ENERGY STAR® Program Requirements
Product Specification for Displays

Eligibility Criteria
Draft 2 Version 6.0

Following is the Version 6.0 ENERGY STAR Product Specification for Displays. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Product Types:

1) Electronic Display (Display): A commercially-available product with a display screen and associated electronics, often encased in a single housing, that as its primary function displays visual information from (1) a computer, workstation or server via one or more inputs (e.g., VGA, DVI, HDMI, Display Port, IEEE 1394), (2) external storage (e.g., USB flash drive, memory card), or (3) a network connection.

a) Computer Monitor: A device that displays a computer's user interface and open programs, allowing the user to interact with the computer, typically using a keyboard and mouse.

b) Digital Picture Frame: An electronic device whose primary function is to display digital images. It may also feature a programmable timer, occupancy sensor, audio, video, or bluetooth or wireless connectivity, for example.

c) Signage Display: An electronic device with a display screen that is typically marketed as signage for use in retail and department stores, restaurants, museums, hotels, outdoor venues, airports, conference rooms and education markets.

Note: EPA welcomes stakeholder feedback on a definition of signage displays based on the technical characteristics, such as pixel size (e.g., number of pixels per square inch), of these products instead of how they are marketed, as is currently included.

B) External Power Supply (EPS): Also referred to as External Power Adapter. A component contained in a separate physical enclosure external to a display, designed to convert line voltage ac input from the mains to lesser dc voltage(s) in order to provide power to the display. An EPS connects to the display via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

C) Operational Modes:

1) On Mode: The power mode in which the product is connected to a mains power source, has been activated, and is providing one or more of its principal functions. The common terms, “active,” “in-use,” and “normal operation” also describe this mode. The power in this mode is typically greater than the power in Sleep Mode and Off Mode.

2) Sleep Mode: The power mode that the product enters automatically after indication from a data or network connection, or as determined by the product itself, while it is connected to a mains power source, is not producing sound or picture, and is not transmitting or receiving program information and/or data. The product can switch to On Mode from this mode in response to data or network connections, sensors, or user interface devices. While in Sleep Mode, the product offers one or more of the following user-oriented or protective functions, which may persist for an indefinite time:

a) facilitating the activation or deactivation of other modes (including On Mode) via an occupancy sensor, remote control, or internal timer;

b) continuous function: information or status displays including clocks; or,

c) continuous function: sensor-based functions.

3) Off Mode: The power mode in which the product is connected to a mains power source, is not providing any On Mode or Sleep Mode functions, and where the mode may persist for an indefinite time. The product may only exit Off Mode by cause of direct user actuation of a manual power switch.

Note: In an effort to standardize definitions among similar products, the definitions for On Mode, Sleep Mode and Off Mode for display products have been adopted from the ENERGY STAR Television specification and revised for clarity. EPA welcomes stakeholder feedback on the revised definition. It is EPA's understanding that use of these definitions does not impact the applicability of the data being reviewed in this specification development process or affect qualification.

D) Luminance: The photometric measure of the luminous intensity per unit area of light travelling in a given direction, expressed in units of candelas per square meter (cd/m^2).

1) Maximum Luminance: The preset setting in which the display is displaying the brightest On Mode conditions, as specified by the manufacturer, for example, in the user manual.

2) As-shipped Luminance: The factory default preset setting which is selected by the manufacturer for normal home or applicable market use.

Note: Based on stakeholder feedback, EPA has clarified the definitions of as-shipped luminance and maximum luminance.

E) Screen Area: The viewable screen width multiplied by the viewable screen height.

F) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness of a display as a function of ambient light.

G) Product Family: A high-level description referring to a group of displays, made by the same manufacturer, typically sharing one common basic design that often contains variations in hardware configurations.

H) Representative Model: The product configuration equivalent to that which is intended to be marketed and labeled as ENERGY STAR.

Note: In an effort to ensure accurate product representation, EPA proposes revised definitions of a product family and a representative model based on product configuration. This definition harmonizes with other ENERGY STAR specifications.

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of a display as specified herein and are powered directly from ac mains, via an external power supply, or via a data or network connection, are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2. Typical products that would be eligible for qualification under this specification include:

i. Computer Monitors;

ii. Digital Picture Frames;

iii. Signage Displays; and,

iv. Additional products including monitors with keyboard, video and mouse (KVM) switch functionality, ultra-thin clients, and other industry-specific displays that meet the efficiency criteria.

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. Products with a viewable diagonal screen size greater than 60";

ii. Products with an integrated television tuner;

iii. Products that are marketed and sold as televisions, including products with a computer input port (e.g., VGA) that are marketed and sold primarily as televisions;

iv. Products that are component televisions. A component television is a product that is composed of two or more separate components (e.g., display device and tuner) that are marketed and sold as a television under a single model or system designation. A component television may have more than one power cord;

v. Dual-function televisions / computer monitors that are marketed and sold as dual-function televisions / computer monitors;

vi. Tablet computers (i.e., electronic readers, smartphones); and,

vii. Products that must meet FDA specifications for medical devices that prohibit power management capabilities and do not have a power state meeting the definition of Sleep Mode.

Note:

Displays with a diagonal screen size greater than 60": Currently, EPA has limited data on the power consumption for displays greater than 60" and is therefore unable to include them in the scope of this specification. EPA welcomes additional data that would enable EPA to consider expanding the scope of this specification to displays greater than 60".

Displays used in medical applications: Based on research and stakeholder feedback, displays used in medical applications were found to carry a range of different features. To promote efficiency without harming performance, *only* products used in diagnostic medical applications that have power management capabilities and a power state meeting the definition of Sleep Mode are included in the scope of this specification. Further, only products that *do not* need to meet FDA's specifications for medical devices (i.e., requiring lifetime luminance maintenance and prohibiting power management) are eligible for qualification under this specification. More information on FDA requirements is available at: http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/default.htm.

Overlap with the Televisions specification: To remove a possible overlapping scope with the Televisions specification, EPA proposes to exclude the following products from the Displays specification: products with an integrated tuner, products that are explicitly marketed and sold as dual-function televisions / computer monitors, and products that are component televisions. These products may qualify under the ENERGY STAR Televisions specification.

3 QUALIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.

3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.2 General Requirements

3.2.1 External Power Supply: If the product is shipped with an EPS, the EPS 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.

- External Power Supplies shall meet level V requirements when tested using the *Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies, Aug. 11, 2004*.

3.2.2 Power Management:

i. Products shall offer at least one power management feature that is enabled by default, and that can be used to automatically transition from On Mode to Sleep Mode (e.g., support for VESA Display Power Management Signaling (DPMS), enabled by default).

ii. Products that generate content for display from one or more internal sources shall have a sensor or timer enabled by default to automatically engage Sleep or Off Mode.

Note: EPA commends the advances in power management that display manufacturers have implemented. EPA understands manufacturers continue to develop and implement innovative power management functions involving new technologies such as occupancy sensors, proximity sensors, timer functions, and display dimming capabilities. Although some stakeholders submitted comments on these technologies, EPA would like to understand these technologies better, their prevalence in the market, energy savings they offer consumers and, as appropriate, encourage their broader application.

In addition, EPA is investigating ways to decrease the energy consumption when displays are left on and considers implementing a default delay time to sleep requirement. EPA welcomes stakeholder feedback on the impact of the requirement and typical delay times currently employed in existing products.

3.3 On Mode Requirements

3.3.1 For products that do not offer ABC, or for which ABC is not enabled by default, On Mode power (P_{ON}), as calculated per the ENERGY STAR test method, referenced in Section 4 below, shall be less than or equal to the Maximum On Mode Power Requirement (P_{ON_MAX}), as calculated per Table 1.

Table 1: Calculation of Maximum On Mode Power Requirements ($P_{ON\ MAX}$)

Product Type Diagonal Screen Size, *d* (inches)	**$P_{ON\ MAX}$ (watts)** *Where:* ▪ *r = Screen resolution in megapixels* ▪ *A = Viewable screen area, rounded to the nearest 0.1 square inches.*
$d < 12.0$	$(6.0 \times r) + (0.05 \times A) + 3.0$
$12.0 \leq d < 25.0$	$(6.0 \times r) + (0.0145 \times A) + 4.0$
$25.0 \leq d < 30.0$	$(6.0 \times r) + (0.18 \times A) - 40.0$
$30.0 \leq d \leq 60.0$	$(0.27 \times A) + 8.0$

Note:

On Mode power levels for displays. Displays less than 30" mainly encompass two types of products: digital picture frames, which are typically less than 12" in diagonal screen size, and computer monitors, which typically range in screen size between 12" and under 30". Displays greater than 30" are typically marketed as professional signage.

Digital picture frames (products less than 12"): Digital picture frames were added to the scope of products during the previous Version 5.1 specification. In 2010, ENERGY STAR qualified digital picture frames represented approximately 10% of the market. Given this low market share, EPA is not inclined to increase the stringency of the performance requirements for these products at this time. That said, a review of the current ENERGY STAR qualified product list shows a broad selection of competitively priced products from a variety of manufacturers. EPA is therefore proposing to retain the existing On Mode power requirements for these products. EPA welcomes feedback on this approach as well as any additional data that stakeholders would like to share.

Computer Monitors (12" to under 30"): The market share of ENERGY STAR qualified computer monitors under Version 5.1 grew significantly in 2010, suggesting that a change in the On Mode power requirements may be warranted. A review of the qualifying and non-qualifying offerings of ENERGY STAR Displays Partners indicates that EPA's data set is representative of models currently on the market. New, separate On Mode power equations are proposed, reflecting the performance of roughly the top quartile of models. More specifically, for monitors with resolution of 2.074 MP, one of the most common resolutions, 21% of models in the popular 18"-24" size range would qualify. EPA's current data set supports a good selection of products from a range of manufacturers that would be available and cost effective at the proposed levels. EPA welcomes feedback on these proposed On Mode power requirements as well as any additional data that stakeholders would like to share.

Professional signage (30" to 60"): Displays larger than 30", namely professional signage products, were added to the scope of products during the previous Version 5.1 specification. In 2010, ENERGY STAR professional signage products represented less than 10% of the market. Given this low market share, EPA is not inclined to increase the stringency of the performance requirements for these products at this time. That said, a review of ENERGY STAR's currently qualified product listing shows a broad selection of competitively priced products from a variety of manufacturers. EPA is therefore proposing to retain the existing On Mode power requirements for these products. EPA welcomes feedback on this approach as well as any additional data that stakeholders would like to share.

Resolution: Many stakeholders highlighted instances where resolution had a direct impact on the power consumption of the display, increasing On Mode power independently from the viewable screen area. EPA has therefore decided to retain resolution in the On Mode power equation. The proposed allowance of 6 watts per megapixel for resolution is based on analysis of the correlation between resolution and On Mode power found in ENERGY STAR qualified products for different product sizes. However, EPA has received additional feedback from some stakeholders suggesting that a lower W/MP would be more appropriate and, therefore, continues to seek information regarding its proposal to account for resolution in the On Mode power equation.

Data/Networking Capabilities: Given the relatively large power consumption of the principal features compared to the relatively small power consumption of data/networking capabilities in On Mode for products with such capabilities, EPA does not propose any adders to compensate for the additional power consumption in On Mode. EPA still welcomes stakeholder feedback on the additional power consumption in Sleep Mode due to these capabilities.

3.3.2 For products with Automatic Brightness Control (ABC) enabled by default, On Mode power (P_{ON}), as calculated per Equation 1, shall be less than or equal to the Maximum On Mode Power Requirement (P_{ON_MAX}), as calculated per Table 1.

Equation 1: Calculation of On Mode Power for Products with ABC Enabled by Default

TBD

Note: EPA and the U.S. Department of Energy (DOE) are interested in improving the measurement associated with ABC enabled by default. Both EPA and DOE believe that the test conditions for room illuminance should be representative of consumer use. EPA proposes adopting the forthcoming DOE-proposed Television testing conditions for ABC enabled by default. EPA intends to adopt the DOE test procedure once it is finalized and is referencing the DOE recommendations for testing televisions to harmonize with the Version 6.0 draft specification for Televisions. EPA anticipates including a revised proposal for addressing ABC in a subsequent draft of this Displays specification later this Fall.

3.3.3 For products powered with a low-voltage dc source, On Mode power (P_{ON}), as calculated per Equation 2, shall be less than or equal to the Maximum On Mode Power Requirement (P_{ON_MAX}), as calculated per Table 1.

Equation 2: Calculation of On Mode Power for Products Powered by a Low-voltage Dc Source

$$P_{ON} = P_L - P_S$$

Where:

- *P_{ON} is the calculated On Mode power,*
- *P_L is the ac power consumption of the low-voltage dc source with the unit under test (UUT) as the load.*
- *P_S is the marginal loss of the ac power supply of the source.*

Note: The test method and qualification criteria have been clarified to delineate guidance for testing products powered by a low-voltage dc source, and the procedure for determining the On Mode Power for these products.

3.4 Sleep Mode Requirements

3.4.1 Measured Sleep Mode power (P_{SLEEP}) shall be less than or equal to the Maximum Sleep Mode Power Requirement (P_{SLEEP_MAX}), as specified in Table 2.

Table 2: Maximum Sleep Mode Power Requirements (P_{SLEEP_MAX})

P_{SLEEP_MAX} (watts)
0.5

3.4.2 For products that offer more than one Sleep Mode (e.g., "Sleep" and "Deep Sleep"), measured Sleep Mode power (P_{SLEEP}) in any Sleep Mode shall not exceed the Maximum Sleep Mode power Requirement (P_{SLEEP_MAX}).

Note: Although stakeholders expressed concern that a 0.5 W limit would not allow displays with data/networking capabilities to qualify, EPA has not received sufficient test data to reconsider the requirement. Many ENERGY STAR qualified displays can already meet the 0.5 W limit. EPA welcomes feedback and data on any additional features, such as peripherals or data/network capabilities, which could increase power consumption in Sleep Mode.

3.5 Off Mode Requirements

3.5.1 Measured Off Mode power (P_{OFF}) shall be less than or equal to the Maximum Off Mode Power Requirement ($P_{OFF\ MAX}$) specified in Table 3.

Table 3: Maximum Off Mode Power Requirements (P_{OFF_MAX})

P_{OFF_MAX} (watts)
0.5

Note: Based on analysis of currently qualified products and data submitted, the majority of ENERGY STAR qualified displays that have an Off Mode already meet the 0.5 W limit. EPA has therefore decided to retain the proposal of the 0.5 W limit in Off Mode, harmonizing with the Off Mode requirement in the European Commission (EC) Ecodesign Regulation No 1275/2008.

3.6 Luminance Reporting Requirements

3.6.1 The as-shipped luminance and the maximum luminance shall be reported.

Note: EPA proposes to continue requiring manufacturers to provide the as-shipped and maximum luminance in order to understand how products are shipped in the marketplace, relative to their maximum screen luminance and also relative to how they are tested.

4 TOXICITY AND RECYCLABILITY REQUIREMENTS

4.1.1 Display products shall contain restricted levels of the following materials, where the maximum concentration values tolerated by weight in homogeneous materials are: lead (0.1%), mercury (0.1%), cadmium (0.01%), hexavalent chromium (0.1%), polybrominated biphenyls (PBB) (0.1%), or polybrominated diphenyl ethers (PBDE) (0.1%). Batteries are exempt.

4.1.2 Display products shall be designed for ease of disassembly and recyclability where external enclosures, sub-enclosures, chassis and electronic subassemblies are easily removable with commonly available tools, by hand, or by a recycler's automated processes. Products shall identify and provide ease of access to, and removal of, materials with special handling needs.

Note: The proposed toxicity requirement and compliance approach is consistent with the European Union RoHS Directive, which also applies to displays. The RoHS Directive, formally known as Directive 2002/95/EC of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment, was amended by 2005/618/EC and went into effect in 2006. Accordingly, products that currently meet the EU RoHS Directive would satisfy this toxicity requirement. In some cases, the RoHS Directive allows for specific, limited exemptions for specific materials and provides expiration dates for these exemptions. EPA welcomes feedback from stakeholders to understand if any materials exempted for a given period of time under the RoHS Directive currently apply to components typically found in display products. A list of the exemptions under the RoHS Directive can be found under Annex III at the following URL: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:174:0088:0110:EN:PDF.

The proposed design for ease of disassembly and recyclability is harmonized with the existing IEEE 1680.1 standard. Through research, EPA has found that many display manufacturers in the marketplace already meet this requirement. In a future specification revision, EPA envisions proposing additional requirements to ensure greater product recyclability and increased recycled content in products.

EPA continues to anticipate that existing reporting efforts and maintenance of relevant quality assurance documentation would be required to demonstrate compliance with these requirements.

5 TEST REQUIREMENTS

5.1 Test Methods

5.1.1 When testing the Unit Under Test (UUT), the test methods identified in Table 4 shall be used to determine ENERGY STAR qualification.

Table 4: Test Methods for ENERGY STAR Qualification

Diagonal Screen Size, *d* (inches)	Test Method
All Screen Sizes	ENERGY STAR Test Method for Displays Rev. Sep 2011. IEC 62087, Ed 3.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment IEC 62301, Ed 2.0: Household Electrical Appliances-Measurement of Standby Power

Note: Based on positive stakeholder feedback on using IEC 62087 Ed 3.0 for all display sizes, EPA has decided to retain the proposal and implement the use of this standard across all sizes. EPA still welcomes stakeholder feedback on any products that cannot be tested using IEC 62087.

5.2 Number of Units Required for Testing

5.2.1 A Representative Model shall be selected for testing per the following requirements:

i. For qualification of a product family of all product types, the product configuration that represents the worst-case power consumption for each product category within the family shall be considered the Representative Model.

Note: EPA has clarified that for qualification purposes, the product configuration that represents the highest as-shipped power consumption for each product category within the product family will be considered the Representative Model. Some stakeholders asked to allow products within the same model line to be qualified as separate families. EPA intends for the product family provision to facilitate qualification and testing, leaving the choice of increasing the testing and qualification burden up to the manufacturer.

6 USER INTERFACE

6.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard, *IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments*. For details, see http://eetd.LBL.gov/Controls. In the event that the manufacturer does not adopt *IEEE P1621*, the manufacturer shall provide EPA with its rationale for not doing so.

7 EFFECTIVE DATE

7.1.1 Effective Date: The Version 6.0 ENERGY STAR Display Products specification shall take effect on September 30, 2012. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

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

Note: EPA anticipates releasing a Final Version 6.0 specification in December 2011. As such, the effective date provided above allows manufacturers time to work with certification bodies and update product literature as needed to comply with the new requirements. As of September 30, 2012, only those models that have been third-party certified by an EPA recognized Certification Body will remain on the ENERGY STAR Qualified Product List. More information regarding product qualification will be provided along with the Final Draft specification. For information on third-party certification visit: www.energystar.gov/3rdpartycert**.**