ENERGY STAR® Program Requirements for Computers

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for computers. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.

2. Obtain certification of ENERGY STAR qualification from a Certification Body recognized by EPA for computers prior to associating the ENERGY STAR name or mark with any product. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform computer testing.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.

4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale.

5. Provide clear and consistent labeling of ENERGY STAR qualified computers.

    5.1. Partner shall adhere to the following product-specific commitments regarding use of the ENERGY STAR certification mark on qualified products:

        5.1.1. Partner must use the ENERGY STAR mark in one of the following ways:

            1) Via permanent or temporary label on the top or front of the product. All temporary labeling must be affixed to the product with an adhesive or cling-type application; or

            2) Via electronic labeling. Electronic labeling must meet the following requirements:

                a. The ENERGY STAR mark in cyan, black, or white must appear at system start-up, and must display for a minimum of 5 seconds;

                b. The ENERGY STAR mark must be at least 10% of the screen by area, must not be smaller than 76 pixels x 78 pixels, and must be legible.

                EPA will consider alternative proposals for electronic labeling on a case-by-case basis.

        5.1.2. If additional information about the ENERGY STAR program or other products is provided by the Partner on its website, Partner must comply with the ENERGY STAR Web Linking Policy, which can be found at www.energystar.gov/partners;

6. Work with Value Added Resellers (VARs) of Partner's products to help ensure that computer products remain in compliance with ENERGY STAR requirements.

6.1. Any party within the distribution channel of an ENERGY STAR qualified computer that alters the power profile of a product after its date of manufacture through hardware or software modifications must ensure that the product continues to meet the ENERGY STAR requirements before delivering this product to the end customer. If the product no longer meets the requirements, it may not bear the ENERGY STAR mark;

6.2. If a VAR makes any modifications to a computer that was previously qualified as ENERGY STAR, re-brands the product, and promotes it as ENERGY STAR, the VAR must become an ENERGY STAR Partner and follow the requirements outlined in this document.

Verifying Ongoing Product Qualification

7. Participate in third-party verification testing through a Certification Body recognized by EPA for computers.

8. Comply with tests that EPA/DOE may conduct at its discretion on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

9. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:

9.1. Partner must submit the total number of ENERGY STAR qualified computers shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).

9.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.

9.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;

10. Report to EPA any attempts by laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.

11. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Training and Consumer Education

12. Partner shall comply with the following, product-specific requirements concerning training and education:

12.1. Agree to complete steps to educate users of their products about the benefits of power management by including the following information with each ENERGY STAR qualified computer in the user manual or as part of a printed box insert:

12.1.1. Energy and cost savings potential;

12.1.2. Environmental benefits; and

12.1.3. The ENERGY STAR logo, plus information on ENERGY STAR and a link to www.energystar.gov.

12.2. Include a link to www.energystar.gov/powermanagement from product web pages, product specifications, and related content pages.

12.3. At the Partner's request, EPA will supply suggested facts and figures related to the above criteria, template elements, or a complete template suitable for use in user guides or box inserts.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.

- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.

- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.

- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.

- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.

- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.

- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.

- Join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders.

- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.

ENERGY STAR® Program Requirements
Product Specification for Computers

Eligibility Criteria
Draft Version 5.2

1 Following is the Version 5.2 ENERGY STAR Product Specification for Computers. A product shall meet all
2 of the identified criteria if it is to earn the ENERGY STAR.

3 # 1   DEFINITIONS

4 A) <u>Product Types</u>:

5 1) <u>Computer</u>: A device which performs logical operations and processes data. For the purposes of
6 this specification, computers include both stationary and portable units, including desktop
7 computers, integrated desktop computers, notebook computers, small-scale servers, thin clients,
8 and workstations. Although computers are capable of using input devices and displays, such
9 devices are not required to be included with the computer upon shipment. Computers are
10 composed of, at a minimum:

11 a) A central processing unit (CPU) to perform operations;

12 b) User input devices such as a keyboard, mouse, digitizer or game controller; and

13 c) An integrated display screen and/or the ability to support an external display screen to output
14 information.

15 2) <u>Desktop Computer</u>: A computer whose main unit is designed to be located in a permanent
16 location, often on a desk or on the floor. Desktop computers are not designed for portability and
17 are designed for use with an external display, keyboard, and mouse. Desktop computers are
18 intended for a broad range of home and office applications.

19 a) <u>Integrated Desktop Computer</u>: A desktop computer in which the computing hardware and
20 display are integrated into a single housing, and which is connected to ac mains power
21 through a single cable. Integrated desktop computers come in one of two possible forms: (1) a
22 system where the display and computer are physically combined into a single unit; or (2) a
23 system packaged as a single system where the display is separate but is connected to the
24 main chassis by a dc power cord and both the computer and display are powered from a
25 single power supply. As a subset of desktop computers, integrated desktop computers are
26 typically designed to provide similar functionality as desktop systems.

27 3) <u>Notebook Computer</u>: A computer designed specifically for portability and to be operated for
28 extended periods of time both with and without a direct connection to an ac mains power source.
29 Notebook computers include an integrated display and are capable of being powered by an
30 integrated battery or other portable power source. In addition, most notebooks use an external
31 power supply and have an integrated keyboard and pointing device. Notebook computers are
32 typically designed to provide similar functionality to desktops, including operation of software
33 similar in functionality as that used in desktops. For purposes of this specification, tablet
34 computers, which use both a touch-sensitive screen and a physical keyboard, are considered
35 Notebook Computers.

36 **Note:** Slate computing devices are defined loosely as a type of computer lacking a physical keyboard,
37 relying solely on touchscreen input, having solely a wireless network connection (e.g., Wi-Fi, 3G), and
38 primarily powered from an internal battery (with connection to the mains for charging, not primary
39 powering of the device). This group of emerging devices are marketed independently of the notebook
40 computer and Smartphone designations. Two similar computer types are referenced in the ENERGY
41 STAR computer specification: tablet computers are within scope as part of the notebook type, yet
42 "handhelds" are explicitly excluded from the program.

43 For the purposes of this specification, EPA considers Slate computing devices to be under the handheld
44 type and consequently not eligible for the ENERGY STAR computer program at this time. It is important
45 that EPA consider closely the usage modes and power profile of any computer type within the ENERGY
46 STAR computer program to ensure efficiency levels and requirements are appropriate and fair. EPA will
47 proceed with further review of slates with the intent to address such products in the next revision to this
48 specification.

49 4) <u>Small-scale Server</u>: A computer that typically uses desktop components in a desktop form factor,
50 but is designed primarily to be a storage host for other computers. Small-scale Servers are
51 designed to perform functions such as providing network infrastructure services (e.g., archiving)
52 and hosting data/media. These products are not designed to process information for other
53 systems or run web servers as a primary function. A Small-scale Server has the following
54 characteristics:

55 a) Designed in a pedestal, tower, or other form factor similar to those of desktop computers such
56 that all data processing, storage, and network interfacing is contained within one box/product;

57 b) Designed to operate 24 hours/day, 7 days/week, with minimal unscheduled downtime (on the
58 order of hours/year);

59 c) Capable of operating in a simultaneous multi-user environment serving several users through
60 networked client units; and

61 d) Designed for an industry accepted operating system for home or low-end server applications
62 (e.g., Windows Home Server, Mac OS X Server, Linux, UNIX, Solaris).

63 5) <u>Thin Client</u>: An independently-powered computer that relies on a connection to remote computing
64 resources to obtain primary functionality. Main computing functions (e.g., program execution, data
65 storage, interaction with other Internet resources) are provided by the remote computing
66 resources. Thin Clients covered by this specification are (1) limited to devices with no rotational
67 storage media integral to the computer and (2) designed for use in a permanent location (e.g. on a
68 desk) and not for portability.

69 6) <u>Workstation</u>: A high-performance, single-user computer typically used for graphics, CAD, software
70 development, financial and scientific applications among other compute intensive tasks.
71 Workstations covered by this specification (a) are marketed as a workstation; (b) provide mean
72 time between failures (MTBF) of at least 15,000 hours (based on either Bellcore TR-NWT-000332,
73 issue 6, 12/97 or field collected data); and (c) support error-correcting code (ECC) and/or buffered
74 memory. In addition, a workstation meets three or more of the following criteria:

75 a) Provide supplemental power support for high-end graphics (e.g., PCI-E 6-pin 12V
76 supplemental power feed);

77 b) Provide more than 4 PCI-E slots on the motherboard (i.e., greater than x4) in addition to
78 graphics slot(s) and/or PCI-X support;

79 c) Do not provide support for Uniform Memory Access (UMA) graphics;

80		d)	Provide 5 or more PCI, PCI-E, or PCI-X slots;

81   e)   Provide support for 2 or more processors (shall support physically separate processor
82   packages/sockets, i.e., requirement cannot be met with support for a single multi-core
83   processor); and/or

84   f)   Qualification by 2 or more Independent Software Vendor (ISV) product certifications; these
85   certifications can be in process, but shall be completed within 3 months of qualification.

86   B)   <u>Product Category</u>: A second-order classification or sub-type within a product type that is based on
87   product features and installed components. Product categories are used in this specification to
88   determine qualification and test requirements.

89   C)   <u>Computer Components</u>:

90   1)   <u>Display</u>: A display screen and its associated electronics encased in a single housing, or within the
91   computer housing (e.g., notebook or integrated desktop computer), that is capable of displaying
92   output information from a computer via one or more inputs, such as a VGA, DVI, Display Port,
93   and/or IEEE 1394. Examples of computer display technologies are the cathode-ray tube (CRT)
94   and liquid crystal display (LCD).

95   2)   <u>Discrete Graphics Processing Unit (GPU)</u>: A graphics processor with a local memory controller
96   interface and local graphics-specific memory.

97   3)   <u>External Power Supply (EPS)</u>: Also referred to as External Power Adapter. A component
98   contained in a separate physical enclosure external to the computer casing, designed to convert
99   line voltage ac input from the mains to lower dc voltage(s) in order to provide power to the
100   computer. An external power supply shall connect to the computer via a removable or hard-wired
101   male/female electrical connection, cable, cord or other wiring.

102   4)   <u>Internal Power Supply (IPS)</u>: A component internal to the computer casing and designed to
103   convert ac voltage from the mains to dc voltage(s) for the purpose of powering the computer
104   components. For the purposes of this specification, an internal power supply shall be contained
105   within the computer casing but be separate from the main computer board. The power supply
106   shall connect to the mains through a single cable with no intermediate circuitry between the power
107   supply and the mains power. In addition, all power connections from the power supply to the
108   computer components, with the exception of a DC connection to a display in an Integrated
109   Desktop Computer, shall be internal to the computer casing (i.e., no external cables running from
110   the power supply to the computer or individual components). Internal dc-to-dc converters used to
111   convert a single dc voltage from an external power supply into multiple voltages for use by the
112   computer are not considered internal power supplies.

113   D)   <u>Operational Modes</u>:

114   1)   <u>Off Mode</u>: The lowest power mode which cannot be switched off (influenced) by the user and that
115   may persist for an indefinite time when the appliance is connected to the main electricity supply
116   and used in accordance with the manufacturer's instructions. For systems where ACPI standards
117   are applicable, Off Mode correlates to ACPI System Level S5 state.

118   2)   <u>Sleep Mode</u>: A low power mode that the computer enters automatically after a period of inactivity
119   or by manual selection. A computer with Sleep capability can quickly "wake" in response to
120   network connections or user interface devices with a latency of less than or equal to 5 seconds
121   from initiation of wake event to system becoming fully usable including rendering of display. For
122   systems where ACPI standards are applicable, Sleep Mode most commonly correlates to ACPI
123   System Level S3 (suspend to RAM) state.

124   3) Idle State: The power state in which the operating system and other software have completed
125   loading, a user profile has been created, activity is limited to those basic applications that the
126   system starts by default, and the computer is not in Sleep Mode.

127   4) Active State: The power state in which the computer is carrying out useful work in response to a)
128   prior or concurrent user input or b) prior or concurrent instruction over the network. Active State
129   includes active processing, seeking data from storage, memory, or cache, including Idle State
130   time while awaiting further user input and before entering low power modes.

131   E) Networking and Additional Capabilities:

132   1) Additional Internal Storage: Any and all internal hard disk drives (HDD) or solid state drives (SSD)
133   shipping with a computer beyond the first. This definition does not include external drives.

134   2) Network Interface: The components (hardware and software) whose primary function is to make
135   the computer capable of communicating over one or more network technologies. Examples of
136   Network Interfaces are IEEE 802.3 (Ethernet) and IEEE 802.11 (Wi-Fi).

137   3) Wake Event: A user, scheduled, or external event or stimulus that causes the computer to
138   transition from Sleep Mode or Off Mode to an active state of operation. Examples of wake events
139   include, but are not limited to: movement of the mouse, keyboard activity, controller input, real-
140   time clock event, or a button press on the chassis, and in the case of external events, stimulus
141   conveyed via a remote control, network, modem, etc.

142   4) Wake On LAN (WOL): Functionality which allows a computer to transition from Sleep Mode or Off
143   Mode to an Active State of operation when directed by a network Wake Event via Ethernet.

144   5) Full Network Connectivity: The ability of the computer to maintain network presence while in low
145   power modes and intelligently wake when further processing is required (including occasional
146   processing required to maintain network presence). Presence of the computer, its network
147   services and applications, is maintained even though the computer is in a low power mode. From
148   the vantage point of the network, a computer with full network connectivity that is in low power
149   mode is functionally equivalent to an idle computer with respect to common applications and
150   usage models. Full network connectivity in low power mode is not limited to a specific set of
151   protocols but can cover applications installed after initial installation. Also referred to as "network
152   proxy" functionality.

153   g) Network Proxy - Base Capability: To maintain addresses and presence on the network while
154   in low power mode, the system handles IPv4 ARP and IPv6 NS/ND.

155   h) Network Proxy - Remote Wake: While in low power mode, the system is capable of remotely
156   waking upon request from outside the local network. Includes Base Capability.

157   i) Network Proxy - Service Discovery/Name Services: While in low power mode, the system
158   allows for advertising host services and network name. Includes Base.

159   j) Network Proxy - Full Capability: While in low power mode, the system supports Base
160   Capability, Remote Wake, and Service Discovery/Name Services.

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161 **Notes:** The Full Network Connectivity definition has been revised to refer generically to "low power mode"
162 instead of Sleep Mode. Provisions (a) through (d) have been added in reference to final provisions in the
163 Ecma International ECMA-393 standard. These partial implementations of the network proxy are reflected
164 in tables 5 and 6.

165   F)   Marketing and Shipment Channels:

166   1)   Enterprise Channels: Sales channels typically used by large and medium-sized business,
167   government, educational, or other organizations to purchase computers for use in managed
168   client/server environments.

169   2)   Model Number: A unique marketing name or identification reference that applies to a specific
170   hardware and software configuration (e.g., operating system, processor type, memory, GPU), and
171   is either pre-defined or selected by a customer.

172   3)   Model Name: A marketing name that includes reference to the computer model number, product
173   description, or other branding references.

174   Product Family: A group of product models that are (1) made by the same manufacturer, (2)
175   subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design.
176   Product models within a family differ from each other according to one or more characteristics or
177   features that either (1) have no impact on product performance with regard to ENERGY STAR
178   qualification criteria, or (2) are specified herein as acceptable variations within a product family.
179   For all Computer product types with the exception of Workstations, acceptable variations within a
180   product family include:

181   (1) Color,

182   (2) Number and type of processor,

183   (3) Memory configuration,

184   (4) Number and type of GPU,

185   (5) Number and type of hard-disk drives,

186   (6) Number and type of removable-media drives,

187   (7) Number and type of network or other data (including display) interfaces,

188   (8) Number and type of user input interfaces.

189   For Workstations, acceptable variations within a product family include:

190   (1) Number of GPUs

191   **Note:** The definition for Product Family has been updated to align with standard language across the
192   program. EPA intends for the previous Version 5.0 product family implementation to remain unchanged in
193   this revision.

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of a Computer <u>and</u> one of the following Product Type definitions, as specified herein, are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2:

    i.   Desktop Computers,

    ii.   Integrated Desktop Computers,

    iii. Notebook Computers,

    iv. Workstations,

    v.   Small-scale Servers that are marketed and sold for non-data center use,

    vi. Thin Clients.

2.2 Excluded Products

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

2.2.2 The following products are not eligible for qualification under this specification:

    i.   Computer Servers, as defined in ENERGY STAR Computer Server specification,

    ii.   Small-scale Servers that are marketed and sold for use in data centers,

    iii. Handheld Computers,

    iv. Game Consoles,

    v.   Personal Digital Assistant devices (PDAs),

    vi. Smart Phones,

    vii. Handheld gaming devices, typically battery powered and intended for use with an integral display as the primary display.

> **Note:** Game Consoles will be further addressed under a separate ENERGY STAR product specification, with development of specialized requirements building on past drafts distributed through the ENERGY STAR Computer program in late 2009 to early 2010. Drafts and comments related to Game Consoles may be found at www.energystar.gov/productdevelopment.

3   QUALIFICATION CRITERIA

3.1   Significant Digits and Rounding

3.1.1   All calculations shall be carried out with actual measured or observed values. Only the final result of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.1.2   Unless otherwise specified, compliance with specification limits shall be evaluated using exact values without any benefit from further rounding.

3.2   Power Supply Requirements

3.2.1   <u>Internal Power Supplies (IPS)</u>:

    i.   IPS with maximum rated output current less than 75 watts shall meet minimum efficiency requirements as specified in Table 1.

    ii.   IPS with maximum rated output current greater than or equal to 75 watts shall meet <u>both</u> minimum efficiency requirements and minimum power factor requirements, as specified in Table 1.

> **Note:** The highlighted text incorporates an ENERGY STAR program clarification that was distributed by EPA on June 19, 2009. Please refer to the ENERGY STAR website for further information:
> http://www.energystar.gov/ia/partners/downloads/V5_0_Computer_Clarification.pdf

3.2.2   <u>External Power Supplies (EPS)</u>:

    i.   EPS with integral cooling fans shall meet minimum efficiency requirements and minimum power factor requirements, as specified in Table 1.

    ii.   EPS without integral cooling fans shall meet the level V performance requirements under the International Efficiency Marking Protocol and include the level V marking. Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies.

Table 1: Requirements for Internal Power Supplies and External Power Supplies with Integral Cooling

Loading Condition (Percentage of Nameplate Output Current)	Minimum Efficiency	Minimum Power Factor
20%	0.82	-
50%	0.85	-
100%	0.82	0.90

3.3   Power Management Requirements

3.3.1   Products shall include power management features in their "as-shipped" condition as specified in Table 2, subject to the following conditions:

250   i.   For Thin Clients, the WOL requirement shall apply products designed to receive software
251   updates from a centrally managed network while in Sleep Mode or in Off Mode. Thin Clients
252   whose standard software upgrade framework does not require off-hours scheduling are
253   exempt from the WOL requirement.

254   ii.   For Notebooks, WOL may be automatically disabled when the product is disconnected from
255   ac mains power.

256   iii.   For all products with WOL, directed packet filters shall be enabled and set to an industry
257   standard default configuration.

258   **Table 2: Power Management Requirements**

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Notebooks	Workstations	Small-scale Servers	Thin Clients
Sleep Mode	(1) Sleep Mode shall be set to activate after no more than 30 minutes of user inactivity. (2) The speed of any active 1 Gb/s Ethernet network links shall be reduced when transitioning to Sleep Mode or Off Mode.	Yes	Yes	Yes	Yes	No	No
Display Sleep Mode	(1) Display Sleep Mode shall be set to activate after no more than 15 minutes of user inactivity.	Yes	Yes	Yes	Yes	Yes	Yes

Wake on LAN (WOL)	(1) Computers with Ethernet capability shall provide users with an option to enable and disable WOL for Sleep Mode.
	(2) Computers with Ethernet capability that are shipped through enterprise channels shall either:
	  (a) be shipped with WOL enabled by default for Sleep Mode, when the computer is operating on ac mains power; or
	  (b) provide users with the ability to enable WOL that is accessible from both the client operating system user interface and over the network.
		Yes	Yes	Yes	Yes	Yes	Yes

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Notebooks	Workstations	Small-scale Servers	Thin Clients
Wake Management	(1) Computers with Ethernet capability that are shipped through enterprise channels shall: (a) be capable of both remote (via network) and scheduled (via real-time clock) wake events from Sleep Mode, and (b) provide clients with the ability to centrally manage (via vendor tools) any wake management settings that are configured through hardware settings if the manufacturer has control over such features.	Yes	Yes	Yes	Yes	Yes	Yes

259 **3.4   User Information Requirements**

260 3.4.1   Products shall be shipped with informational materials to notify customers of the following:

261   i.   A description of power management settings that have been enabled by default,

262   ii.   A description of the timing settings for various power management features, and

263   iii.   Instructions for properly waking the product from Sleep Mode.

264 3.4.2   Products shall be shipped with one or more of the following:

265   i.   A list of default power management settings.

266   ii.   A note stating that default power management settings have been selected for compliance
267   with ENERGY STAR (within 15 min of user inactivity for the display, within 30 min for the
268   computer, if applicable per Table 2), and are recommended by the ENERGY STAR program
269   for optimal energy savings.

270   iii.   Information about ENERGY STAR and the benefits of power management, to be located at or
271   near the beginning of the hard copy or electronic user manual, or in a package or box insert.

272 **3.5   Requirements for Desktop, Integrated Desktop, and Notebook Computers**

273 3.5.1   TEC Categories: Desktops, Integrated Desktops shall be evaluated in the categories described in
274   Table 3, and Notebook Computers shall be evaluated in the categories described in Table 4.

275   i.   Products or product configurations shall be evaluated using the highest letter category to
276   which they apply.

277   ii.   Products available in configurations fitting multiple categories within the appropriate table shall
278   be evaluated under all appropriate categories and as specified in section **Error! Reference**
279   **source not found.**.

280   **Table 3: Categorization of Desktop and Integrated Desktop Computers**

Product Category	Number of Physical CPU Cores	System Memory (GB)	Discrete GPU	GPU Frame Buffer Width (bits)
A	< 2	Any	Yes or No	N/A or any
A	Any	< 2.0	Yes or No	N/A or any
B	2	≥ 2.0	Yes or No	N/A or any
C	> 2	≥ 2.0	Yes or No	N/A or any
C	> 2	Any	Yes	Any
D	≥ 4	≥ 4.0	Yes or No	N/A or any
D	≥ 4	Any	Yes	> 128

281   **Table 4: Categorization of Notebook Computers**

Product Category	Number of Physical CPU Cores	System Memory (GB)	Discrete GPU	GPU Frame Buffer Width (bits)
A	Any	Any	Any	Any
B	Any	Any	Yes	Any
C	≥ 2	≥ 2.0	Yes	> 128

282

283 3.5.2   Calculated Typical Energy Consumption (E_{TEC}) per Equation 1 shall be less than or equal to the
284   maximum TEC requirement (E_{TEC_MAX}), as calculated per Equation 2, subject to the following
285   requirements:

286   i.   The Additional Internal Storage adder ($TEC_{STORAGE}$) shall be applied if there are one or more
287   internal storage devices present in the product, in which case it shall only be applied once.

288   ii.   For a product to qualify for the Full Network Connectivity weightings, the following criteria shall
289   be satisfied:

290   •   Products shall meet a non-proprietary Full Network Connectivity standard that has been
291   approved by the EPA and the European Union as meeting the goals of ENERGY
292   STAR. Such approval must be in place prior to submittal of product data for
293   qualification.

| 294 | • | Products shall have the applied level of functionality enabled and configured by default upon shipment. If Full Network Connectivity features are not enabled by default, the system shall be tested and reported with Conventional TEC weightings. |

<p style="text-align:center">Equation 1: TEC Calculation (E_{TEC}) for Desktop, Integrated Desktop, and Notebook Computers</p>

$$E_{TEC} = (8760 / 1000) * \{(P_{OFF} * T_{OFF}) + (P_{SLEEP} * T_{SLEEP}) + (P_{IDLE} * T_{IDLE})\}$$

Where:
- P_{OFF} = *Measured power consumption in Off Mode (W)*
- P_{SLEEP} = *Measured power consumption in Sleep Mode (W)*
- P_{IDLE} = *Measured power consumption in Idle Mode (W)*
- T_{OFF}, T_{SLEEP}, *and* T_{IDLE} *are mode weightings as specified in Table 5 (for Desktops and Integrated Desktops) or Table 6 (for Notebooks).*

<p style="text-align:center">Equation 2: E_{TEC_MAX} Calculation for Desktop, Integrated Desktop,</p>

$$E_{TEC\_MAX} = TEC_{BASE} + TEC_{MEMORY} + TEC_{GRAPHICS} + TEC_{STORAGE}$$

Where:
- TEC_{BASE} , TEC_{MEMORY} , $TEC_{GRAPHICS}$, *and* $TEC_{STORAGE}$ *are adders as specified in Table 7 (for Desktops and Integrated Desktops) or Table 8 (for Notebooks).*

Table 5: Mode Weightings for Desktop and Integrated Desktop Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Base Capability	**Remote Wake**	**Service Discovery/Name Services**	**Full Proxying**
T_{off}	55%	**50%**	**47%**	**43%**	40%
T_{sleep}	5%	**14%**	**20%**	**25%**	30%
T_{idle}	40%	**36%**	**33%**	**32%**	30%

Table 6: Mode Weightings for Notebook Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Base Capability	**Remote Wake**	**Service Discovery / Name Services**	**Full Proxying**
T_{off}	60%	**54%**	**49%**	**48%**	45%
T_{sleep}	10%	**18%**	**24%**	**26%**	30%
T_{idle}	30%	**28%**	**27%**	**26%**	25%

**Table 7: Maximum TEC Allowances
for Desktop and Integrated Desktop Computers**

Product Category	TEC$_{BASE}$ (kWh)	TEC$_{MEMORY}$ (kWh) *Where: m = System Memory (GB)*	TEC$_{GRAPHICS}$ (kWh)	TEC$_{STORAGE}$ (kWh) *(Applies once if system has more than one Additional Internal Storage element.)*
A	148.0	1.0 (*per GB > 2.0*)	35.0 (*GPU Frame Buffer Width ≤ 128-bit*) / 50.0 (*GPU Frame Buffer Width > 128-bit*)	25.0
B	175.0	1.0 (*per GB > 2.0*)	35.0 (*GPU Frame Buffer Width ≤ 128-bit*) / 50.0 (*GPU Frame Buffer Width > 128-bit*)	25.0
C	209.0	1.0 (*per GB > 2.0*)	50.0 (*GPU Frame Buffer Width > 128-bit*)	25.0
D	234.0	1.0 (*per GB > 4.0*)	50.0 (*GPU Frame Buffer Width > 128-bit*)	25.0

Table 8: Maximum TEC Allowances for Notebook Computers

Product Category	TEC$_{BASE}$ (kWh)	TEC$_{MEMORY}$ (kWh) *Where: m = System Memory (GB)*	TEC$_{GRAPHICS}$ (kWh)	TEC$_{STORAGE}$ (kWh) *(Applies once if system has more than one Additional Internal Storage element.)*
A	40.0	0.4 (*per GB > 4.0*)	-	3.0
B	53.0	0.4 (*per GB > 4.0*)	3.0 (*GPU Frame Buffer Width > 64-bit*)	3.0
C	88.5	0.4 (*per GB > 4.0*)	-	3.0

3.6 Requirements for Workstations

3.6.1 Weighted power consumption (P_{TEC}) as calculated per Equation 3 shall be less than or equal to the maximum weighted power consumption requirement (P_{TEC_MAX}) as calculated per Equation 4.

<p style="text-align:center;"><strong style="color:red;">Equation 3: P_{TEC} Calculation for Workstations</p>

322

323
$$P_{TEC} = (P_{OFF} * T_{OFF}) + (P_{SLEEP} * T_{SLEEP}) + (P_{IDLE} * T_{IDLE})$$

324 *Where:*
325 ▪ *P_{OFF} = Measured power consumption in Off Mode (W)*
326 ▪ *P_{SLEEP} = Measured power consumption in Sleep Mode (W)*
327 ▪ *P_{IDLE} = Measured power consumption in Idle Mode (W)*
328 ▪ *T_{OFF}, T_{SLEEP}, and T_{IDLE} are mode weightings as specified in Table*
329 *9*

330

<p style="text-align:center;"><strong style="color:red;">Table 9: Mode Weightings for Workstations</p>

T_{OFF}	T_{SLEEP}	T_{IDLE}
0.35	0.10	0.55

331

332

<p style="text-align:center;">Equation 4: P_{TEC_MAX} Calculation for Workstations</p>

333
$$P_{TEC\_MAX} \le 0.28 * \{P_{MAX} + (N_{HDD} * 5)\}$$

334 *Where:*
335 ▪ *P_{MAX} = Measured maximum power consumption (W)*
336 ▪ *N_{HDD} = Number of installed hard disk drives (HDD) or solid state*
337 *drives (SSD)*

338 3.6.2 <u>Desktop Workstations</u>: Products marketed as workstations may qualify for ENERGY STAR under
339 the Desktop requirements in Section 3.5, instead of the Workstation requirements in Section 3.6.1,
340 at the Partner's option. EPA will identify Workstations qualified as Desktops as "Desktops" in all
341 ENERGY STAR marketing materials, on qualified product lists, etc.

342 **Note:** Requirement 3.6.2 has been added to clarify the administrative process for Workstations that qualify
343 under the TEC requirements for Desktops. The policy defined in this section and in Section 4.2.1 was
344 established after finalization of the Version 5.0 specification.

345 ## 3.7 Requirements for Small-scale Servers

346 3.7.1 Measured Off Mode power (P_{OFF}) shall be less than or equal to the maximum Off Mode power
347 consumption requirement (P_{OFF_MAX}) listed in Table 10, as calculated per Equation 5, subject to
348 the following requirements:

349 i. Products shall be evaluated using the highest letter category to which they apply.

350 ii. The Off Mode Wake-On-LAN (WOL) adder (P_{OFF_WOL}) shall only be applied to products that
351 offer WOL that is enabled by default upon shipment.

352

<p style="text-align:center;"><strong style="color:red;">Equation 5: Calculation of P_{OFF_MAX} for Small-scale Servers</p>

353
$$P_{OFF\_MAX} = P_{OFF\_BASE} + P_{OFF\_WOL}$$

354 3.7.2 Measured Idle State power (P_{IDLE}) shall be less than or equal to the maximum Idle State power
355   consumption requirement (P_{IDLE_MAX}) specified in Table 10.

356 **Table 10: Classification & Power Consumption Requirements**
357 **for Small-scale Servers**

Small-scale Server Classification			Operational Mode Requirements		
Product Category	Number of Physical Cores or Discrete Processors	System Memory (GB)	P_{OFF_BASE} (watts)	P_{OFF_WOL} (watts)	P_{IDLE_MAX} (watts)
A	any	any	2.0	0.7	50.0
B	> 1	> 1.0	2.0	0.7	65.0

3.8 Requirements for Thin Clients

359 3.8.1 Measured Off Mode power (P_{OFF}) shall be less than or equal to the maximum Off Mode power
360   consumption requirement (P_{OFF_MAX}) in Table 11, as calculated per Equation 6, subject to the
361   following requirements.

362   i. Products shall be evaluated using the highest letter category to which they apply.

363   ii. The Off Mode Wake-On-LAN (WOL) adder (P_{OFF_WOL}) shall only be applied to products that
364   offer WOL that is enabled by default upon shipment.

365 **Equation 6: Calculation of P_{OFF_MAX} for Thin Clients**

366
$$P_{OFF\_MAX} = P_{OFF\_BASE} + P_{OFF\_WOL}$$

367 3.8.2 For products that offer a Sleep Mode, measured Sleep Mode power (P_{SLEEP}) shall be less than or
368   equal to the maximum Sleep Mode power consumption requirement (P_{SLEEP_MAX}) in Table 11, as
369   calculated per Equation 7, subject to the following requirement.

370   i. The Sleep Mode Wake-On-LAN (WOL) adder (P_{SLEEP_WOL}) shall only be applied to products
371   that offer WOL that is enabled by default upon shipment.

372 **Equation 7: Calculation of P_{SLEEP_MAX} for Thin Clients**

373
$$P_{SLEEP\_MAX} = P_{SLEEP\_BASE} + P_{SLEEP\_WOL}$$

374 3.8.3 Measured Idle State power (P_{IDLE}) shall be less than or equal to the maximum Idle State power
375   consumption requirement (P_{IDLE_MAX}) specified in Table 11.

**Table 11: Classification & Power Consumption Requirements
for Thin Clients**

Thin Client Classification		Operational Mode Requirements				
Product Category	Support for Local Multimedia Encode and Decode	P_{OFF_BASE} (watts)	P_{OFF_WOL} (watts)	P_{SLEEP_BASE} (watts)	P_{SLEEP_WOL} (watts)	P_{IDLE_MAX} (watts)
A	-	2.0	0.7	2.0	0.7	12.0
B	Yes	2.0	0.7	2.0	0.7	15.0

4 TESTING

4.1 Test Methods

4.1.1   When testing Computer products, the test methods identified in Table 12 shall be used to determine ENERGY STAR qualification.

Table 12: Test Methods for ENERGY STAR Qualification

Product Type or Component	Test Method
All	ENERGY STAR Test Method for Computers, Rev. Aug-2010
Internal Power Supply	EPRI Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.4.2 (available at www.efficientpowersupplies.org)
Multi-output External Power Supply	
Single-output External Power Supply with Integral Cooling	

4.2 Number of Units Required for Testing

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

i.   For qualification of an individual product configuration, the unique configuration that is intended to be marketed and labeled as ENERGY STAR is considered the Representative Model.

ii.   For qualification of a product family of all product types, with the exception of Workstations, product configurations that represent the worst-case power consumption for each product category within the family are considered Representative Models.

iii.   For qualification of a product family of Workstations under the Workstation or Desktop product type, each unique configuration with a single GPU that is intended to be marketed and labeled as ENERGY STAR is considered the Representative Model.

394 4.2.2 A single unit of each Representative Model shall be selected for testing. If test results for any
395 operational mode power measurement are within 10% of ENERGY STAR requirements, two
396 additional units of the same Representative Model with an identical configuration shall be tested.

397 4.2.3 All tested units shall meet ENERGY STAR qualification requirements.

398 **4.3 International Market Qualification**

399 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for
400 each market in which they will be sold and promoted as ENERGY STAR.

401 **4.4 Customer Software and Management Service Pre-Provisioning**

402 4.4.1 If a manufacturing Partner is hired by a customer to load a custom image to an ENERGY STAR
403 qualified computer, the Partner shall take the following steps:

404 i. Inform the customer that their product may not meet ENERGY STAR with the custom image.
405 A sample notification letter is available on the ENERGY STAR Web site.

406 ii. Encourage the customer to test the product for ENERGY STAR compliance.

407 iii. Encourage the customer, should the product no longer meet ENERGY STAR, to make use of
408 EPA's free technical assistance that can assist with Power Management performance, which
409 can be found at www.energystar.gov/fedofficeenergy.

410 # 5 USER INTERFACE

411 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard
412 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices
413 Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

414 # 6 EFFECTIVE DATE

415 6.1.1 <u>Effective Date</u>: The Version 5.2 ENERGY STAR Computers specification shall take effect on the
416 dates specified in Table 13. To qualify for ENERGY STAR, a product model shall meet the
417 ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is
418 specific to each unit and is the date (e.g., month and year) on which a unit is considered to be
419 completely assembled.

420 6.1.2 <u>Future Specification Revisions</u>: EPA reserves the right to change this specification should
421 technological and/or market changes affect its usefulness to consumers, industry, or the
422 environment. In keeping with current policy, revisions to the specification are arrived at through
423 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
424 STAR qualification is not automatically granted for the life of a product model.

425 **Table 13: Specification Effective Dates**

Effective Date
July 1, 2009

APPENDIX A:
Sample Calculations

I. **Desktop, Integrated Desktop, Notebook Computers:** Below is a sample TEC calculation intended to show how levels for compliance are determined based on functional adders and operational mode measurements.

Following is a sample E_{TEC} evaluation for a Category A Notebook Computer with integrated GPU, 8 GB Memory, and 1 HDD.

A) Measure values using the ENERGY STAR Computers Test Method:

    4) Off Mode = 1.0 W

    5) Sleep Mode = 1.7 W

    6) Idle State = 10.0 W

B) Calculate E_{TEC} from power measurements and weightings:

Toff	0.60
Tsleep	0.10
Tidle	0.30

    1) E_{TEC} = (8760/1000) * (Poff * Toff + Psleep * Tsleep + Pidle * Tidle)

    2) E_{TEC} = (8760/1000) * (1.0 * 0.60 + 1.7 * 0.10 + 10.0 * 0.30)

    3) E_{TEC} = 33.03 kWh / year

C) Determine which Capability Adjustments apply:

    1) Discrete Graphics? *No, therefore does not apply for Premium Graphics adder.*

    2) Memory: *8 GB installed, meets memory threshold, calculate ((8 – 4) * 0.4 kWh) = 1.6 kWh*

D) Calculate E_{TEC_MAX} by adding any capability adjustments to the Base TEC requirement:

Category A	40.0
Category B	53.0
Category C	88.5

    1) E_{TEC_MAX} = 40.0 kWh / year + 1.6 kWh / year

    2) E_{TEC_MAX} = 41.6 kWh / year

E) Compare E_{TEC} to the E_{TEC_MAX} to determine if the model qualifies:

    1) 33.03 kWh / year < 41.6 kWh / year

F) Therefore, the notebook meets ENERGY STAR requirements.

454 II. **Workstations:** Below is a sample P_{TEC} calculation for a Workstation with 2 hard drives.

455   A) Measure values using the ENERGY STAR Computers Test Method:

456   1) Off Mode = 2 W

457   2) Sleep Mode = 4W

458   3) Idle State = 80W

459   4) Max Power = 180W

460   B) Note number of Hard Drives installed:

461   5) Two hard drives installed during test.

462   C) Calculate P_{TEC} from power measurements and weightings using Equation 3:

Toff	0.35
Tsleep	0.10
Tidle	0.55

463   6) $P_{TEC} = (.35 * P_{off} + .10 * P_{sleep} + .55 * P_{idle})$

464   7) $P_{TEC} = (.35 * 2 + .10 * 4 + .55 * 80)$

465   8) P_{TEC} = **45.10 W**

466   D) Calculate the P_{MAX} requirement using Equation 4:

467   9) $P_{MAX} = 0.28*[Pmax + (\# HDD * 5)]$

468   10) $P_{MAX} = 0.28*[180 + 2 * 5)]$

469   11) $P_{MAX} = 53.2$

470   E) Compare P_{TEC} to the ENERGY STAR levels to determine if the model qualifies:

471   12) 45.10 < 53.2

472   **G) Therefore, the Workstation meets ENERGY STAR requirements.**

ENERGY STAR® Program Requirements
Product Specification for Computers

Test Method

1 # 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.

4 # 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 Workstations.

9 # 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.

12 # 4   TEST SETUP

13 A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this procedure shall
14   be in accordance with the requirements of IEC 62301, Ed. 1.0, "Measurement of Household Appliance
15   Standby Power", Section 4, "General Conditions for Measurements", unless otherwise noted in this
16   document. In the event of conflicting requirements, the ENERGY STAR test method shall take
17   precedence.

18 B) 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.

20
21

**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 Vac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
China	220 Vac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 1.0 %	2.0 %	50 Hz and 60 Hz	+/- 1.0 %

22
23

**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 Vac	+/- 4.0 %	5.0 %	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 Vac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
China	220 Vac	+/- 4.0 %	5.0 %	50 Hz	+/- 1.0 %
Japan	100 Vac	+/- 4.0 %	5.0 %	50 Hz and 60 Hz	+/- 1.0 %

24

25   C) <u>Ambient Temperature</u>: Ambient temperature shall be from 18° C to 28° C.

26   D) <u>Relative Humidity</u>: Relative humidity shall be from 10% to 80%.

27   E) <u>Power Meter</u>: Power meters shall possess the following attributes:

28   1) <u>Crest Factor</u>: Capability to measure the current waveform without clipping.

29   i)   The peak of the current waveform measured during Sleep Mode and On Mode shall
30   determine the crest factor rating requirement and the appropriate current range setting.

31   ii) The full-scale value of the selected current range multiplied by the crest factor for that range
32   shall be at least 15% greater than the peak current.

33   2) <u>Bandwidth</u>: Minimum bandwidth as determined by an analysis of current and voltage to determine
34   the highest frequency component (harmonic) with a magnitude greater than 1% of the
35   fundamental frequency under the test conditions.

36   3) <u>Minimum Frequency Response</u>: 3.0 kHz

37   4) <u>Minimum Sampling Frequency</u>: 60 Hz

38   5) <u>Minimum Resolution</u>:

39   i)   0.01 W for measurement values less than 10 W;

40   ii) 0.1 W for measurement values from 10 W to 100 W; and

41   iii) 1.0 W for measurement values greater than 100 W.

42 F) <u>Measurement Accuracy</u>:

43   1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
44   uncertainty of less than or equal to 2% at the 95% confidence level.

45   2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than
46   or equal to 0.01 W at the 95% confidence level.

47 # 5 TEST CONDUCT

48 A) <u>As-shipped Condition</u>: Computers shall be tested with configuration and settings in their default "as–
49   shipped" condition, unless otherwise specified in this document. Note that test procedure steps that
50   require alternative configurations are marked with an asterisk ("*").

51 B) <u>Test Procedure Order</u>: Section 6 and/or 7 shall be followed in the order it is written.

52 C) <u>Measurement Location:</u> Power consumption of a computer shall be measured and tested at the ac
53   input to the unit under test (UUT).

54 D) <u>Networking</u>:

55   i)   Desktops, Integrated Desktops, Notebooks, Thin Clients, and Small-Scale Servers with
56   Ethernet (IEEE 802.3) capability shall be connected to a live Ethernet network switch and any
57   wireless radios shall be turned off. The computer shall maintain this live connection to the
58   switch for the duration of testing, disregarding brief lapses when transitioning between link
59   speeds.

60   ii) Thin Clients shall run intended terminal/remote connection software during all tests.

61   iii) Desktops, Integrated Desktops, and Notebook Computers without Ethernet capability shall
62   maintain a live wireless connection to a wireless router or network access point, which
63   supports the highest and lowest data speeds of the client radio, for the duration of testing.

64   iv) The network connection shall be live during all tests.

65

66 E) <u>State of Units for Test (Power Management Capabilities)</u>: The following requirements shall be followed
67   when determining whether models should be qualified with or without WOL:

68   1) Off Mode: Computers shall be tested in their "as-shipped" condition for Off Mode. Models that will
69   be shipped with WOL enabled for Off Mode shall be tested with WOL enabled.

70   2) Sleep Mode: Computers shall be tested their "as-shipped" condition for Sleep Mode.

71   i)   Models sold through enterprise channels shall be tested, qualified, and shipped with WOL
72   enabled/disabled as specified in Table 2 in the ENERGY STAR Eligibility Criteria for
73   Computers.

74   ii)   Products going directly to consumers through normal retail channels only are not required to
75   be shipped with WOL enabled from Sleep, and may be tested, qualified, and shipped with
76   WOL either enabled or disabled.

77   3) Full Network Connectivity ("Proxying"): Desktop, Integrated Desktop, and Notebook Computers
78   shall be tested for Idle, Sleep, and Off with proxying features enabled or disabled as shipped.

6   TEST PROCEDURES FOR ALL PRODUCTS

6.1   UUT Preparation

81   4) Connect the power meter directly between the ac input voltage source and the UUT.

82   5) Record the ac voltage and frequency.

83   6) Boot the computer and wait until the operating system has fully loaded. If necessary, run the initial
84   operating system setup and allow all preliminary file indexing and other one-time/periodic
85   processes to complete.

86   7) Record basic information about the computer's configuration – computer type, operating system
87   name and version, processor type and speed, and total and available physical memory, etc.

88   8) Record basic information about the video card or graphics chipset (if applicable) - video
89   card/chipset name, frame buffer width, resolution, amount of onboard memory, and bits per pixel.

90   9) * Ensure that the UUT is configured as shipped including all accessories, WOL enabling, and
91   software shipped by default, except as specified below.

92   i)   Desktop computers shipped without accessories shall be configured with a standard mouse,
93   keyboard and external computer display.

94   ii)   Integrated Desktop computers shipped without accessories shall be configured with a
95   standard mouse and keyboard.

96   iii) Notebook computers without an integrated pointing device or digitizer shall be configured with
97   a mouse.

98   iv) Notebook computers shall not be configured with a docking station.

99   v)   If possible, the notebook computer battery pack(s) shall be removed for all tests. If removal is
100   impossible, the battery shall be fully charged prior to the beginning the test and left in place for
101   the duration of the test, and its presence reported.

102   vi) Small-Scale Servers and Thin Clients shipped without accessories shall be configured with a
103   standard mouse, keyboard and external computer display (if server has display output
104   functionality).

105 vii) Primary hard drives shall not be power managed ("spun-down") during Idle testing unless
106   containing non-volatile cache integral to the drive (e.g. "hybrid" hard drives or similar non-
107   removable disk caching architectures). Any secondary internal hard drive(s) may be tested
108   with hard drive power management enabled as shipped. If these additional drives are not
109   power managed when shipped to customers, they shall be tested without such features
110   implemented.

111 10) * The following guidelines shall be followed to configure power settings for computer displays
112   (adjusting no other power management settings):

113   i) For computers with external computer displays: use the computer display power management
114   settings to prevent the display from powering down to ensure it stays on for the full length of
115   the Idle test as described below.

116   ii) For computers with integrated computer displays: use the power management settings to set
117   the display to power down after 1 minute.

118 11) Shut down the UUT.

6.2   Off Mode Testing

120 1) With the UUT in Off Mode, set the meter to begin accumulating true power values at a frequency
121   greater than or equal to 1 reading per second.

122 2) Accumulate power values for 5 minutes and record the average (arithmetic mean) value observed
123   during that 5 minute period.[1]

6.3   Idle Mode Testing

125 1) Switch on the computer and begin recording elapsed time, starting either when the computer is
126   initially switched on, or immediately after completing any log in activity necessary to fully boot the
127   system.

128 2) Once logged in with the operating system fully loaded and ready, close any open windows so that
129   the standard operational desktop screen or equivalent ready screen is displayed.

130 3) Between 5 and 15 minutes after the initial boot or log in, set the meter to begin accumulating true
131   power values at a frequency greater than or equal to 1 reading per second.

132 4) Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value
133   observed during that 5 minute period.

6.4   Sleep Mode Testing

135 1) Place the computer in Sleep mode.

136 2) Reset the meter (if necessary) and begin accumulating true power values at a frequency greater
137   than or equal to 1 reading per second.

---

[1] Laboratory-grade, full-function meters can integrate values over time and report the average value automatically. Other meters would require the user to capture a series of changing values every 5 seconds for a five minute period and then compute the average manually.

138   3) Accumulate power values for 5 minutes and record the average (arithmetic mean) value observed
139   during that 5 minute period.

140   4) If testing both WOL enabled and WOL disabled for Sleep, wake the computer and change the
141   WOL from Sleep setting through the operating system settings or by other means. Repeat the
142   Sleep mode test with the alternate configuration.

143 7   MAXIMUM POWER TEST FOR WORKSTATIONS

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

149   Additional information on these benchmarks, including free downloads, can be found at the URLs
150   found below:

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

151 7.1   UUT Preparation

152   1) Connect an approved meter capable of measuring true power to an ac line voltage source set to
153   the appropriate voltage/frequency combination for the test. The meter should be able to store and
154   output the maximum power measurement reached during the test or be capable of another
155   method of determining maximum power.

156   2) Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
157   should be connected between the meter and the UUT.

158   3) Record the ac voltage.

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

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

163   6) Ensure all guidelines set by the SPEC organization for running SPECviewperf have been met.

164 7.2   Maximum Power Testing

165   1) Set the meter to begin accumulating true power values at an interval of less than or equal to 1
166   reading per second, and begin taking measurements.

167   2) Run SPECviewperf and as many simultaneous instances of Linpack as needed to fully stress the
168   system.

169   3) Accumulate power values until SPECviewperf and all instances have completed running. Record
170   the maximum power value attained during the test.

171   4) The following data shall also be recorded:

172   i)   Value of the n (the array size) used for Linpack,

173   ii)   Number of simultaneous copies of Linpack run during the test,

174   iii) Version of SPECviewperf run for test,

175   iv) All compiler optimizations used in compiling Linpack and SPECviewperf, and

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