



ENERGY STAR® Program Requirements Product Specification for Computers

Draft Test Method Rev. May-2014

1 **Note:** U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) received
2 industry comments on the Draft ENERGY STAR Computers Specification Version 6.1, released in March
3 2014. While comments on the specification are still being considered, DOE and EPA are releasing this
4 draft of the test method which includes provisions for testing slates/tablets in order to provide interested
5 parties an opportunity to comment.

6 **1 OVERVIEW**

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

9 **2 APPLICABILITY**

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

- 12 ▪ The procedure in Section 6 shall be conducted on all eligible products that are covered under the
13 scope as defined in Section 2 of the ENERGY STAR Final Draft Eligibility Criteria for Computers.
- 14 ▪ The procedure in Section 7 shall be conducted only on eligible Workstation Computer products.

15 **3 DEFINITIONS**

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

18 **4 TEST SETUP**

19 **4.1 Test Setup and Instrumentation**

20 Test setup and instrumentation for all portions of this procedure shall be in accordance with the
21 requirements of International Electrotechnical Commission (IEC) standard, IEC 62301, "Household
22 Electrical Appliances – Measurement of Standby Power" Edition 2.0, 2011-01, Section 4, "General
23 Conditions for Measurements", unless otherwise noted in this document. In the event of conflicting
24 requirements, the ENERGY STAR test method shall take precedence.

- 25 A) Input Power: Products intended to be powered from alternating current (ac) mains shall be connected
26 to a voltage source appropriate for the intended market, as specified in Table 1 and Table 2.

27
28

Table 1: Input Power Requirements for Products with Nameplate Rated Power Less Than or Equal to 1500 watts (W)

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 volts (V) ac	+/- 1.0 %	2.0 %	60 hertz (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 %

29
30

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 or 60 Hz	+/- 1.0 %

31 B) Ambient Temperature: Ambient temperature shall remain between 18 °C and 28 °C, inclusive, for the
32 duration of the test.

33 C) Relative Humidity: Relative humidity shall remain between 10% and 80%, inclusive, for the duration of
34 the test.

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

36 1) Accuracy: ± 2% (± 2 digits) of the digitally displayed value; and

37 2) Acceptance Angle: 3 degrees or less.

38 The overall tolerance of LMDs is found by taking the absolute sum of 2%of the targeted screen
39 luminance and a 2 digit tolerance of the displayed value's least significant digit. For example, if the
40 screen luminance value is 90 candela per meter squared (cd/m²) and the LMD's least significant digit
41 is a tenth of one cd/m², 2% of 90 cd/m² would be 1.8 cd/m² and a 2 digit tolerance of the least
42 significant digit would be 0.2 cd/m². Thus, the displayed value would need to be 90 ± 2 cd/m² (1.8
43 cd/m² + 0.2 cd/m²).

44 *Note: The term "nit" is sometimes used instead of the official SI unit cd/m². One nit is equivalent to*
45 *one cd/m².*

46 E) Power Meter: Power meters shall possess the following attributes:

47 1) Crest Factor:

48 a) An available current crest factor of 3 or more at its rated range value; and

49 b) A bound on the current range of 10 milliamperes (mA) or less.

50 2) Minimum Frequency Response: 3.0 kilo-hertz (kHz)

51 3) Minimum Resolution:

52 a) 0.01 W for measurement values less than 10 W;

- 53 b) 0.1 W for measurement values from 10 W to 100 W; and
54 c) 1.0 W for measurement values greater than 100 W.
55 4) Measurement Accuracy: Measurement uncertainty as introduced by the instrument that measures
56 the input power to the unit under test (UUT), including any external shunts.
57 a) Power measurements with a value greater than or equal to 0.5 W shall be made with an
58 uncertainty of less than or equal to 2% at the 95% confidence level.
59 b) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less
60 than or equal to 0.01 W at the 95% confidence level.

61 **5 TEST CONDUCT**

62 **5.1 Guidance for Implementation of IEC 62623**

63 The Test Conduct shall be carried out according to the requirements in IEC 62623, “Desktop and Notebook
64 Computers – Measurement of Energy Consumption” Edition 1.0, 2012-10 (IEC 62623 Ed. 1.0, 2012-10)
65 reference with the following guidance.
66

- 67 A) Small-Scale Servers, Thin Clients, and Workstations shall be configured in a manner identical to
68 Desktops (non-integrated). Slates/Tablets and Two-In-One Computers shall be configured in a
69 manner identical to Notebooks unless otherwise specified.
70 1) Thin Clients shall run intended terminal/remote connection software during all tests.
71 B) Wake on LAN (WoL) settings shall be in as shipped condition for testing Sleep Mode and Off Mode.
72 C) For models that do not offer a Sleep Mode enabled by default, Section 6.2 shall measure power in the
73 lowest-latency user-activated mode or state that preserves machine state and is enabled by default.
74 1) If no such state separate from Long Idle State or Off Mode exists, the measurement in
75 Section 6.2 shall be skipped.
76 D) For Long Idle Mode Testing (Section 6.3), the UUT shall be allowed no more than 20 minutes from
77 the point of ceased user input before measurements must be started. If any default settings cause the
78 UUT to enter Long Idle after 20 minutes, begin taking measurements when the UUT has reached the
79 20 minute mark. Display sleep settings shall be set to default for Long Idle Mode Testing.
80 E) For Short Idle Mode Testing (Section 6.4), the UUT shall be allowed no more than five minutes from
81 the point of ceased user input before measurements must be taken. Display sleep settings shall be
82 disabled for Short Idle Mode Testing. If any other default settings cause the UUT to exit Short Idle
83 during the measurement time, extend the settings so that the UUT remains in short idle for the
84 duration of the measurement.
85 F) Desktop, Integrated Desktop, Notebook Computers, Slates/Tablets and Two-In-One Computers shall
86 be tested for Idle, Sleep, and Off Mode with Full Network Connectivity (“Proxying”) features using the
87 as shipped setting.
88 G) Cellular network connections shall be disabled for testing. Additionally, Bluetooth should be left as-
89 shipped.

90 **Note:** Based on stakeholder feedback, DOE has clarified what the state of cellular and Bluetooth
91 connects should be set at during testing.

92 **5.2 Preparing Display Luminance of Notebooks, Integrated Desktops,** 93 **Slates/Tablets and Two-In-One Computers**

- 94 A) Before performing any tests, disable display dimming, display Sleep Mode, Computer Sleep Mode,
95 and automatic brightness control (ABC) in the Computer settings. Document all settings that were
96 changed from the default configuration.
- 97 1) If ABC cannot be disabled, position a light source such that at least 300 lux directly enters the
98 ABC sensor.
- 99 B) Display the three vertical bar video signal as defined in section 3.2.1.3 of IEC 60107-1, "Methods of
100 measurement on receivers for television broadcast transmissions – Part 1: General conditions –
101 Measurements at radio and video frequencies" Edition 3.0, 1997 (IEC 60107-1 Ed. 3.0, 1997). For
102 Slates/Tablets or Two-In-One Computers, the three bar image shall be configured with the default
103 application.
- 104 C) Allow 30 minutes for display warm-up.
- 105 D) With the LMD, measure the luminance in the center of the display.
- 106 E) Calibrate the UUT display brightness to the closest brightness setting that is at least 90 cd/m² for
107 Notebook Computers or Two-In-One Computers, at least 150 cd/m² for Integrated Desktop
108 Computers and at least 200 cd/m² for Slates/Tablets. If the UUT's brightest setting cannot achieve the
109 specified brightness, then set the UUT display to the brightest setting.
- 110 **Note:** DOE requests feedback regarding the use of 200 cd/m² as the brightness value used for
111 testing Slates/Tablets. Additionally, DOE requests data or information to determine if 200 cd/m² or
112 some other value would be appropriate .
- 113 F) The display shall be configured with the ENERGY STAR test image, which can be found [here](#)¹. It may
114 be set as the "desktop background" (wallpaper) or shown via an image display application. The image
115 shall be scaled to completely fill the display area. For Slates/Tablets, the display shall be configured
116 with the default image display application.
- 117 G) For all testing specified in Section 6, the UUT shall not be rebooted or restarted until after the power
118 measurements for Long Idle Mode and Short Idle Mode tests are taken.

119 **6 TEST PROCEDURES FOR ALL PRODUCTS**

120 **6.1 UUT Preparation**

121 UUT preparation shall be performed according to IEC 62623, Ed.1.0, 2012-10, Section 5.2: Test Setup;
122 with the additional guidance in Section 5 of this document.

123 **6.2 Sleep Mode Testing**

124 Sleep Mode power shall be measured according to IEC 62623, Ed.1.0, 2012-10, Section 5.3.3:
125 Measuring Sleep Mode; with the additional guidance in Section 5 of this document.

126 **6.3 Long Idle Mode Testing**

127 Long Idle Mode power shall be measured according to IEC 62623, Ed.1.0, 2012-10, Section 5.3.4:
128 Measuring Long Idle Mode; with the additional guidance in Section 5 of this document.

129 **6.4 Short Idle Mode Testing**

130 Short Idle Mode power shall be measured according to IEC 62623, Ed.1.0, 2012-10, Section 5.3.5:
131 Measuring Short Idle Mode; with the additional guidance in Section 5 of this document.

132 **6.5 Off Mode Testing**

¹ <https://www.energystar.gov/ia/partners/images/ComputerTestingImage.bmp>

Off Mode power shall be measured according to IEC 62623, Ed.1.0, 2012-10, Section 5.3.2: Measuring Off Mode; with the additional guidance in Section 5 of this document.

133 **6.6 Additional Testing For Reporting**

134 For Notebook Computers or Two-In-One Computers, repeat the Short Idle test with the display brightness
135 set to the closest setting that is at least 200 cd/m².

For Slates/Tablets, repeat the Short Idle test with the display brightness set to the closest setting that is at least 90 cd/m².

136 **Note:** DOE has included an additional test for reporting to enable EPA to determine the impact of
137 luminance on notebook computers and slates/tablets.

138 **7 TEST PROCEDURES FOR WORKSTATIONS**

139 **7.1 Maximum Power Test**

140 The maximum power for Workstations is found by the simultaneous operation of two industry standard
141 benchmarks: Linpack to stress the core system (e.g., processor, memory, etc.) and SPECviewperf®
142 (latest available version for the UUT) to stress the system's Graphics Processing Unit (GPU). This test
143 shall be repeated three times on the same UUT, and all three measurements shall fall within a ± 2%
144 tolerance relative to the average of the three measured maximum power values. The average power
145 should be used for qualification and/or TEC calculations.

146

147 Additional information on these benchmarks, including free downloads, can be found at the following
148 locations as specified in Table 3.

149

Table 3: Benchmark Information for Maximum Power Test

Benchmark	Website
Linpack	http://www.netlib.org/linpack/
SPECviewperf	http://www.spec.org/benchmarks.html#gpc

150 A) UUT Preparation:

151 1) Connect a power meter capable of measuring true power to an ac line voltage source set to the
152 appropriate voltage/frequency combination for the test. The meter shall have all the attributes
153 listed in Section 4.1 E). The meter shall also store and output the maximum power measurement
154 reached during the test or be capable of another method of determining maximum power.

155 2) Plug the UUT into the measurement power outlet on the meter. No power strips or uninterruptible
156 power supply (UPS) units shall be connected between the meter and the UUT.

157 3) Record the ac voltage.

158 4) Boot the UUT and, if not already installed, install Linpack and SPECviewperf as indicated on the
159 above Websites.

160 5) Set Linpack with all the defaults for the given architecture of the UUT and set the appropriate
161 array size "n" for maximizing power draw during the test.

162 6) Ensure all technical guidelines relevant to running the benchmark set by the Standard
163 Performance Evaluation Corporation (SPEC) organization for running SPECviewperf have been
164 met.

- 165 7) For additional information regarding Linpack setup, see Section 9.1 Typical Linpack Starting
166 Parameters.
- 167 B) Maximum Power Testing:
- 168 1) Set the meter to begin accumulating true power values at a rate greater than or equal to one
169 reading per second, and begin taking measurements.
- 170 2) Run SPECviewperf and as many simultaneous instances of Linpack as needed to fully stress the
171 system. Recommended setup information can be found in Section 9.1 C).
- 172 3) Accumulate power values until SPECviewperf and all Linpack instances have completed running.
173 Record the maximum power value attained during the test.
- 174 4) The following data shall also be recorded:
- 175 a) Value of “n” (the array size) used for Linpack;
- 176 b) Number of simultaneous copies of Linpack run during the test;
- 177 c) Version of SPECviewperf run for test;
- 178 d) All compiler optimizations used in compiling Linpack and SPECviewperf; and
- 179 e) A precompiled binary for end users to download and run both SPECviewperf and Linpack.
180 These can be distributed either through a centralized standards body such as SPEC, by the
181 original equipment manufacturer (OEM), or by a related third party.

182 7.2 Benchmark Test

183 The benchmark test shall be performed by running both benchmarks listed below separately. The UUT
184 shall be rebooted before testing with each benchmark. Additional information on these benchmarks,
185 including downloads, can be found at the following locations specified in Table 4. All testing shall be
186 performed with the latest available version of the benchmarks.

187 **Table 4: Information for Benchmark Testing**

Benchmark	Website
Linpack	http://www.netlib.org/linpack/
SPECviewperf	http://www.spec.org/benchmarks.html#gpc

- 188 A) UUT Preparation:
- 189 1) The UUT shall be setup identical to Step 1) through Step 4) of Section 7.1 A)
- 190 2) If not already installed, install the benchmark as indicated on the websites listed in Table 4.
- 191 3) Configure the benchmark as specified in Section 7.2 B).
- 192 4) Time Measurement: Time measurements may be performed with a standard stopwatch or other
193 time keeping device with a resolution of at least 1 second.
- 194 B) Benchmark Configurations:
- 195 1) Linpack
- 196 a) Configure the Linpack settings identically to the maximum power workstation test (e.g. Follow
197 Step 5) and Step 7) of Section 7.1 A)).
- 198 b) Run as many simultaneous instances of Linpack as needed to fully stress the system.
199 Recommended settings would be to set the number of simultaneous instances of Linpack
200 equal to the number of logical and/or physical CPU cores of the system.

- 201 2) SPECviewperf
- 202 a) Configure the settings identically to the maximum power workstation test (e.g. Follow Step 6)
- 203 of Section 7.1 A)).
- 204 C) Benchmark Testing:
- 205 1) Set the meter to begin accumulating true power values at a rate of greater than or equal to one
- 206 reading per second and begin power and time measurement.
- 207 2) Execute the benchmark.
- 208 3) Stop time measurement and accumulate power values for the entire duration of the benchmark
- 209 run.
- 210 4) The following data shall be reported:
- 211 a) Linpack
- 212 i. Value of “n” (the array size) used for Linpack;
- 213 ii. Number of instances of Linpack simultaneously run on the system;
- 214 iii. All compiler options used in compiling Linpack;
- 215 iv. Energy consumed over the duration of the test; and
- 216 v. Linpack output file in text format which contains system performance in floating point
- 217 operations per second (Flops) in addition to other Linpack parameters (e.g. number of
- 218 tests, problem size, etc.).
- 219 b) SPECviewperf
- 220 i. Version of SPECviewperf used;
- 221 ii. All compiler optimizations used in compiling SPECviewperf;
- 222 iii. Duration of the test;
- 223 iv. Energy consumed over the duration of the test; and
- 224 v. All files and folders present in the Result folder of SPECviewperf suite shall be reported.

225 **8 REFERENCES**

- 226 A) IEC 62301 Edition 2.0 2011-01, Household electrical appliances – Measurement of standby power.
- 227 B) IEC 60107-1 Edition 3.0 1197-04, Methods of measurement on receivers for television broadcast
- 228 transmissions – Part 1: General Considerations – Measurements at radio and video frequencies.
- 229 C) IEC 62623 Edition 1.0 2012-10, Desktop and notebook computers – Measurement of energy
- 230 consumption.

231 **9 APPENDIX: BENCHMARK PARAMETERS**

232 **9.1 Typical Linpack Starting Parameters**

233 Below are some typical starting values for the use of Linpack for testing Workstations. These values are

234 starting points and not meant to be binding. The tester is free to use the settings most advantageous to

235 their UUT. Platform and Operating System (OS) will have a significant impact on the applicability of these

236 starting values. The below assumes Linux as the test OS.

- 237 A) Number of equations (problem size): See Equation.
- 238 B) Leading dimensions of array: See Equation.

239 The matrix size (the combination of number of equations and leading dimensions of array) should be
240 the maximum size that will fit in the Random Access Memory (RAM) on the machine.
241 This AWK script will calculate matrix size on a Linux machine:

```
242 awk '  
243     BEGIN {  
244         printf "Maximum matrix dimension that will fit in RAM on this machine: "  
245     }  
246     /^MemTotal:/ {  
247         print int(sqrt(($2*1000)/8)/1000) "K"  
248     }  
249     '/proc/meminfo
```

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

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

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

255

256

Equation 1: Memory Size Calculation

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

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