



ENERGY STAR® Program Requirements Product Specification for Imaging Equipment

Test Method for Determining Imaging Equipment Energy Use Rev. Jul-2011

1 OVERVIEW

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

Note: This document contains proposed changes to the ENERGY STAR test methods for both Operational Mode (OM) and Typical Energy Consumption (TEC) imaging equipment products. The proposed changes incorporate the feedback received during and after the imaging equipment webinar held on April 13, 2011. EPA thanks all stakeholders who participated and provided feedback and welcomes additional comments on the changes outlined below.

Please note that significant changes are proposed for the network connections used in the OM and TEC test methods; only one network connection is to be used for the test, and the network connection is specified in Table 6, below. These changes would eliminate at least 57% of OM products from the dataset used during the development of the revised Version 2.0 specification as their energy consumption would be different when measured according to the revised test method. On the other hand, the changes proposed to the TEC test method should affect few products as most were tested using a single Ethernet connection as specified in Table 6.

2 APPLICABILITY

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

7 **Table 1: Test Procedure Applicability**

Product Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Copier	Standard	Direct Thermal (DT), Dye Sublimation (DS), Electro-photographic (EP), Solid Ink (SI), Thermal Transfer (TT)	Typical Energy Consumption (TEC)
	Large	DT, DS, EP, SI, TT	Operational Mode (OM)
Digital Duplicator	Standard	Stencil	TEC
Fax Machine	Standard	DT, DS, EP, SI, TT	TEC
		Ink Jet (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,	TEC

		TT	
		IJ, Impact	OM
	Large or Small	DT, DS, EP, Impact, IJ, SI, TT	OM
Scanner	All	N/A	OM

8 3 TEST SETUP

9 A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall
10 be in accordance with the requirements of IEC standard 62301, Ed. 2.0, "Measurement of Household
11 Appliance Standby Power", Section 4, "General Conditions for Measurements". In the event of
12 conflicting requirements, the ENERGY STAR test method shall take precedence.

Note: The reference procedure for test setup has been updated to the most recent version of IEC standard 62301 Ed. 2.0.

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14 B) Ac Input Power: Products intended to be powered from an ac mains power source shall be connected
15 to a voltage source appropriate for the intended market, as specified in Table 2 or Table 3.
16 1) Products shipped with external power supplies (EPSs) shall first be connected to the EPS and
17 then to the voltage source specified in Table 2 or Table 3.
18 2) If a product is designed to operate at a voltage/frequency combination in a specific market that is
19 different from the voltage/frequency combination for that market (e.g., 230 volts (V), 60 hertz (Hz)
20 in North America), the manufacturer should test the product at the regional combination that most
21 closely matches the product's design capabilities and note this fact on the test reporting sheet.

23 **Table 2: Input Power Requirements for Products with**
24 **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/60 Hz	+/- 1.0 %

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Table 3: Input Power Requirements for Products with 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/60 Hz	+/- 1.0 %

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29 C) Low-voltage Dc Input Power:

- 30 1) Products may only be powered with a low-voltage dc source (e.g., via network or data
31 connection) if the dc source is the only acceptable source of power for the product (e.g., no ac
32 plug or EPS is included with the product).
- 33 2) Products powered by low-voltage dc shall be configured with an ac source of the dc power for
34 testing (e.g., an ac-powered universal serial bus (USB) hub).
- 35 3) The power reported for units under test (UUT) requiring low-voltage dc input power shall be equal
36 to the ac power drawn by the dc power source during normal testing minus the ac power drawn
37 by the dc power source with no load applied, as measured in the sections that follow.
- 38 i) Connect the dc source to the power meter and relevant ac supply as specified in Table 2 or
39 Table 3.
- 40 ii) Verify that the dc source is unloaded.
- 41 iii) Allow the dc source to warm up for a minimum of 30 minutes.
- 42 iv) Measure and record the unloaded dc source power (P_S) according to section 5.3 of IEC
43 standard 62301 Ed. 2.0.

Note: IEC standard 62301 Ed. 2.0 does not include dc powered products within its scope and notes that the possibility of inclusion is “under consideration”. However, ENERGY STAR believes the power measurement techniques in section 5.3 of the standard are applicable.

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45 D) Ambient Temperature: Ambient temperature shall be $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

46 E) Relative Humidity: Relative humidity shall be from 10% to 80%.

47 F) Power Meter: Power meters shall possess the following attributes:

- 48 1) Minimum Frequency Response (Recommended): 3.0 kHz
- 49 2) Minimum Resolution:
- 50 i) 0.01 W for measurement values less than 10 W;
- 51 ii) 0.1 W for measurement values from 10 W to 100 W;
- 52 iii) 1 W for measurement values from 100 W to 1.5 kW; and
- 53 iv) 10 W for measurement values greater than 1.5 kW.

54 v) Measurements of accumulated energy should have resolutions which are generally
55 consistent with these values when converted to average power. For accumulated energy
56 measurements, the figure of merit for determining required accuracy is the maximum power
57 value during the measurement period, not the average, since it is the maximum that
58 determines the metering equipment and setup.

59 G) Measurement Uncertainty: The uncertainty of all measurements conducted under this test method
60 shall meet the requirements of section 4.4.1 of IEC standard 62301, Ed. 2.0.

Note: The section on measurement accuracy was updated to eliminate redundancy by referencing the uncertainty requirements in IEC standard 62301 Ed. 2.0.

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62 H) Time Measurement: Time measurements may be performed with an ordinary stopwatch with
63 resolution of at least 1 second.

64 I) Paper Specifications:

65 1) Standard format products shall be tested in accordance with Table 4.

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

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Table 4: 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

68 4 PRE-TEST UUT CONFIGURATION FOR ALL PRODUCTS

69 4.1 General Configuration

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

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

75 2) For all products, the product speed shall be based on:

76 i) The manufacturer-claimed print speed, unless the product cannot print, in which case,

77 ii) The manufacturer-claimed copy speed, unless the product cannot print or copy, in which
78 case,

79 iii) The manufacturer-claimed scan speed.

80 3) For non-Continuous Form products, with the exception of mailing machines, the product speed
81 shall be calculated per Table 5. If the maximum claimed speeds differ when producing images on
82 A4 or 8.5" x 11" paper, the higher of the two shall be used.

83 **Table 5: Calculation of Product Speed for Standard, Small, and Large Format Products with the**
 84 **Exception of Mailing Machines**

Media Format	Media Size	Product Speed, s (ipm) <i>Where: s_P is the maximum claimed monochrome 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	$16 \times s_P$

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 86 4) For Continuous Form products, product speed shall be calculated per Equation 1

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

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$$s = 16ws_L$$

89 *Where:*

- 90 • s is the product speed, in ipm,
- 91 • w is the width of the media, in meters (m),
- 92 • s_L is the maximum claimed monochrome speed, in meters per
- 93 minute.

94 5) For Mailing Machines, product speed shall be reported in units of mail pieces per minute (mppm).
 95 B) Color: Color-capable products shall be tested making monochrome images unless incapable of doing
 96 so.

Note: ENERGY STAR has decided not to include color testing in the Test Method due to the limited apparent prevalence of color printing in typical use and its limited impact on energy consumption.

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 98 C) Network Connections: Products that are capable of being network-connected as-shipped shall be
 99 connected to a network.
 100 1) Products shall be connected to only one network or data connection for the duration of the test.
 101 2) The type of network connection depends on the characteristics of the UUT and shall be the
 102 topmost available connection in the appropriate column of Table 6, with the exception of products
 103 with 10 Gigabits per second (Gb/s) Ethernet, which shall be tested at 1 Gb/s.

Table 6: Network or Data Connections for Use in Test

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

Note: The above table is intended to balance the requirements of the test method to be reflective of typical use while maintaining uniformity in testing. Specifically, it was assumed that individuals are more likely to use Wi-Fi than commercial users, and though this may not always be the case, testing in a standard fashion will make the tests more repeatable.

Also, since only one interface shall now be active during the test, ENERGY STAR is considering eliminating allowances for functional adders such as data and network connections. Furthermore, ENERGY STAR is also considering eliminating allowances for other functional adders such as hard disk drives and memory. ENERGY STAR welcomes comments on this proposal, and/or updated allowance levels where the adders are to be retained. For a list of updated adder allowances being proposed by EPA, please see the letter to stakeholders distributed along with this draft test method, dated July 8, 2011.

- 3) Products connected to Ethernet, per paragraph 5.1.C)2) above, and capable of supporting Energy Efficient Ethernet (IEEE Standard 802.3az)², shall be connected to a network switch or router that also supports Energy Efficient Ethernet for the duration of the test.

¹ Also referred to as a Parallel or Centronics interface.

² 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.

Note: Since IEEE 802.3az was ratified recently (in September 2010), ENERGY STAR does not expect any currently-qualified products to be affected by this standard and does not expect this change to require any retesting.

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111 4) In all cases the type of connection used during the test shall be reported.

112 **4.2 Configuration for Fax Machines**

113 A) All fax machines and products incorporating fax machines that connect to a telephone line shall be
114 connected to a telephone line during the test.

Note: ENERGY STAR assumes that products purchased with fax capability will be operated with a connection to a telephone line, and should therefore be tested as such. However, ENERGY STAR does not expect this test method change to require any retesting, as during the April 13 webinar partners stated that fax connection should not have an impact on energy consumption

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116 B) Unless sending jobs via phone line, originals may be placed in the document feeder before the test
117 begins.

118 1) Products without a document feeder may make all images from a single original placed on the
119 platen.

120 2) Fax machines shall be tested with one image per job.

121 **4.3 Configuration for Digital Duplicators**

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

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

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

128 **5 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS**

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

130 1) Set up the UUT per the instructions in the Manufacturer's Instructions or documentation.

131 i) Accessories such as paper source and finishing hardware that are intended to be installed or
132 attached by the end-user shall be installed; however, their use in the test is at the
133 manufacturer's discretion (e.g., any paper source may be used).

134 ii) If the product is connected to a computer during the test, the computer shall be running the
135 manufacturer's default driver using settings corresponding to the default settings upon
136 shipment.

Note: To clarify the test method and promote repeatability, ENERGY STAR decided to clarify that key driver settings used during testing correspond to the defaults upon shipment, regardless of the implementation details of those settings. Based on stakeholder input, ENERGY STAR does not intend to require testing with the same driver as that installed upon shipment. Specifically, ENERGY STAR would like to ensure that any image sent to the UUT via a computer has been processed by the OEM driver using default settings.

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2) Connect the UUT to its power source.

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3) Power on the UUT and perform initial system configuration, as applicable. Verify that default delay times are configured according to product specifications and/or manufacturer recommendations.

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

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

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iii) Auto-off for OM Products: If a product has an Auto-off Mode enabled as shipped, it shall be enabled prior to performing the test.

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4) User-controllable anti-humidity features shall be turned off or disabled for the duration of testing.

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5) Let the UUT sit for at least 15 minutes, or until it has completed initialization and is ready for use.

Note: ENERGY STAR is considering extending initial pre-conditioning time to 2 hours prior to any testing to ensure that all products begin testing with their internal temperature equal to that of the ambient air. ENERGY STAR welcomes stakeholder feedback on the necessity of such a requirement.

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6) For products designed to operate on battery power when not connected to the mains power source, the battery shall be either:

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i) Removed from the product; or

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ii) Fully charged for at least 24 hours before beginning the test and left in place for the duration of the test.

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6 TYPICAL ELECTRICITY CONSUMPTION (TEC) TEST PROCEDURE

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6.1 Job Structure

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A) Jobs per Day: The number of jobs per day (N_{JOBS}) is specified in Table 7.

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Table 7: 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

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B) Images per Job:

162 1) Except for fax machines, the number of images shall be computed according to Equation 2,
163 below. For convenience, Table 11 at the end of this document provides the resultant images per
164 job computation for each integer product speed up through 100 ipm.

165 **Equation 2: Calculation of Number of Images per Job**

$$N_{IMAGES} = \text{int} \left[\frac{(0.5 \times s^2)}{N_{JOBS}} \right],$$

167 *Where:*

- 168 • N_{IMAGES} is the number of images per job, rounded down
169 (truncated) to the nearest integer,
- 170 • s is the (monochrome) maximum reported speed in images per
171 minute (ipm), calculated in section 5.1.A), of this test
172 procedure, and
- 173 • N_{JOBS} is the number of jobs per day, as calculated per Table 7.

Note: ENERGY STAR has decided not to modify the usage assumptions integrated into the TEC test procedure (i.e., the number of images per job, and the number of jobs per day) due to a lack of data indicating a more representative usage pattern.

174 C) Test Image: Test Pattern A from ISO/IEC standard 10561:1999 shall be used as the original image
175 for all testing.

176 1) Test images shall be rendered in 10 point size in a fixed-width Courier font (or nearest
177 equivalent).

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

Note: As mentioned above, ENERGY STAR has decided not to include color testing in the Test Method due to the limited apparent prevalence of color printing in typical use and its limited impact on energy consumption.

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

183 1) Each image in a print job shall be sent separately, i.e., all images may be part of the same
184 document, but shall not be specified in the document as multiple copies of a single original image
185 (unless the product is a digital duplicator).

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

188 E) Copy Jobs:

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

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

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

- 197 3) Originals may be placed in the document feeder before the test begins.
198 i) Products without a document feeder may make all images from a single original placed on
199 the platen.

200 6.2 Measurement Procedures

- 201 A) Measurement of TEC shall be conducted according to Table 8 for printers, fax machines, digital
202 duplicators with print capability, and MFDs with print capability, and Table 9 for copiers, digital
203 duplicators without print capability and MFDs without print capability, subject to the following
204 provisions:
- 205 1) Paper: There shall be sufficient paper in the UUT to perform the specified print or copy jobs.
- 206 2) Duplexing: Products shall be tested in simplex mode, unless the speed of duplex mode output is
207 greater than the speed of simplex mode output, in which case they shall be tested in duplex
208 mode. Originals for copying shall be simplex images.
- 209 i) Manufacturers that wish to have units tested in duplex must provide a rated speed for the unit
210 in duplex mode.
- 211 ii) For all products tested, the product speed and the mode in which it was tested will be
212 recorded.
- 213 3) Service/Maintenance Modes: Service/maintenance modes (including color calibration) should not
214 be included in TEC measurements.
- 215 i) Any service/maintenance modes that occur during the test shall be noted.
- 216 ii) If a service/maintenance mode occurs during a job other than the first job, the results from
217 the job with the service/maintenance mode may be replaced with results from a substitute
218 job. In this case, the substitute job shall be inserted into the test procedure immediately
219 following Job 4. The 15 minute job interval shall be maintained at all times.

Note: The previously specified accuracy requirements have been removed as they were redundant with those in section 4 (Test Setup), above. All requirements have been updated to be harmonized with IEC standard 62301 Ed. 2.0.

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- 221 4) Energy Measurement Method: All measurements shall be recorded as accumulated energy over
222 time, in Wh; all time shall be recorded in minutes.
- 223 i) "Zero meter" references may be accomplished by recording the accumulated energy
224 consumption at that time rather than literally zeroing the meter.

**Table 8: TEC Test Procedure for Printers, Fax Machines,
Digital Duplicators with Print Capability, 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	Minutes (min)	
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	Minutes (min)	–
4	Ready (or other)	Wait until the meter shows that the unit has entered its final Sleep Mode or the time specified by the manufacturer.	–	–	–
5	Sleep	Zero meter; measure energy and time over 1 hour. Record the energy and time.	Sleep energy, E_{SLEEP}	Watt-hours (Wh)	Sleep
			Sleep time, t_{SLEEP} (≤ 1 hour)	Minutes (min)	
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
			Active1 time	Minutes (min)	
7	Ready (or other)	Repeat Step 6.	Job2 energy, E_{JOB2}	Watt-hours (Wh)	Same as above
			Active2 time	Minutes (min)	
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 Sleep Mode or the final Sleep Mode for units with multiple Sleep modes, or the time specified by the manufacturer.	Final energy, E_{FINAL}	Watt-hours (Wh)	Ready, Sleep
			Final time, t_{FINAL}	Minutes (min)	

Table 9: TEC Test Procedure for Copiers, Digital Duplicators without Print Capability, 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	Minutes (min)	
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	Minutes (min)	–
4	Ready (or other)	Wait until the meter shows that the unit has entered its final Sleep Mode or the time specified by the manufacturer.	–	–	–
5	Sleep	Zero meter; measure energy and time over 1 hour or until unit enters Auto-off Mode. Record the energy and time.	Sleep energy	Watt-hours (Wh)	Sleep
			Sleep time (≤ 1 hour)	Minutes (min)	
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	Minutes (min)	
7	Ready (or other)	Repeat Step 6.	Job2 energy, E_{JOB2}	Minutes (min)	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 the time specified by the manufacturer. 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}	Minutes (min)	
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}	Watt-hours (Wh)	Auto-off
			Auto-off time, t_{AUTO}	Minutes (min)	

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Note:

- 1) Because there is a lack of specific product examples with a power buffer, ENERGY STAR does not intend to modify the test method to require recording energy consumed during Step 2 of the TEC measurement.
- 2) ENERGY STAR has clarified the TEC test method in Table 8 and Table 9 above, and will clarify the reporting requirements to indicate that the duration of time until the UUT has reached its final sleep or auto-off mode shall be specified by the manufacturer. This change will remove potential testing ambiguity by specifying how long testers must wait before concluding measurement in those modes.

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7 OPERATIONAL MODE (OM) TEST PROCEDURE

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7.1 Measurement Procedures

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A) Measurement of OM power and delay times shall be conducted according to Table 10, subject to the following provisions:

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- 1) All power figures shall be recorded in W in accordance with section 5.3 of IEC standard 62301 Ed. 2.0, unless otherwise specified in this document.

Note: The previously-specified accuracy requirements have been removed as they were redundant with those in section 4 (Test Setup), above. All requirements have been updated to be harmonized with IEC standard 62301 Ed. 2.0

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- 2) Service/Maintenance Modes: Service/maintenance modes (including color calibration) should not be included in measurements. Any adaptation of the procedure needed to exclude such modes that occur during the test shall be noted.

Table 10: 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 measure Sleep Mode power).	Off power P_{OFF}	Watts (W)

253 Notes:

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- Step 1 – If the unit has no Ready indicator, use the time at which the power consumption level stabilizes to the Ready level, and note this detail when reporting the product test data.
 - Steps 4 and 5 – For products with more than one Sleep level, repeat these steps as many times as necessary to capture all successive Sleep levels and report these data. Two Sleep levels are typically used in large-format copiers and MFDs that use high-heat marking technologies. For products lacking this Mode, disregard Steps 4 and 5.
 - Steps 4 and 6 – Default-delay time measurements are to be measured in parallel fashion, cumulative from the start of Step 4. For example, a product set to enter a Sleep level in 15 minutes and enter a second Sleep level 30 minutes after entering the first Sleep level will have a 15-minute default-delay time to the first level and a 45 minute default-delay time to the second level.

265 **8 TEST PROCEDURES FOR PRODUCTS WITH A DIGITAL FRONT**
266 **END (DFE)**

267 This step applies only to products that have a DFE as defined in Section 1 of the ENERGY STAR
268 Program Requirements for Imaging Equipment.
269

270 **Note:** ENERGY STAR intends to incentivize energy efficiency of imaging products with DFEs by
271 measuring the energy consumption of the DFE in the modes that are most prevalent: Ready and Sleep.
272 This change will require retesting of all imaging equipment units with DFEs.

273
274 Following retesting, the energy savings potential of DFE energy consumption requirements will be
275 analyzed and DFE energy consumption requirements may be proposed for discussion during the
276 specification development process.

- 277
- 278 A) If the DFE has a separate main power cord, regardless of whether the cord and controller are
279 internal or external to the imaging product, a five-minute energy measurement of the DFE alone
280 shall be made while the main product is in Ready Mode. The unit must be connected to a network
281 if shipped as network-capable.
- 282 B) If the DFE does not have a separate main power cord, the manufacturer shall measure the dc
283 power required for the DFE when the unit as a whole is in a Ready Mode. This will most
284 commonly be accomplished by taking an instantaneous power measurement of the dc input to
285 the DFE.

286 **Note:** ENERGY STAR is proposing to require that manufacturers directly report the dc power to the DFE
287 without adjusting for any power supply inefficiency as such adjustments are likely to be unreliable without
288 knowing the efficiency curve of the power supply used for the test.

- 289
- 290 C) Repeat either of the above measurements, which depend on the DFE Type, while the imaging
291 product is in its final sleep mode and record the DFE power.

292 **9 REFERENCES**

- 293 A) ISO/IEC 10561:1999. Information technology — Office equipment — Printing devices — Method
294 for measuring throughput — Class 1 and Class 2 printers.
- 295 B) IEC 62301:2011. Household Electrical Appliances – Measurement of Standby Power. Ed. 2.0.

Table 11: Number of Images per Day Calculated for Product Speeds from 1 to 100 ipm.

Speed	Interim		Interim		Speed	Interim		Interim		Speed	Interim		Interim	
	Jobs/Day	Images/Day	Images/Job	Images/Job		Jobs/Day	Images/Day	Images/Job	Images/Job		Jobs/Day	Images/Day	Images/Job	Images/Job
1	8	1	0.06	1	8	51	32	1301	40.64	40	1280			
2	8	2	0.25	1	8	52	32	1352	42.25	42	1344			
3	8	5	0.56	1	8	53	32	1405	43.89	43	1376			
4	8	8	1.00	1	8	54	32	1458	45.56	45	1440			
5	8	13	1.56	1	8	55	32	1513	47.27	47	1504			
6	8	18	2.25	2	16	56	32	1568	49.00	49	1568			
7	8	25	3.06	3	24	57	32	1625	50.77	50	1600			
8	8	32	4.00	4	32	58	32	1682	52.56	52	1664			
9	9	41	4.50	4	36	59	32	1741	54.39	54	1728			
10	10	50	5.00	5	50	60	32	1800	56.25	56	1792			
11	11	61	5.50	5	55	61	32	1861	58.14	58	1856			
12	12	72	6.00	6	72	62	32	1922	60.06	60	1920			
13	13	85	6.50	6	78	63	32	1985	62.02	62	1984			
14	14	98	7.00	7	98	64	32	2048	64.00	64	2048			
15	15	113	7.50	7	105	65	32	2113	66.02	66	2112			
16	16	128	8.00	8	128	66	32	2178	68.06	68	2176			
17	17	145	8.50	8	136	67	32	2245	70.14	70	2240			
18	18	162	9.00	9	162	68	32	2312	72.25	72	2304			
19	19	181	9.50	9	171	69	32	2381	74.39	74	2368			
20	20	200	10.00	10	200	70	32	2450	76.56	76	2432			
21	21	221	10.50	10	210	71	32	2521	78.77	78	2496			
22	22	242	11.00	11	242	72	32	2592	81.00	81	2592			
23	23	265	11.50	11	253	73	32	2665	83.27	83	2656			
24	24	288	12.00	12	288	74	32	2738	85.56	85	2720			
25	25	313	12.50	12	300	75	32	2813	87.89	87	2784			
26	26	338	13.00	13	338	76	32	2888	90.25	90	2880			
27	27	365	13.50	13	351	77	32	2965	92.64	92	2944			
28	28	392	14.00	14	392	78	32	3042	95.06	95	3040			
29	29	421	14.50	14	406	79	32	3121	97.52	97	3104			
30	30	450	15.00	15	450	80	32	3200	100.00	100	3200			
31	31	481	15.50	15	465	81	32	3281	102.52	102	3264			
32	32	512	16.00	16	512	82	32	3362	105.06	105	3360			
33	32	545	17.02	17	544	83	32	3445	107.64	107	3424			
34	32	578	18.06	18	576	84	32	3528	110.25	110	3520			
35	32	613	19.14	19	608	85	32	3613	112.89	112	3584			
36	32	648	20.25	20	640	86	32	3698	115.56	115	3680			
37	32	685	21.39	21	672	87	32	3785	118.27	118	3776			
38	32	722	22.56	22	704	88	32	3872	121.00	121	3872			
39	32	761	23.77	23	736	89	32	3961	123.77	123	3936			
40	32	800	25.00	25	800	90	32	4050	126.56	126	4032			
41	32	841	26.27	26	832	91	32	4141	129.39	129	4128			
42	32	882	27.56	27	864	92	32	4232	132.25	132	4224			
43	32	925	28.89	28	896	93	32	4325	135.14	135	4320			
44	32	968	30.25	30	960	94	32	4418	138.06	138	4416			
45	32	1013	31.64	31	992	95	32	4513	141.02	141	4512			
46	32	1058	33.06	33	1056	96	32	4608	144.00	144	4608			
47	32	1105	34.52	34	1088	97	32	4705	147.02	147	4704			
48	32	1152	36.00	36	1152	98	32	4802	150.06	150	4800			
49	32	1201	37.52	37	1184	99	32	4901	153.14	153	4896			
50	32	1250	39.06	39	1248	100	32	5000	156.25	156	4992			

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307 **10 APPENDIX A: TEST REPORTING TEMPLATE**

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Laboratory Information	
Laboratory Name	
Address	
Test Office	
Dates Test Conducted	

309

Product Description	
Product Type	
Media Format	
Marking Technology	
Product Brand	
Model Name (if available)	
Model Number	
Default Delay Time to Sleep Mode	
Rated Voltage	
Image Speed (ipm, ppm)	

310

Test Results (to be completed for each unique test)	
Standby Energy (Wh)	
Ready Mode Energy (Wh)	
Time to Ready Mode (min)	
Time to Sleep Mode (min)	
Sleep Energy, E_{SLEEP} (Wh)	
Sleep Time, t_{SLEEP} (min)	
Job1 Energy, E_{JOB1} (Wh)	
Recovery Time (min)	
Job2 Energy, E_{JOB2} (Wh)	
Active1 Time, $t_{ACTIVE1}$ (min)	
Job3 Energy, E_{JOB3} (Wh)	
Job4 Energy, E_{JOB4} (Wh)	
Final Energy, E_{FINAL} (Wh)	
Final Time, t_{FINAL} (min)	

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