



ENERGY STAR® Program Requirements Product Specification for Computers

Draft 3 Test Method Rev. Nov-2012

1 OVERVIEW

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

2 APPLICABILITY

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

- 7 ▪ Section 6 shall be conducted on all eligible Computer products.
- 8 ▪ Section 7 shall be conducted on all eligible Workstation Computer products.

3 DEFINITIONS

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

4 TEST SETUP

13 Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall be
14 in accordance with the requirements of IEC 62301, Ed. 2.0, "Household Electrical Appliances –
15 Measurement of Standby Power," Section 4, "General Conditions for Measurements", unless otherwise
16 noted in this document. In the event of conflicting requirements, the ENERGY STAR test method shall
17 take precedence.

18 A) Input Power: Products intended to be powered from ac mains shall be connected to a voltage source
19 appropriate for the intended market, as specified in Table 1 and Table 2.

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Table 1: Input Power Requirements for Products with 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 2: 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 %

- 24 B) Ambient Temperature: Ambient temperature shall remain between 18 °C and 28 °C, inclusive, for the
25 duration of the test.
- 26 C) Relative Humidity: Relative humidity shall remain between 10% and 80%, inclusive, for the duration of
27 the test.

Note: In response to stakeholder comments, the requirement for “Darkroom Conditions” has been removed. DOE testing has shown that a darkroom is not necessary to measure screen luminance values.

- 28 D) Light Measuring Device (LMD): All LMDs shall meet the following specifications:

- 29 1) Accuracy: ± 2 percent (± 2 digits) of the digitally displayed value;
- 30 2) Repeatability: Within 0.4 percent (± 2 digits) of displayed value; and
- 31 3) Acceptance Angle: 3 degrees or less.

32 The overall tolerance of LMDs is found by taking the absolute sum of 2 percent of the targeted screen
33 luminance and a 2 digit tolerance of the displayed value’s least significant digit. For example, if the
34 screen luminance value is 90 cd/m² and the LMD’s least significant digit is a tenth of one cd/m², 2% of
35 90 cd/m² would be 1.8 cd/m² and a 2 digit tolerance of the least significant digit would be 0.2 cd/m².
36 Thus, the displayed value would need to be 90 \pm 2 cd/m² (1.8 cd/m² + 0.2 cd/m²).

37 *Note: The term “nit” is sometimes used instead of the official SI unit cd/m². One nit is equivalent to*
38 *one cd/m².*

Note: Based on stakeholder comments that luminance meters measure values in cd/m², and not nits, DOE has modified Section 5 E) of the test method to replace “nits” with “cd/m²”, and has included a permanent note indicating the equivalence of nits and cd/m².

- 39 E) Power Meter: Power meters shall possess the following attributes:
- 40 1) Crest Factor:
- 41 a) An available current crest factor of 3 or more at its rated range value; and
- 42 b) A bound on the current range of 10 mA or less.
- 43 2) Minimum Frequency Response: 3.0 kHz
- 44 3) Minimum Resolution:
- 45 a) 0.01 W for measurement values less than 10 W;
- 46 b) 0.1 W for measurement values from 10 W to 100 W; and
- 47 c) 1.0 W for measurement values greater than 100 W.
- 48 4) Measurement Accuracy: Measurement uncertainty as introduced by the instrument that measures
- 49 the input power to the unit under test, including any external shunts.
- 50 a) Power measurements with a value greater than or equal to 0.5 W shall be made with an
- 51 uncertainty of less than or equal to 2% at the 95% confidence level.
- 52 b) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less
- 53 than or equal to 0.01 W at the 95% confidence level.

54 **5 TEST CONDUCT**

55 **5.1 Guidance for Implementation of ECMA-383**

- 56 A) Small-Scale Servers, Thin Clients, and Workstations shall be configured in a manner identical to
- 57 Desktops (non-integrated).
- 58 1) Thin Clients shall run intended terminal/remote connection software during all relevant tests.
- 59 B) Wake on LAN (WoL) settings shall be in as shipped condition for testing Sleep Mode and Off Mode.
- 60 C) For Thin Client Computers that do not offer a Sleep Mode, Section 6.3 can be skipped and power
- 61 measured in the Long Idle Mode shall be substituted for Sleep Mode measurement.
- 62 D) For Long Idle Mode Testing (Section 6.4), the Unit Under Test (UUT) shall be allowed no more than
- 63 20 minutes from the point of ceased user input before measurements must be recorded.
- 64 E) For Short Idle Mode Testing (Section 6.5), the UUT shall be allowed no more than five minutes from
- 65 the point of ceased user input before measurements must be recorded.
- 66 F) Desktop, Integrated Desktop, and Notebook Computers shall be tested for Idle, Sleep, and Off with
- 67 Full Network Connectivity ("Proxying") features enabled or disabled as shipped.

68 **5.2 Preparing Display Luminance of Notebooks and Integrated Desktops**

- 69 A) Before performing any tests, disable display dimming, display sleep mode, computer sleep mode, and
- 70 automatic brightness control (ABC) in the computer settings. Document all settings that were
- 71 changed from the default configuration.
- 72 1) If ABC cannot be disabled, position a light source so that at least 300 lux directly enters the ABC
- 73 sensor.
- 74 B) Display the IEC 60107:1-1997, Methods of measurement on receivers for television broadcast
- 75 transmissions – Part 1: General conditions – Measurements at radio and video frequencies, three
- 76 vertical bar signal.
- 77 C) Allow 30 minutes for display warm-up.

- 78 D) With the LMD, measure the luminance in the center of the display in accordance with IEC 60107-1:
79 1997.
- 80 E) Calibrate the UUT display brightness to the closest brightness setting that is at least 90 cd/m² for
81 notebooks and at least 150 cd/m² for integrated desktop computers. If the UUT's brightest setting
82 cannot achieve the specified brightness, then set the UUT display to the brightest setting.
- 83 *Note: The display brightness setting does not need to be exactly 90/150 cd/m², but it shall be as close as*
84 *possible while still being over 90/150 cd/m².*
- 85 F) The display shall be configured with the ENERGY STAR test image. It may be set as the "desktop
86 background" (wallpaper) or shown via an image display application. The image shall be scaled to
87 completely fill the display area. The ENERGY STAR test image may be acquired from the [TBD].
- 88 G) Reset the display sleep setting to its as shipped value.
- 89 H) For Sleep Mode Testing (Section 6.3), Long Idle Mode Testing (Section 6.4) and Short Idle Mode
90 Testing (Section 6.5), the UUT shall not be rebooted or restarted until after the power measurement is
91 taken.

Note: Based on stakeholder comments, DOE has added language in Section 6.2 H) to clarify that the UUT shall not be rebooted or restarted until after the power measurement is taken. This is to prevent any display settings from being reset due to a reboot or restart.

92 **6 TEST PROCEDURES FOR ALL PRODUCTS**

93 **6.1 UUT Preparation**

94 UUT preparation shall be performed according to *ECMA-383, Ed.3: Measuring the Energy Consumption*
95 *of Personal Computing Products; Section 6.1: Test Setup*; with the additional guidance in Section 5 of this
96 document.

97 **6.2 Off Mode Testing**

98 Off Mode power shall be measured according to *ECMA-383, Ed.3: Measuring the Energy Consumption of*
99 *Personal Computing Products; Section 6.2.1: Measuring Off Mode*; with the additional guidance in
100 Section 5 of this document.

101 **6.3 Sleep Mode Testing**

102 Sleep Mode power shall be measured according to *ECMA-383, Ed. 3: Measuring the Energy*
103 *Consumption of Personal Computing Products; Section 6.2.2: Measuring Sleep Mode*; with the additional
104 guidance in Section 5 of this document.

105 **6.4 Long Idle Mode Testing**

106 Long Idle Mode power shall be measured according to *ECMA-383, Ed. 3: Measuring the Energy*
107 *Consumption of Personal Computing Products; Section 6.2.3: Measuring Long Idle Mode*; with the
108 additional guidance in Section 5 of this document.

109 **6.5 Short Idle Mode Testing**

110 Short Idle Mode power shall be measured according to *ECMA-383, Ed. 3: Measuring the Energy*
111 *Consumption of Personal Computing Products; Section 6.2.4: Measuring Short Idle Mode*; with the
112 additional guidance in Section 5 of this document.

113 7 TEST PROCEDURES FOR WORKSTATIONS

114 7.1 Maximum Power Test

115 The maximum power for workstations is found by the simultaneous operation of two industry standard
116 benchmarks: Linpack to stress the core system (e.g., processor, memory, etc.) and SPECviewperf®
117 (latest available version for the UUT) to stress the system's GPU. This test shall be repeated three times
118 on the same UUT, and all three measurements shall fall within a $\pm 2\%$ tolerance relative to the average of
119 the three measured maximum power values.

120 Additional information on these benchmarks, including free downloads, can be found at the following
121 locations:

Linpack <http://www.netlib.org/linpack/>

SPECviewperf® <http://www.spec.org/benchmarks.html#gpc>

122 A) UUT Preparation:

- 123 1) Connect an approved meter capable of measuring true power to an ac line voltage source set to
124 the appropriate voltage/frequency combination for the test. The meter should be able to store and
125 output the maximum power measurement reached during the test or be capable of another
126 method of determining maximum power.
- 127 2) Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
128 should be connected between the meter and the UUT.
- 129 3) Record the ac voltage.
- 130 4) Boot the UUT and, if not already installed, install Linpack and SPECviewperf as indicated on the
131 above Websites.
- 132 5) Set Linpack with all the defaults for the given architecture of the UUT and set the appropriate
133 array size "n" for maximizing power draw during the test.
- 134 6) Ensure all technical guidelines relevant to running the benchmark set by the Standard
135 Performance Evaluation Corporation (SPEC) organization for running SPECviewperf have been
136 met.
- 137 7) For additional information regarding Linpack setup, see Section 8.1 Typical Linpack Starting
138 Parameters.

139 B) Maximum Power Testing:

- 140 1) Set the meter to begin accumulating true power values at an interval of less than or equal to one
141 reading per second, and begin taking measurements.
- 142 2) Run SPECviewperf and as many simultaneous instances of Linpack as needed to fully stress the
143 system.
- 144 3) Accumulate power values until SPECviewperf and all instances have completed running. Record
145 the maximum power value attained during the test.
- 146 4) The following data shall also be recorded:
 - 147 a) Value of the n (the array size) used for Linpack;
 - 148 b) Number of simultaneous copies of Linpack run during the test;
 - 149 c) Version of SPECviewperf run for test;
 - 150 d) All compiler optimizations used in compiling Linpack and SPECviewperf; and

- 151 e) A precompiled binary for end users to download and run of both SPECviewperf and Linpack.
152 These can be distributed either through a centralized standards body such as SPEC, by the
153 OEM, or by a related third party.

154 7.2 Partial Load Test

Note: EPA and DOE are planning to replace the maximum power test for workstations with a more representative benchmark in the next version (Version 7.0) of the ENERGY STAR Program Requirements for Computers. However, the Version 6.0 specification will require data collection and reporting on specified benchmarks in preparation for Version 7.0.

DOE and EPA believe that the benchmarks should be representative of real world applications for workstations. As such, DOE plans to include all four of the following benchmarks:

1. Linpack <http://www.netlib.org/linpack/>
2. SPECviewperf® 11 <http://www.spec.org/gwpg/gpc.static/vp11info.html>
3. SPEC CPU2006 <http://www.spec.org/cpu2006/>
4. CINEBENCH <http://www.maxon.net/products/cinebench/overview.html>

DOE plans to include benchmark setup and configuration details in the next draft test method. DOE and EPA welcome feedback on the proposed benchmarks. In particular, DOE is interested to know if these benchmarks, or a combination of two or more when used together, are relevant and representative of real world applications for workstations.

155 8 APPENDIX: BENCHMARK PARAMETERS

156 8.1 Typical Linpack Starting Parameters

157 Below are some typical starting values for the use of Linpack for testing workstations. These values are
158 starting points and not meant to be binding. The tester is free to use the settings most advantageous to
159 their UUT. Platform and Operating System (OS) will have a significant impact on the applicability of these
160 starting values. The below assumes Linux as the testing OS.

161 A) Number of equations (problem size): See Equation.

162 B) Leading dimensions of array: See Equation.

163 The matrix size (the combination of number of equations and leading dimensions of array) should be
164 the maximum size that will fit in the Random Access Memory (RAM) on the machine.

165 This AWK script will calculate matrix size on a Linux machine:

```
166 awk '
167     BEGIN {
168         printf "Maximum matrix dimension that will fit in RAM on this machine: "
169     }
170     /^MemTotal:/ {
171         print int(sqrt(($2*1000)/8)/1000) "K"
172     }
173 ' /proc/meminfo
```

174 Use the output of this to determine what matrix size to input for both the "Number of equations" and
175 "Leading dimensions of array" inputs. The "Number of equations" will be equal to the printed output.
176 The "Leading dimensions of the array" will be the output rounded up to the nearest multiple of eight.

177 This calculation can be most easily calculated by taking the memory size, in bytes, of the UUT
178 (denoted as m) and substituting m in Equation 1.

$$\frac{\sqrt{\frac{m \times 1000}{8}}}{1000}$$

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Equation 1: Memory Size Calculation

181 C) *Number of trials*: c - 1 where c equals the number of logical and/or physical CPU cores of the system.
182 The tester needs to determine which is more advantageous for the unit. The -1 leaves one core open
183 for use by SPECviewperf.

184 D) *Data alignment value*: Typically four with Linux systems. The best value to use is the page size
185 boundary of the OS.