to cover
28 products that are marketed as digital duplicators.

29 7) Mailing Machine: A product whose primary function is to print postage onto mail pieces. This
30 definition is intended to cover products that are marketed as mailing machines.

31 B) Marking Technologies:

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

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

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

65 C) Operational Modes:

66 1) On Mode:

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

75 2) Off Mode: The power state that the product enters when it has been manually or automatically
76 switched off but is still plugged in and connected to the mains. This mode is exited when
77 stimulated by an input, such as a manual power switch or clock timer to bring the unit into Ready
78 State. When this state is resultant from a manual intervention by a user, it is often referred to as
79 Manual Off, and when it is resultant from an automatic or predetermined stimuli (e.g., a delay time
80 or clock), it is often referred to as Auto-off.¹

81 3) Sleep Mode: A reduced power state that a product enters either automatically after a period of
82 inactivity (i.e., Default Delay Time), in response to user manual action (e.g., at a user-set time of
83 day, in response to a user activation of a physical switch or button), or in response to external
84 electrical stimulus (e.g., network stimulus, fax call, remote control). For products evaluated under
85 the TEC test method, Sleep Mode permits operation of all product features (including
86 maintenance of network connectivity), albeit with a possible delay to transition into Active State.
87 For products evaluated under the OM test method, Sleep Mode permits operation of all product
88 features considered Primary Function adders, albeit with a possible delay to transition into Active
89 State.

90 4) Standby: The lowest power consumption state which cannot be switched off (influenced) by the
91 user and that may persist for an indefinite time when the product is connected to the main
92 electricity supply and used in accordance with the manufacturer's instructions.^{1,2} Standby is the
93 product's minimum power state. For Imaging Equipment products addressed by this specification,
94 the "Standby" Mode usually corresponds to Off Mode, but may correspond to Ready State or
95 Sleep Mode. A product cannot exit Standby and reach a lower power state unless it is physically
96 disconnected from the main electricity supply as a result of manual manipulation.

97 D) Media Format:

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

101 2) Standard Format: Products designed for standard-sized media (e.g., Letter, Legal, Ledger, A3,
102 A4, B4), including those designed to accommodate continuous-form media between 210 mm and
103 406 mm wide. Standard-size products may also be capable of printing on small-format media.

104 3) Small Format: Products designed for media sizes smaller than those defined as Standard (e.g.,
105 A6, 4"x6", microfilm), including those designed to accommodate continuous-form media less than
106 210 mm wide.

107 4) Continuous Form: Products that do not use a cut-sheet media format, and that are designed for
108 applications such as printing of bar codes, labels, receipts, banners, and engineering drawings.
109 Continuous form products can be of small, standard, or large format.

110 E) Additional Terms:

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

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

1 For the purposes of this specification "mains" or the "main electricity supply" refers to the input power source, including a dc power supply for products that operate solely off dc power.

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

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

120 4) Digital Front-end (DFE): A functionally-integrated server that hosts other computers and
121 applications and acts as an interface to imaging equipment. A DFE provides greater functionality
122 to the imaging product.

123 a) A DFE offers three or more of the following advanced features:

- 124 i. Network connectivity in various environments;
- 125 ii. Mailbox functionality;
- 126 iii. Job queue management;
- 127 iv. Machine management (e.g., waking the imaging equipment from a reduced power
128 state);
- 129 v. Advanced graphic user-interface (UI);
- 130 vi. Ability to initiate communication with other host servers and client computers (e.g.,
131 scanning to email, polling remote mailboxes for jobs); or
- 132 vii. Ability to post-process pages (e.g., reformatting pages prior to printing).

133 b) Type 1 DFE: A DFE that draws its dc power from its own ac power supply (internal or
134 external), which is separate from the power supply that powers the imaging equipment. This
135 DFE may draw its ac power directly from a wall outlet, or it may draw it from the ac power
136 associated with the imaging product's internal power supply

137 c) Type 2 DFE: A DFE that draws its dc power from the same power supply as the imaging
138 equipment with which it operates. Type 2 DFEs must have a board or assembly with a
139 separate processing unit that is capable of initiating activity over the network and can be
140 physically removed, isolated, or disabled using common engineering practices to allow power
141 measurements to be made.

142 d) Type 3 DFE: A DFE that is not shipped with the imaging product it supports. This DFE draws
143 its dc power from its own external ac power supply, which is separate from the power supply
144 that powers the imaging equipment.

145 **Note:** EPA is interested in stakeholder feedback on the proposed restructured definitions for imaging
146 products with DFEs.

147 5) Network Connection: A connection that permits the exchange of information between the imaging
148 product and one or more external powered devices.

149 6) Functional Adder: A data or network interface or other component that adds functionality to the
150 marking engine of an imaging equipment product and provides a power allowance when qualifying
151 products according to the OM method.

152 **Note:** In a July 8 memo to stakeholders, EPA proposed a new approach to functional adders for OM
153 products. The current Version 1.2 Imaging Equipment Specification provides Primary and Secondary
154 Functional Adder allowances to accommodate the power consumption in Sleep Mode of additional
155 capabilities such as data and network interfaces. The proposed new adder approach better reflects
156 advances in technology and the way that Imaging products are used. Our proposal and the data analysis
157 are described in the accompanying "Explanation of the Draft 1 Levels for Operational Mode (OM) Products
158 and Functional Adder Allowances." EPA is interested in stakeholder feedback on these proposed updates.
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160 7) Operational Mode (OM): For the purposes of this specification, a method of comparing product
161 energy performance via an evaluation of power (measured in watts) in various operating states, as
162 specified in Section 9 of the ENERGY STAR Imaging Equipment test method.

- 163 8) Typical Electricity Consumption (TEC): For the purposes of this specification, a method of
164 comparing product energy performance via an evaluation of typical electricity consumption
165 (measured in kilowatt-hours) during normal operation over a specified period of time, as specified
166 in Section 8 of the ENERGY STAR Imaging Equipment test method.
- 167 9) Marking Engine: The fundamental engine of an imaging product that drives image production. A
168 marking engine relies upon functional adders for communication ability and image processing.
169 Without functional adders and other components, a marking engine cannot acquire image data for
170 processing and is non-functional.
- 171 10) Base Product: The most fundamental configuration of a particular Product Model, which
172 possesses the minimum number of functional adders available. Optional components and
173 accessories are not considered part of a base product.
- 174 11) Accessory: A piece of peripheral equipment that is not necessary for the operation of the Base
175 Product, but that may be added before or after shipment in order to add functionality. An
176 accessory may be sold separately under its own model number, or sold with a base product as
177 part of a package or configuration.
- 178 12) Product Model: An imaging equipment product that is sold or marketed under a unique model
179 number or marketing name. A product model may be comprised of a base product or a base
180 product plus accessories.
- 181 13) Representative Model: An imaging equipment product that is defined by (1) a product
182 configuration equivalent to that which is intended to be marketed and labeled as ENERGY STAR
183 and (2) the highest energy using configuration within a product family if more than one model is
184 qualified under a common basic design.

185 **Note:** The above definition is proposed for addition to clarify the testing requirements in Section 4.2. EPA
186 seeks comments on the proposed definition.

- 187 14) Product Family: A group of product models that are (1) made by the same manufacturer, (2)
188 subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design.
189 Product models within a family differ from each other according to one or more characteristics or
190 features that either (1) have no impact on product performance with regard to ENERGY STAR
191 qualification criteria, or (2) are specified herein as acceptable variations within a product family.
192 For Imaging Equipment, acceptable variations within a product family include:
- 193 a) Color,
- 194 b) Housing,
- 195 c) Input voltage and frequency,
- 196 d) Input or output paper-handling accessories,
- 197 e) Internal storage drive (hard disk drives (HDD) or solid state drives (SDD)), or
- 198 f) Any of the functional adders specified in Table 7.

199 **2 SCOPE**

200 **2.1 Included Products**

- 201 2.1.1 Commercially-available products that meet one of the Imaging Equipment definitions in Section 1

202 and are capable of being powered from (1) a wall outlet, (2) a data or network connection, or (3)
 203 both a wall outlet and a data or network connection, are eligible for ENERGY STAR qualification,
 204 with the exception of products listed in Section 2.2.

205 2.1.2 An imaging equipment product must further be classified as either “TEC” or “OM” in Table 1,
 206 below, depending on the method of ENERGY STAR evaluation.

207 **Note:** Despite diminishing shipments, based on stakeholder input, EPA is proposing to retain scanners
 208 within the scope while increasing the stringency of the specification, with different specification levels for
 209 different product speeds. Also, despite diminishing sales, EPA is proposing to retain fax machines within
 210 the scope of the specification, also based on stakeholder feedback on the importance of continuing to
 211 provide product differentiation for institutional purchasers.
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 213 EPA is interested in stakeholder feedback on the proposal to retain these product categories within the
 214 scope of the specification.

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218 **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, Impact | 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 |
| | Small | High Performance IJ | TEC |
| Scanner | All | N/A | OM |

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220 **Note:** Stakeholders have proposed adding Standard-format impact MFDs and Small-format high
 221 performance Inkjet printers. Standard-format impact MFDs have been added as a new OM category in the
 222 table above, while small-format high-performance ink jet printers have been added as a new TEC
 223 category. EPA welcomes comments on the proposed changes. These additions and their classification as
 224 either OM or TEC have been made based on EPA’s approach of categorizing products based on their
 225 known usage patterns.
 226
 227 EPA is not proposing to reclassify any current OM products as TEC nor test OM products in Active Mode.

228 **2.2 Excluded Products**

229 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for
230 qualification under this specification. The list of specifications currently in effect can be found at
231 www.energystar.gov/products.

232 2.2.2 Products that satisfy one or more of the following conditions are not eligible for ENERGY STAR
233 qualification under this specification:

234 i. Products that are designed to operate directly on three-phase power.

235 **3 QUALIFICATION CRITERIA**

236 **3.1 Significant Digits and Rounding**

237 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

238 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly
239 measured or calculated values without any benefit from rounding.

240 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR
241 website shall be rounded to the nearest significant digit as expressed in the corresponding
242 specification limit.

243 **3.2 General Requirements**

244 3.2.1 External Power Supply (EPS):

245 i. If the product is shipped with a single-voltage EPS, the EPS shall meet the level V
246 performance requirements under the International Efficiency Marking Protocol and include the
247 level V marking. Additional information on the Marking Protocol is available at
248 www.energystar.gov/powersupplies.

249 ii. External Power Supplies shall meet level V requirements when tested using the Test Method
250 for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power
251 Supplies, Aug. 11, 2004.

252 3.2.2 Additional Cordless Handset: Fax machines and MFDs with fax capability that are sold with
253 additional cordless handsets shall use an ENERGY STAR qualified handset, or one that meets
254 the ENERGY STAR Telephony specification when tested to the ENERGY STAR test method on
255 the date the imaging product is qualified as ENERGY STAR. The ENERGY STAR specification
256 and test method for telephony products may be found at www.energystar.gov/products.

257 3.2.3 Functionally Integrated MFD: If an MFD consists of a set of functionally integrated components
258 (i.e., the MFD is not a single physical device), the sum of the measured energy or power
259 consumption for all components shall be less than the relevant MFD energy or power
260 consumption requirements for ENERGY STAR qualification.

261 3.2.4 Wakeup: UUT shall not wake for common network traffic unless the traffic is designated for the
 262 unit to perform a user requested service. Common traffic including ARP and NS Simple Network
 263 Management Protocol (SNMP) packets should not wake the device.

264 **Note:** EPA's intent is that ENERGY STAR qualified imaging equipment will use power management
 265 features "out of the box", saving energy, without requiring special configuration of the imaging device or
 266 other devices (such as PCs) on the local network. If fully-networked machines are awakened by ordinary
 267 network events while in sleep, these disturbances and energy consumption should be captured when
 268 testing for ENERGY STAR qualification.

269 3.2.5 DFE Requirements: The DFE ready mode power of an imaging equipment product that is sold
 270 with a Type 1 or Type 2 DFE shall be less than or equal to the Maximum Ready Mode Power, as
 271 specified in Table 2 for the given DFE type.

- 272 i. The ready mode power of a DFE that meets the Maximum Ready Mode Power should be
- 273 excluded or subtracted from the TEC energy and OM power measurements.
- 274 ii. Section 3.3.2i provides further detail on subtracting TEC values for DFEs for TEC products;
- 275 iii. Section 3.4.2 provides further detail for excluding DFEs from OM Sleep and Standby levels.
- 276 iv. No requirements shall apply to Type 3 DFEs.

277 **Table 2: Maximum Ready Mode Power Requirement for Type 1 and Type 2 DFEs**

| DFE Category | Category Description (From Small-Scale Servers) | Maximum Ready Mode Power (W) | |
|--------------|--|------------------------------|------------|
| | | Type 1 DFE | Type 2 DFE |
| A | All DFEs that do meet the definition of Category B will be considered under Category A for ENERGY STAR qualification. | 50 | 42.5 |
| B | To qualify under Category B DFEs must have: Processor(s) with greater than 1 physical core or greater than 1 discrete processor; and Minimum of 1 gigabyte of system memory. | 65 | 55 |

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 279 **Note:** EPA intends to treat DFEs similarly to small scale servers in the ENERGY STAR 5.2 Computer
 280 specification, as they have similar hardware and software functionality. Type 1 DFE values are pulled
 281 directly from the computer specification, while Type 2 DFE values are a reduced value to compensate for
 282 added efficiency from using in the internal imaging product power supply. For a more detailed explanation
 283 of the values shown in Table 2, please refer to the DFE Ready Mode Power Requirements supporting
 284 document.

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 286 EPA is interested in stakeholder feedback on the proposed approach and maximum ready mode power
 287 requirements for imaging products with DFEs.

289 3.3 Requirements for Typical Electricity Consumption (TEC) Products

290 **Note:** Without the availability of appropriate test data, EPA has decided not to propose a recovery time
 291 requirement for TEC products but is interested in providing this data to consumers on the qualified product
 292 listing. EPA is interested in stakeholder feedback on this proposed approach.

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 294 3.3.1 Automatic Duplexing Capability:

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

297 **Table 3: Automatic Duplexing Requirements for**
 298 **all TEC Copiers, MFDs, and Printers**

| Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | Automatic Duplexing Requirement |
|--|---------------------------------|
| $s \leq 19$ | None |
| $s > 19$ | Integral to the base product |

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300 **Note:** Based on analysis of the currently qualified products list, the majority of ENERGY STAR-qualified
 301 monochrome products with speed greater than 19 ipm already offer automatic duplexing. However, as
 302 similar duplexing technology is available for color products, monochrome and color products have been
 303 combined into one category for simplicity. EPA welcomes comments on this proposal as well as further
 304 comments on the inclusion of automatic duplexing on OM product categories where it is applicable.
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306 **Note:** EPA has recently received information from a Partner about a product that operates faster in duplex
 307 mode than simplex: because it prints on both sides of the page simultaneously, it can output two duplex
 308 images in the same time as a single simplex image.
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310 As testing these products in simplex mode would double the printing time of a job, thereby doubling the
 311 energy consumption due to the fixed power losses such as the fuser, the current (Version 1.2) test method
 312 would put these products at a disadvantage. Since the ENERGY STAR program is interested in promoting
 313 duplexing, EPA and DOE have amended the associated Version 2.0 test method to test these products in
 314 duplex mode—their faster and less consumptive mode. EPA welcomes comments on this proposal and
 315 whether this difference in testing would impact end-users' ability to equitably compare the TEC between
 316 products.

317 3.3.2 Typical Electricity Consumption: Calculated Typical Electricity Consumption (TEC) per Equation 1
 318 or Equation 2 shall be less than or equal to the Maximum TEC Requirement (TEC_{MAX}) specified in
 319 Table 4, to the nearest 0.1 kilowatt-hour.

- 320 i. For imaging products with a Type 2 DFE that meet the Type 2 DFE maximum ready mode
 321 power allowance values found in Table 2, the energy consumption of the DFE, calculated per
 322 the example below, should be excluded when comparing the product's measured TEC value
 323 to TEC_{MAX} . The DFE shall not interfere with the ability of the imaging product to enter or exit
 324 its lower-power modes. In order to take advantage of this exclusion, the DFE must meet the
 325 definition in Section 1 and be a separate processing unit that is capable of initiating activity
 326 over the network.

327 **Example:** A printer's total TEC result is 24.5 kWh/week and its internal DFE consumes 40 W in Ready
 328 mode. $40\text{ W} \times 168\text{ hours/week} = 6.72\text{ kWh/week}$, which is then subtracted from the tested TEC value:
 329 $24.5\text{ kWh/week} - 6.72\text{ kWh/week} = 17.78\text{ kWh/week}$. 17.78 kWh/week is then compared to the following
 330 criteria.

- 331 ii. For printers, fax machines, digital duplicators with print capability, and MFDs with print
 332 capability, TEC shall be calculated per Equation 1.
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Equation 1: TEC Calculation for Printers, Fax Machines, Digital Duplicators with Print Capability, and MFDs with Print Capability

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

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Where:

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- *TEC is the typical weekly energy consumption for printers, fax machines, digital duplicators with print capability, and MFDs with print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- *E_{JOB_DAILY} is the daily job energy, as calculated per Equation 3, in kWh;*
- *E_{FINAL} is the final energy, as measured in the test procedure, converted to kWh;*
- *N_{JOBS} is the number of jobs per day, as calculated in the test procedure,*
- *t_{FINAL} is the final time to Sleep, as measured in the test procedure, converted to hours;*
- *E_{SLEEP} is the Sleep energy, as measured in the test procedure, converted to kWh; and*
- *t_{SLEEP} is the Sleep time, as measured in the test procedure, converted to hours.*

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

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

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

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Where:

- *TEC is the typical weekly energy consumption for copiers, digital duplicators without print capability, and MFDs without print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- *E_{JOB_DAILY} is the daily job energy, as calculated per Equation 3, in kWh;*
- *E_{FINAL} is the final energy, as measured in the test procedure, converted to kWh;*
- *N_{JOBS} is the number of jobs per day, as calculated in the test procedure;*
- *t_{FINAL} is the final time to Sleep, as measured in the test procedure, converted to hours;*
- *E_{AUTO} is the Auto-off energy, as measured in the test procedure, converted to kWh; and*
- *t_{AUTO} is the Auto-off time, as measured in the test procedure, converted to hours.*

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

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Equation 3: Daily Job Energy Calculation for TEC Products

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

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Where:

- *E_{JOB_DAILY} is the daily job energy, expressed in kilowatt-hours (kWh);*

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- E_{JOBi} is the energy of the i^{th} job, as measured in the test procedure, converted to kWh; and
- N_{JOBS} is the number of jobs per day, as calculated in the test procedure.

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Note: EPA proposes to maintain the TEC test procedure usage profiles as we believe the current profiles fairly reflect the way products are used. EPA has no test or qualification data to support that the TEC usage assumptions result in an artificially high paper and energy consumption.

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Table 4: Maximum TEC Requirement

| Color Capability | Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | TEC _{MAX} (kWh, to the nearest 0.1 kWh) |
|------------------|--|--|
| Monochrome | $s \leq 7$ | 0.5 |
| | $7 < s \leq 44$ | $(s \times 0.07)$ |
| | $44 < s \leq 74$ | $(s \times 0.20) - 5.7$ |
| | $s > 74$ | $(s \times 0.70) - 42.7$ |
| Color | $s \leq 45$ | $(s \times 0.07) + 1.4$ |
| | $45 < s \leq 70$ | $(s \times 0.2) - 4.5$ |
| | $s > 70$ | $(s \times 0.70) - 39.5$ |

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Note: EPA is proposing to treat MFD and non MFD products the same for the purposes of maximum TEC requirements. Current qualified product data show that many MFD products can perform as well, if not better than, printer products of the same color capability and speed, and therefore do not require a higher power consumption limit.

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Note: EPA is not proposing a default-delay time requirement for TEC products because the TEC metric already accounts for the time that a product remains in ready mode following a print job and there is lack of available test data to allow setting requirements. EPA is interested in stakeholders' input on the benefits of providing this data to consumers on the qualified product listing.

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EPA continues to welcome any information on the typical use of TEC products and the expected benefit of default-delay time requirements.

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3.4 Requirements for Operational Mode (OM) Products

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Note: Without the availability of appropriate test data, EPA has decided not to propose a recovery time requirement for OM products but is interested in stakeholders input on the benefits of providing this data to consumers on the qualified product listing.

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EPA is interested in stakeholder feedback on this proposed approach and appreciates any information on the typical use of OM devices, and the expected benefit of recovery time requirements.

404

405 3.4.1 Multiple Sleep Modes: If a product is capable of automatically entering multiple successive Sleep
406 Modes, the same Sleep Mode shall be used to determine qualification under the default delay time
407 to sleep requirements specified in Section 3.4.3 and the Sleep Mode power consumption
408 requirements specified in Section 3.4.4.

409 3.4.2 DFE Requirements: For imaging products with a functionally-integrated DFE that relies on the
410 imaging product for its power, and that meets the appropriate maximum ready mode power
411 allowance found in Table 2, the power consumption of the DFE should be excluded when
412 comparing the product's measured Sleep Mode power to the combined marking-engine and
413 functional-adder criteria limits below and when comparing the measured Standby Mode power to
414 the Standby criteria limits below.

- 415 i. The DFE must not interfere with the ability of the imaging product to enter or exit its lower-
416 power modes.
- 417 ii. In order to take advantage of this exclusion, the DFE must meet the definition in Section 1 and
418 be a separate processing unit that is capable of initiating activity over the network.

419 3.4.3 Default Delay Time: Measured Default Delay Time to Sleep (t_{SLEEP}) shall be less than or equal to
420 the Maximum Default Delay Time to Sleep ($t_{\text{SLEEP_MAX}}$) requirement specified in Table 5, subject to
421 the following conditions:

- 422 i. The maximum machine delay time shall be less than or equal to 4 hours, which is only
423 adjustable by the manufacturer. This maximum machine delay time cannot be influenced by
424 the user and typically cannot be modified without internal, invasive product manipulation.
- 425 ii. When reporting data and qualifying products that can enter Sleep mode in multiple ways,
426 partners should reference a Sleep level that can be reached automatically. If the product is
427 capable of automatically entering multiple, successive Sleep levels, it is at the manufacturer's
428 discretion which of these levels is used for qualification purposes; however, the default-delay
429 time provided must correspond with whichever level is used.
- 430 iii. Default delay time does not apply to OM products that can meet sleep mode requirements in
431 ready mode.

432 **Note:** EPA is interested in stakeholder feedback on the proposed approach of qualifying OM products that
433 have no distinct sleep mode but meet the maximum standby requirements.

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Table 5: Maximum Default Delay Time to Sleep for OM Products

| Product Type | Media Format | Monochrome Product Speed, s, as Calculated in the Test Method (ipm or mppm) | 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 |
| Mailing Machine | All | $s \leq 50$ | 20 |
| | | $50 < s \leq 100$ | 30 |
| | | $100 < s \leq 150$ | 40 |
| | | $s > 150$ | 60 |

439 3.4.4 Sleep Mode Power Consumption: Measured Sleep Mode power consumption (P_{SLEEP}) shall be
440 less than or equal to the maximum Sleep Mode power consumption requirement (P_{SLEEP_MAX})
441 determined per Equation 4, subject to the following conditions:

- 442 i. Only those interfaces that are present and used during the test, including any fax interface,
443 may be considered functional adders.
444 ii. Product functionality offered through a DFE shall not be considered either a functional adder.
445 iii. A single interface that performs multiple functions may be counted only once.
446 iv. Any interface that meets more than one interface type definition shall be classified according
447 to the functionality used during the test.
448 v. For products that meet the Sleep Mode power requirement in Ready State, no further
449 automatic power reductions are required to meet Sleep Mode requirements.

450

451 **Equation 4: Calculation of Maximum Sleep Mode Power**
452 **Consumption Requirement for OM products**

453
$$P_{SLEEP_MAX} = P_{MAX_BASE} + \sum_1^n Adder_{INTERFACE} + \sum_1^m Adder_{OTHER}$$

454 *Where:*

- 455 • P_{SLEEP_MAX} is the maximum Sleep Mode power consumption requirement,
456 expressed in watts (W), and rounded to the nearest 0.1 watt;
- 457 • P_{MAX_BASE} is the maximum Sleep Mode power allowance for the base marking
458 engine, as determined per Table 6, in watts;
- 459 • $Adder_{INTERFACE}$ is the power allowance for the interface functional adders
460 used during the test, including any fax capability and as selected by the
461 manufacturer from Table 7, in watts;
- 462 • n is the number of allowances claimed for interface functional adders used
463 during the test, including any fax capability and is less than or equal to 2
- 464 • $Adder_{OTHER}$ is the power allowance for any non-interface functional adders in
465 use during the test, as selected by the manufacturer from Table 7, in watts;
466 and
- 467 • m is the number of allowances claimed for any non-interface functional
468 adders in use during the test.

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Table 6: Sleep Mode Power Allowance for Base Marking Engine

| Product Type | Media Format | Marking Technology | | | | P _{MAX_BASE} (watts) |
|-----------------|--------------|--------------------|---------|-----------|----------------|----------------------------------|
| | | Impact | Ink Jet | All Other | Not Applicable | |
| Copier | Large | | | x | | 7.4 |
| Fax Machine | Standard | | x | | | 0.6 |
| Mailing Machine | N/A | | x | x | | 5.6 |
| MFD | Standard | x | | | | 2.3 |
| | | | x | | | 0.6 |
| | Large | | x | | | 4.9 |
| | | | | x | | 7.4 |
| Printer | Small | x | x | x | | 9.0 |
| | Standard | x | | | | 2.3 |
| | | | x | | | 0.6 |
| | Large | x | | x | | 2.5 |
| | | | | x | | 4.9 |
| Scanner | Any | | | | x | 2.7 |

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Table 7: Sleep Mode Power Allowances for Functional Adders

| Adder Type | Connection Type | Max. Data Rate, r (Mbit/second) | Details | Functional Adder Allowance (watts) |
|----------------------------|--------------------------------|--------------------------------------|---|------------------------------------|
| Data or Network Connection | Wired | $r < 20$ | Includes: USB 1.x, IEEE 488, IEEE 1284/Parallel/ Centronics, RS232, Fax Modem | 0.2 |
| | | $20 \leq r < 500$ | Includes: USB 2.x, IEEE 1394/ FireWire/i.LINK, 100Mb Ethernet | 0.4 |
| | | $r \geq 500$ | Includes: USB 3.x, 1G Ethernet | 0.5 |
| | | Any | Includes: Flash memory-card/smart-card readers, camera interfaces, PictBridge | 0.2 |
| | Wireless, Radio-frequency (RF) | Any | Includes: Bluetooth, 802.11 | 2.0 |
| | Wireless, Infrared (IR) | Any | Includes: IrDA. | 0.1 |

| Adder Type | Connection Type | Max. Data Rate, r (Mbit/second) | Details | Functional Adder Allowance (watts) |
|------------------|-----------------|-----------------------------------|--|------------------------------------|
| Cordless Handset | N/A | N/A | Capability of the imaging product to communicate with a cordless handset. Applied only once, regardless of the number of cordless handsets the product is designed to handle. Does not address the power requirements of the cordless handset itself. | 0.5 |
| Memory | N/A | N/A | Applies to the internal capacity available in the imaging product for storing data. Applies to all volumes of internal memory and should be scaled accordingly. | 0.5 |
| Scanner | N/A | N/A | Includes: Cold Cathode Fluorescent Lamp (CCFL) or a technology other than CCFL, such as Light-Emitting Diode (LED), Halogen, Hot-Cathode Fluorescent Tube (HCFT), Xenon, or Tubular Fluorescent (TL) technologies. (Applied only once, regardless of the lamp size or the number of lamps/bulbs employed.) | 0.5 |

475

476 **Note:** In a July 8 memo to stakeholders, EPA proposed a new approach to functional adders for OM
477 products. The current Version 1.2 Imaging Equipment Specification provides Primary and Secondary
478 Functional Adder allowances to accommodate the power consumption in Sleep Mode of additional
479 capabilities such as data and network interfaces. The Draft Test Method has since been amended to allow
480 the use of only one interface (down from three previously), to be selected from a list ordered by typical
481 use. In this Draft 1 specification, EPA proposes to revise the adder approach to better reflect advances in
482 technology and the way that Imaging products are used. EPA has updated the OM requirements in
483 Section 3.4 of this Specification to reflect this proposed approach to Functional Adders. Our proposal and
484 the data analysis are further described in depth in the accompanying “Explanation of the Draft 1 Levels for
485 Operational Mode (OM) Products and Functional Adder Allowances.” EPA is interested in stakeholder
486 feedback on these proposed updates.

487
488 EPA believes that this would more closely reflect the actual use of these products, reward greater
489 efficiency and highlight those products that power down non-essential functions while in sleep mode. The
490 base allowances proposed in Table 6 reflect this new approach. EPA believes that the proposed approach
491 and performance requirements will differentiate top performers while allowing for a good selection of
492 products across speeds at a price that remains cost effective.

493
494 First, in recognition of advances made in technology, EPA proposes to decrease many of the allowances
495 and eliminate others—allowances that have remained unchanged since the Version 1.0 specification was
496 finalized 5 years ago. Following discussions and correspondence with industry leaders, EPA has revised
497 the allowance levels proposed on July 8 based on stakeholder feedback to best reflect the current state of
498 technology.

499
500 The following adders have been removed from Table 7 for simplicity or to reflect improvements in
501 technology:
502

- Internal storage drive: EPA eliminated the internal storage drive adder because hard drives are not typically active during Sleep Mode. Furthermore, both solid state and hard disk drives have low sleep power, with the controller the only component active.
- Power supplies: EPA eliminated the power supply adder because of significant decreases in power supply no-load and low-load power achieved through mandatory standards. The Federal standard for EPSs require a no-load power of 0.5 W and it is common to find EPSs with no-load power as low as 0.1 W.
- PC systems: EPA eliminated the PC system adder because rather than a distinct component that is either present or absent in the device, the PC system adder is currently applied to products that “rely on an external computer for significant resources.”

Second, EPA proposes to limit allowances to those features/functionalities that remain active during sleep mode to better reflect product use. For Primary Functional Adders, this means providing allowances only to the interface used during the test, while for Secondary Functional Adders, it means providing allowances only for those functions that provide value by remaining active in sleep.

EPA welcomes comment on whether the removal of any of these adders will impact the qualification of child models under Section 1, E, 14, above. So far, EPA has added internal storage drives to the list of variations specifically allowed under the Product Family definition, but welcomes additional suggestions.

3.4.5 Standby Power Consumption: Standby Mode power, which is the lesser of the Ready Mode Power, Sleep Mode Power, and Off Mode Power, as measured in the test procedure, shall be less than or equal to the Maximum Standby Power specified in Table 8..

- i. The Imaging Equipment shall meet the Standby Power requirement independent of the state of any other devices (e.g., a host PC) connected to it.

Table 8: Maximum Standby Power Requirement

| Product Type | Maximum Standby Power (watts) |
|-----------------|-------------------------------|
| All OM Products | 0.5 |

Note: Based on analysis of currently qualified products and data submitted, the majority of ENERGY STAR qualified imaging products that have an Off Mode already meet the 0.5 W limit. EPA has therefore decided to retain the proposal of the 0.5 W limit in Standby, harmonizing with the Standby Mode requirement in the European Commission (EC) Ecodesign Regulation No 1275/2008.

EPA has further clarified that the Standby Power requirement applies independent of the state of other devices connected to the Imaging Equipment during the test. This, together with edits to the test method, should resolve recurring questions with testing USB-connected products. EPA welcomes comments on this topic as well as suggestions of further issues for clarification.

3.5 Digital Front End Power Supply Efficiency Requirements

Note: EPA is proposing to remove the DFE power supply efficiency requirements present in the Version 1.2 specification as the power supply efficiency will now be accounted for by the ready mode requirements in Section 3.2.5. EPA welcomes comment on this proposal.

547 **3.6 Toxicity and Recyclability Requirements**

548 3.6.1 Imaging Equipment products shall contain restricted levels of the following materials, where the
549 maximum concentration values tolerated by weight in homogeneous materials are: lead (0.1%),
550 mercury (0.1%), cadmium (0.01%), hexavalent chromium (0.1%), polybrominated biphenyls (PBB)
551 (0.1%), or polybrominated diphenyl ethers (PBDE) (0.1%). Batteries are exempt. The following
552 exemptions are granted for components in Imaging Equipment:

- 553 i. Lead in glass of fluorescent tubes not exceeding 0.2% by weight.
- 554 ii. Copper alloy containing up to 4% lead by weight.
- 555 iii. Electrical or electronic components containing lead in a glass or ceramic other than dielectric
556 ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix.
- 557 iv. Lead in dielectric ceramic in capacitors for a rated voltage of 125V AC or 250 V DC or higher.

558 3.6.2 Imaging Equipment products shall be designed for ease of disassembly and recyclability where
559 external enclosures, sub-enclosures, chassis and electronic subassemblies are easily removable
560 with commonly available tools, by hand, or by a recycler's automated processes. Products shall
561 identify and provide ease of access to, and removal of, materials with special handling needs.

562 3.6.3 For purposes of third-party certification, toxicity and recyclability requirements shall not be
563 reviewed when products are initially qualified or during subsequent verification testing. Instead,
564 consistent with the RoHS Directive (for toxicity) and IEEE 1680 standard (for design for
565 recyclability), manufacturers shall maintain documentation on file that products meet these
566 requirements. EPA reserves the right to request this documentation at any time.

567 3.6.4 To the extent product models are sold in countries other than the U.S., they are not subject to
568 requirements in 3.6.1, 3.6.2 and 3.6.3.

569

570 **Note:**

571 While energy efficiency remains the basis upon which top performers are selected, EPA has a
572 longstanding practice of including criteria related to other aspects of product performance in ENERGY
573 STAR specifications to ensure that overall product performance is maintained relative to a non-qualifying
574 product. To the extent these types of requirements are included, the Agency leverages existing standards
575 and looks to achieve a minimally acceptable level of performance (i.e. not one that is overly
576 stringent/difficult to achieve). By including additional criteria, the ENERGY STAR program seeks to avoid
577 associating the label with poor quality or otherwise undesirable product models, thereby preserving the
578 influence of the label in the market.

579
580 For these requirements, EPA drew from existing standards for toxicity and design for recyclability. EPA
581 looked to the RoHS Directive for a toxicity limit because Imaging products manufacturers have extensive
582 experience with designing products free from certain toxic materials in compliance with the RoHS
583 Directive. The RoHS Directive, formally known as Directive 2002/95/EC of the European Parliament and of
584 the Council on the restriction of the use of certain hazardous substances in electrical and electronic
585 equipment, was amended by 2005/618/EC and went into effect in 2006. Most global manufacturers have
586 been in compliance with RoHS since 2006, when the directive first took effect. Products that currently
587 meet the EU RoHS Directive would satisfy this toxicity requirement. In some cases, the RoHS Directive
588 allows for specific, limited exemptions for specific materials and provides expiration dates for these
589 exemptions. EPA intends to harmonize with the RoHS Directive by adding language in Section 3.6
590 allowing the same exemptions as those outlined in the current RoHS Directive. EPA welcomes feedback
591 from stakeholders to understand if any materials exempted for a given period of time under the RoHS
592 Directive currently apply to components typically found in imaging products. EPA does not intend to
593 require documentation of the need for exemption beyond what is needed by the Partner to demonstrate
594 compliance with the RoHS Directive.

595 The proposed design for ease of disassembly and recyclability is harmonized with the existing IEEE
 596 1680.1 standard and those proposed under the draft 1680.2. EPA believes that many manufacturers in the
 597 marketplace already meet this requirement.
 598
 599
 600 EPA has clarified (Section 3.6.4) that these requirements are exempt from the ENERGY STAR third-party
 601 certification process. Further, EPA added language making clear that the non-energy requirements
 602 proposed here are not intended for international adoption. EPA continues to anticipate that existing
 603 reporting efforts and maintenance of relevant quality assurance documentation would be sufficient to
 604 demonstrate compliance with these requirements.

605 4 TESTING

606 4.1 Test Methods

607 4.1.1 When testing Imaging Equipment products, the test methods identified in Table 9 shall be used to
 608 determine qualification for ENERGY STAR.

609 **Table 9: Test Methods for ENERGY STAR Qualification**

| Product Type | Test Method |
|--------------|---|
| All Products | ENERGY STAR Imaging Equipment Test Method, Rev. XX-2012 |

610

611 4.2 Number of Units Required for Testing

612 4.2.1 Representative Models shall be selected for testing per the following requirements:

- 613 i. For qualification of an individual product model, a product configuration equivalent to that
 614 which is intended to be marketed and labeled as ENERGY STAR is considered the
 615 Representative Model;
- 616 ii. For qualification of a product family, the highest energy using configuration within the family
 617 shall be considered the Representative Model. When submitting product families,
 618 manufacturers continue to be held accountable for any efficiency claims made about their
 619 imaging products, including those not tested or for which data was not reported.

620 4.2.2 A single unit of each Representative Model shall be selected for testing.

621 **Note:** EPA has clarified that for qualification purposes, the product configuration that represents the
 622 highest as-shipped power consumption for each product category within the product family will be
 623 considered the Representative Model. Because of verification testing performed by certification bodies,
 624 EPA believes the existing requirements for additional testing of units near the limit of eligibility criteria is no
 625 longer necessary.

626 **4.3 International Market Qualification**

627 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for
628 each market in which they will be sold and promoted as ENERGY STAR.

629 **5 USER INTERFACE**

630 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard
631 IEEE 1621: Standard for User Interface Elements in Power Control of Electronic Devices
632 Employed in Office/Consumer Environments. For details, see <http://eetd.LBL.gov/Controls>.

633 **6 EFFECTIVE DATE**

634 6.1.1 Effective Date: The Version 2.0 ENERGY STAR Imaging Equipment specification shall take effect
635 on March 1, 2013. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR
636 specification in effect on its date of manufacture. The date of manufacture is specific to each unit
637 and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

638 **Note:** EPA anticipates releasing a Final Version 2.0 specification by June 2012. As such, the effective
639 date provided above allows manufacturers time to work with certification bodies and update product
640 literature as needed to comply with the new requirements. As of February 28, 2013 only those models that
641 have been third-party certified by an EPA recognized Certification Body will remain on the ENERGY STAR
642 Qualified Product List. For information on third-party certification visit: www.energystar.gov/3rdpartycert.

643
644 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
645 technological and/or market changes affect its usefulness to consumers, industry, or the
646 environment. In keeping with current policy, revisions to the specification are arrived at through
647 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
648 STAR qualification is not automatically granted for the life of a product model.

649