



# ENERGY STAR® Program Requirements Product Specification for Imaging Equipment

## Test Method for Determining Professional Imaging Product Energy Use Draft 1, Rev. July-2018

### 1 OVERVIEW

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

**Note:** One stakeholder requested that the Professional Imaging Products test method be placed in one discrete section of the specification as it will “better allow accredited labs to limit the scope of their accreditation to exclude Professional Product testing if such products are not tested in the lab.” EPA has drafted the Test Method for Determining Professional Imaging Product Energy Use to help ease laboratory accreditation. EPA welcomes feedback on this proposal.

### 2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the products under evaluation. Table 1 shall be used to determine the applicability of this ENERGY STAR Test Method..

Table 1. Test Procedure Applicability

Product Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Professional Imaging Products	All	All	Professional Imaging Product

### 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.

### 4 TEST SETUP

#### 4.1 General Test Setup

A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall be in accordance with:

- 1) The requirements of International Organization for Standardization (ISO) Standard 21632, “Graphic technology -- Determination of the energy consumption of digital printing devices including transitional and related modes”, Section 4, “General Conditions”; and

- 2) In the event of conflicting requirements, the ENERGY STAR test method shall take precedence.

- 25 B) Ac Input Power: Products intended to be powered from an ac mains power source shall be connected  
 26 to a voltage source appropriate for the intended market, as specified in Table 2 or Table 3.
- 27 1) If a product is rated to operate at a voltage/frequency combination in a specific market that is  
 28 different from the voltage/frequency combination for that market (e.g., 230 volts (V), 60 hertz (Hz)  
 29 in North America), the unit shall be tested at the manufacturer rated voltage/frequency  
 30 combination for that unit. The voltage/frequency used shall be reported.

31 **Table 2: Input Power Requirements for Products with**  
 32 **Nameplate Rated Power Less Than or Equal to 1500 W**

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

33 **Table 3: Input Power Requirements for Products with**  
 34 **Nameplate Rated Power Greater than 1500 W**

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 V ac	+/- 4.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 V ac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 V ac	+/- 4.0 %	5.0 %	50 Hz or 60 Hz	+/- 1.0 %

- 35 C) Low-voltage Dc Input Power:

36 **Note:** EPA proposes to remove the dc test from the Professional Imaging Product test method as the  
 37 Agency does not expect any Professional Imaging Products to be powered by dc input power.

- 38 D) Ambient Temperature: Ambient temperature shall be 23°C ± 5°C.
- 39 E) Relative Humidity: Relative humidity shall be between 10% and 80%.
- 40 F) Power Meter: Power meters shall possess the following attributes:
- 41 1) Minimum Frequency Response: 3.0 kHz
- 42 2) Minimum Resolution:
- 43 a) 0.01 W for measurement values less than 10 W;
- 44 b) 0.1 W for measurement values from 10 W to 100 W;
- 45 c) 1 W for measurement values from 100 W to 1.5 kW; and
- 46 d) 10 W for measurement values greater than 1.5 kW.

47 e) Measurements of accumulated energy should have resolutions which are generally  
 48 consistent with these values when converted to average power. For accumulated energy  
 49 measurements, the figure of merit for determining required accuracy is the maximum power  
 50 value during the measurement period, not the average, since it is the maximum that  
 51 determines the metering equipment and setup.

52 G) Measurement Uncertainty<sup>1</sup>:

53 1) Measurements of greater than or equal to 1 W shall have an uncertainty of 2% or better at the  
 54 95% confidence level.

55 2) Measurements of less than 1 W shall have an uncertainty of 0.02 W or better at the 95%  
 56 confidence level.

57 **Note:** One stakeholder commented that the change in the measurement uncertainty from 2% to 3%,  
 58 proposed in the previous draft, was unnecessary, since the large equipment with three-phase power  
 59 connection is out of scope for Professional Imaging Products.

61 EPA has incorporated the proposed departure from ISO 21632 to make the test method more  
 62 comparable to the ENERGY STAR test method for non-Professional imaging Products; however, upon  
 63 further review, EPA has also relaxed the uncertainty between 0.5 W and 1 W to equal 0.02 W, for all  
 64 Imaging Equipment (including Professional). This is consistent with IEC 62301 Ed. 2.

65 H) Time Measurement: Time measurements may be performed with a standard stopwatch or other time  
 66 keeping device with a resolution of at least 1 second.

67 I) Paper Specifications:

68 1) Standard Format Products shall be tested in accordance with **Error! Reference source not f**  
 69 **ound..**

70 2) Large, Small, and Continuous Form products shall be tested using any compatible paper size.

71 **Table 4: Paper Size and Weight Requirements**

Market	Paper Size	Basis Weight (g/m <sup>2</sup> )
North America	8.5" × 11"	127.9
Taiwan	A4 or 8.5" × 11"	127.9
Europe / Australia / New Zealand	A4	127.9
Japan	A4	127.9

<sup>1</sup> Measurement uncertainty calculations should be performed according IEC 62301 Ed. 2.0 Appendix D. Only the uncertainty due to the measurement instrument shall be calculated.

72 **Note:** Per ISO 21632, Professional Imaging Products, shall be tested in their best quality (BQ) and best  
73 productivity (BP) combinations. Also, ISO 21632 for Professional Imaging Products specifies testing with  
74 the substrates (media) that will result in, first, the best quality and second, the best productivity. One  
75 stakeholder commented that two separate tests (one BQ and one BP) are unnecessary, and that  
76 Professional Imaging Products can be tested under one Best Quality/Best Picture (BQ/BP) condition.  
77 EPA agrees with the stakeholder in that two separate BQ and BP tests are unnecessary, and that one  
78 test would be less burdensome. EPA proposes to depart from ISO 21632 in regards to paper size and to  
79 test under one Best Quality/Best Picture (BQ/BP) condition. One stakeholder asked EPA to add the  
80 standard test paper of Professional Imaging Products to Table 4: Paper Size and Weight Requirements,  
81 which is 127.9g/m<sup>2</sup>, 85lb, or equivalent. EPA has incorporated the proposed basis weight for Professional  
82 Imaging Products.

83  
84 **Note:** In response to stakeholder comment, EPA is proposing to allow models intended for the Taiwanese  
85 market to be tested with either A4 or 8.5"×11" paper. This will allow manufacturers to use the same  
86 conditions as in North America for models sold in both Taiwan and North America, while allowing others  
87 with models specific to Taiwan to test them with more typical paper. This is the same proposal as in the  
88 non-Professional imaging Product test method, except for the heavier weight of 127.9g/m<sup>2</sup>.

89 J) As-shipped Condition:

90 1) Professional Imaging Products shall be tested under one best quality and best productivity  
91 combination.

92 **Note:** Per ISO 21632, Professional Imaging Products, shall be tested in their best quality (BQ) and best  
93 productivity (BP) combinations. One stakeholder commented that two separate tests (one BQ and one  
94 BP) are unnecessary, and that Professional Imaging Products can be tested under one Best Quality/Best  
95 Picture (BQ/BP) condition. To simplify the test, EPA proposes a departure from ISO 21632 and proposes  
96 testing under one Best Quality/Best Picture (BQ/BP) condition. This will also make the test method more  
97 comparable to the existing ENERGY STAR test.

98 K) Product Speed for Calculations and Reporting: The product speed for all calculations and reporting  
99 shall be the highest speed as claimed by the manufacturer per the following criteria, expressed in  
100 images per minute (ipm) and rounded to the nearest integer:

101 1) In general, for Standard-size products, a single A4 or 8.5" × 11" sheet printed/copied/scanned on  
102 one side in one minute is equal to 1 (ipm).

103 a) When operating in duplex mode a single A4 or 8.5" × 11" sheet printed/copied/scanned on  
104 both sides in one minute is equal to 2 (ipm).

105 2) The product speed shall be based on:

106 a) The highest manufacturer-claimed monochrome print speed, unless the product cannot print,  
107 in which case,

108 b) The highest manufacturer-claimed monochrome copy speed, unless the product cannot print  
109 or copy, in which case,

110 c) The manufacturer-claimed scan speed.

111 Note: EPA recommends that manufacturers report print speeds using the ISO/IEC  
112 24734:2014 test image for consistency with other reporting.

113 **Note:** EPA is proposing to recommend the same test image be used as for the TEC test. EPA welcomes  
114 feedback on this proposal.

115 d) When a manufacturer intends to qualify a product in a certain market by making use of test  
116 results that qualified the product in another market using other sizes of paper (e.g., A4 versus  
117 8.5" × 11"), and if its maximum claimed speeds differ when producing images on different  
118 sizes of paper, the highest speed shall be used.

119 **Note:** ISO 21632 requires calculation and reporting of product speed during test, referred to as  
120 productivity. One stakeholder opposed EPA's proposal of measuring and calculating product speed for  
121 Professional Imaging Products based on productivity and commented that product speed should be  
122 declared as is the case under Version 2.0. As such, EPA proposes a departure from ISO 21632 to  
123 simplify the test and to keep the above requirements pertaining to reported product speed for all products  
124 distinct from any other requirements pertaining to productivity, applicable only to Professional Imaging  
125 Products. This will also make the test method more comparable to the existing ENERGY STAR test  
126 method for Non-Professional Products.

127 3) For Continuous Form products, product speed shall be calculated per Equation 1.

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

129 
$$s = 16 \times w \times s_L$$

130 *Where:*

- 131 • *s is the product speed, in ipm,*
- 132 • *w is the width of the media, in meters (m),*
- 133 • *s<sub>L</sub> is the maximum claimed monochrome speed, in meters per*  
134 *minute.*

135 4) The product speed used for all calculations and qualification, as calculated above, may not be the  
136 same as the product speed used for testing.

137 L) **Color:** Color-capable products shall be tested under the default (as-shipped) setting.

138 **Note:** Per ISO 21632, Professional Imaging Products, shall be tested in their best quality and  
139 best productivity combinations. The best quality combination requires “all colorants of the system” be  
140 used; the best productivity combination requires a print mode that is still saleable (no visible pixilation or  
141 other artifacts and a minimum of 4 colors (if available). Two stakeholders commented that color-capable  
142 Professional Imaging Products be tested with the default (as-shipped) setting, which is 4 colors.

143  
144 EPA proposes to depart from ISO 21632 by requiring the default setting. This will simplify the test and  
145 make the test method more comparable to the existing ENERGY STAR test method for Non-Professional  
146 Products.

147 M) **Network Connections:** Products that are capable of being network-connected as-shipped shall be  
148 connected to a network.

149 1) Products shall be connected to only one network or data connection for the duration of the test.

150 a) Only one computer may be connected to the UUT, either directly or via a network.

151 2) The type of network connection depends on the characteristics of the UUT and shall be the  
152 topmost connection listed in Table 5 available on the unit as-shipped.

**Table 5: Network or Data Connections for Use in Test**

Order of Preference for Use in Test (if Provided by UUT)	Connections for all Products
1	Ethernet – 1 Gb/s
2	Ethernet – 100/10 Mb/s
3	Wi-Fi
4	USB 3.x
5	USB 2.x
6	USB 1.x
7	RS232
8	IEEE 1284 <sup>2</sup>
9	Other Wired – in order of preference from highest to lowest speed
10	Other Wireless – in order of preference from highest to lowest speed
11	If none of the above, test with whatever connection is provided by the device (or none)

154 3) All data and network cables and routers shall support the highest and lowest data speeds of the  
155 UUT's network interface.

156 Example: In the case of Ethernet, the connection shall be via a standard Category (Cat) 5e or  
157 better cable.

158 4) Products connected to a wireless protocol, such as Wi-Fi, shall be connected in close proximity to  
159 the appropriate router or computer.

160 5) Products connected to Ethernet, per paragraph J).M)2) above, and capable of supporting Energy  
161 Efficient Ethernet (IEEE Standard 802.3az)<sup>3</sup>, shall be connected to a network switch or router that  
162 also supports Energy Efficient Ethernet for the duration of the test.

163 6) The tester shall configure the address layer of the protocol, taking note of the following:

164 1) Internet Protocol (IP) v4 and IPv6 have neighbor discovery and will generally configure a  
165 limited, non-routable connection automatically.

166 2) IP can be configured manually or by using Dynamic Host Configuration Protocol (DHCP) with  
167 an address in the 192.168.1.x Network Address Translation (NAT) address space if the UUT  
168 does not behave normally when autoIP is used. The network shall be configured to support  
169 the NAT address space and/or autoIP.

170 3) The UUT shall maintain this live connection to the network for the duration of testing unless  
171 otherwise specified in this Test Method, disregarding any brief lapses (e.g., when  
172 transitioning between link speeds).

<sup>2</sup> Also referred to as a Parallel or Centronics interface.

<sup>3</sup> Institute of Electrical and Electronics Engineers (IEEE) Standard 802.3az-2010. "IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications." 2010.

- 173 N) Service/Maintenance Modes: Service/maintenance modes, including color calibration, shall be in  
174 their default state during testing.
- 175 1) Energy consumption of any automatic adjustments shall be measured if captured by other  
176 portions of the test method (e.g., Production Print).
- 177 2) Any manual interventions, as specified in Section 4.5.3.1.4 of ISO 21632, shall be excluded  
178 to ensure repeatability of the test method.

179 **Note:** ISO 21632 includes a test for energy consumption during maintenance and requires it for models  
180 with daily maintenance needs.

181  
182 EPA is proposing that Professional Imaging Products shall be tested with default settings and without  
183 disabling the automatic adjustment function of color or registration, if it is incorporated in the default  
184 setting. Furthermore, EPA proposes to keep measuring the energy consumption of any automatic  
185 adjustments that happen by default. Any manual processes shall be excluded to ensure repeatability of  
186 the test method.

## 187 5 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS

### 188 5.1 General Initialization

189 A) Prior to the start of testing, the UUT shall be initialized as follows:

- 190 1) Set up the UUT per the instructions in the Manufacturer's Instructions or documentation.
- 191 a) Accessories, such as paper source, that are shipped with the base product and are intended  
192 to be installed or attached by the end-user shall be installed as intended for the product  
193 model. Paper shall be placed in all paper sources designated to hold the paper specified for  
194 testing, and the UUT shall pull from the default paper source, using the as-shipped paper  
195 source settings.
- 196 b) If the product is connected to a computer, either directly or via a network, during the test, the  
197 computer shall be running the newest version of the manufacturer's default driver available at  
198 the time of testing using settings corresponding to the default settings upon shipment, unless  
199 otherwise specified in this test method. The print driver version used for testing shall be  
200 recorded.
- 201 i) In the event that a setting does not have a default and is not defined in this test method,  
202 the setting shall be set according to the tester's discretion and shall be recorded.
- 203 ii) When connecting via a network and multiple computers are connected to the network,  
204 print driver settings apply only to the computer sending the print jobs to the UUT.
- 205 c) For products designed to operate on battery power when not connected to the mains power  
206 source, the battery shall be removed for all tests. For UUTs where operation without a battery  
207 pack is not a supported configuration, the test shall be performed with fully charged battery  
208 pack(s) installed, making sure to report this configuration in the test results. To ensure the  
209 battery is fully charged, perform the following steps:
- 210 i) For UUTs that have an indicator to show that the battery is fully charged, continue  
211 charging for an additional 5 hours after the indication is present.
- 212 ii) If there is no charge indicator, but the manufacturer's instructions provide a time estimate  
213 for when charging this battery or this capacity of battery should be complete, continue  
214 charging for an additional 5 hours after the manufacturer's indication.
- 215 iii) If there is no indicator and no time estimate in the instructions, the duration shall be 24  
216 hours.

- 217 2) Connect the UUT to its power source.
- 218 3) Power on the UUT and perform initial system configuration, as applicable. Verify that default  
219 delay times are configured according to product specifications and/or manufacturer  
220 recommendations.
- 221 a) Product Speed for Testing for Professional Imaging Products: The product shall be tested in  
222 its default as-shipped configuration.

223 **Note:** ISO 21632 for Professional Imaging Products require testing under one Best Quality/Best  
224 Productivity. However, as noted above, in response to stakeholder requests, EPA proposes to simplify  
225 the test and require testing in the default as-shipped configuration.

- 226 4) User-controllable anti-humidity features shall be turned off or disabled for the duration of testing.
- 227 5) Pre-conditioning: Place the UUT in Off Mode, then let the UUT sit idle for 15 minutes.
- 228 a) For EP-TEC products, let the UUT sit in Off Mode for an additional 105 minutes, for a total of  
229 at least 120 minutes (2 hours).
- 230 b) Pre-conditioning is only required prior to beginning the first test on each UUT.

231 **Note:** ISO 21632 for Professional Imaging Products requires one hour or more for pre-conditioning. One  
232 stakeholder specified that ISO 21632 covers equipment other than electro-photographic (EP) equipment,  
233 but as ENERGY STAR covers EP imaging products, EPA proposes to depart from ISO 21632 and will  
234 require 2 hours of pre-conditioning for professional products. This will make the test method more  
235 comparable to the ENERGY STAR test method for Non-professional Imaging Products.

## 237 6 PROFESSIONAL IMAGING PRODUCT TEST PROCEDURE

### 238 6.1 Testing in Accordance with ISO 21632

- 239 A) All testing shall be conducted in accordance with Section 4.5.4 of ISO 21632.

240 **Note:** One stakeholder asked that the proposed test method for Professional Imaging Products be as  
241 specified in Section 4.5.4 of ISO 21632. In particular, the test method should include Job 1 energy and  
242 the average of Jobs 2 and 3, along with Off Mode and Sleep Mode. The stakeholder also commented that  
243 a streamlined test procedure is necessary and that ENERGY STAR keep the main provisions of ISO  
244 21632 (e.g., skip test print/sleep/5% consistency check between jobs).

245  
246 To simplify the test, EPA proposes to reference Section 4.5.4 of ISO 21632, which in turn references  
247 specific preceding sections; also, certain previously-referenced sections, including 4.4 Measuring  
248 Conditions, no longer need to be referenced as these requirements have been brought over from the  
249 Non-Professional Imaging Product ENERGY STAR test method.

250

## 251 7 TEST PROCEDURES FOR PRODUCTS WITH A DIGITAL FRONT 252 END (DFE)

253 This step applies only to products that have a DFE as defined in Section 1 of the ENERGY STAR  
254 Program Requirements for Imaging Equipment.

### 255 7.1 Ready Mode DFE Test

- 256 A) Products that are network-capable as-shipped shall be connected during testing. The network  
257 connection used shall be determined using Table 5.



258 B) If the DFE has a separate main power cord, regardless of whether the cord and controller are internal  
259 or external to the imaging product, a 10 minute power measurement of the DFE alone shall be made,  
260 and the average power recorded while the main product is in Ready Mode.

261 C) If the DFE does not have a separate main power cord, the tester shall measure the dc power required  
262 for the DFE when the unit as a whole is in Ready Mode. This will most commonly be accomplished by  
263 taking an instantaneous power measurements of each dc input into the DFE and adding them  
264 together for the total dc power.

## 265 **7.2 Sleep Mode DFE Test**

266 This testing shall be performed to obtain the Sleep Mode power of a DFE device over a 1 hour period.  
267 The resulting value will be used to qualify Imaging Equipment products that incorporate DFEs with  
268 network-capable Sleep Modes.

269 A) Products that are network-capable as-shipped shall be connected during testing. The network  
270 connection used shall be determined using Table 5.

271 B) If the DFE has a separate main power cord, regardless of whether the cord and controller are internal  
272 or external to the imaging product, a 1 hour power measurement of the DFE alone shall be made,  
273 and the average power recorded while the main product is in Sleep Mode. At the end of the 1 hour  
274 power measurement, a print job shall be sent to the main product to ensure the DFE is responsive.

275 C) If the DFE does not have a separate main power cord, the tester shall measure the dc power required  
276 for the DFE when the unit as a whole is in Sleep Mode. A 1 hour power measurement of the dc input  
277 to the DFE shall be made, and the average power recorded while the main product is in Sleep Mode.  
278 At the end of the 1 hour power measurement, a print job shall be sent to the main product to ensure  
279 the DFE is responsive.

280 D) In cases B) and C), the following requirements apply:

281 1) Manufacturers shall provide information on:

282 a) Whether DFE Sleep Mode is enabled as-shipped; and

283 b) The expected time to sleep of the DFE.

284 2) If the DFE does not respond to the print request at the end of 1 hour, the Ready Mode power  
285 level measured in the test method shall be reported as the Sleep Mode power.

286

287 *Note: All information specified or provided by manufacturers for product testing shall be publicly available.*

## 288 **8 REFERENCES**

289 A) ISO 21632 "Graphic technology -- Determination of the energy consumption of digital printing  
290 devices including transitional and related modes"

291 B) IEC 62301:2011. Household Electrical Appliances – Measurement of Standby Power. Ed. 2.0.