



ENERGY STAR® Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies

FINAL Eligibility Criteria

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Eligibility Criteria

Below is the product specification for ENERGY STAR qualified single voltage external ac-dc and ac-ac power supplies. A product must meet all of the identified criteria if it is to be qualified as ENERGY STAR by its external power supply manufacturer.

- 1) **Definitions:** The goal of this ENERGY STAR external power supply specification is to recognize those models with an efficient ac-dc or ac-ac conversion process. Consistent with this goal and the test methodology, as described in Section 4, EPA has prepared detailed definitions of single voltage external ac-dc and ac-ac power supplies and other related terms as relevant to ENERGY STAR.

Please note the following products are temporarily excluded from this specification as outlined below:

- Those power supplies with battery charging functions intended to recharge batteries that power: 1) flashlights; or 2) end-use products whose *principal output* is mechanical motion, the movement of air, or the production of heat (e.g., power tools and rechargeable vacuums); or 3) detachable batteries for use in the end-use products described in #1 and 2 above. (While it is difficult to precisely delineate and categorize products in today's converging marketplace, in general this exclusion applies to power tools and household appliances that produce heat, light, or motion. It does not affect computer and consumer electronics, such as laptops, digital cameras, monitors, CD players, cell phones, and cordless phones. Further, EPA recognizes that external power supply manufacturers do not always know the exact end-use product their power supply will serve. As such, this exclusion may only apply in those cases where the power supply and end-use product are designed as a system and the intended end-use product is known by the power supply designer.)

For brevity and consistency, these excluded products are hereafter referred to as *excluded battery charging systems*.

The exclusion will be in place from January 1, 2005 through December 31, 2005. During this time, EPA will work with stakeholders to further assess the appropriateness of the external power supply test procedure for the products denoted in the exclusion. EPA will develop a second test procedure and specification for the excluded battery charging systems, as necessary. If a battery charging system test procedure and specification are not developed, the exclusion will expire on December 31, 2005 and battery charging systems will be covered by this ENERGY STAR specification under the broad external power supply definitions found in Sections 1.A and 1.B below.

Note: The language above explicitly excludes battery charging systems typically found in household appliances so that EPA can investigate them further and, as necessary, develop a test method and specification that will best capture their energy savings opportunities. **An exclusion is being implemented so as to allow for additional research and test procedure development while not delaying the introduction of the overall external power supply specification.**

Below is a general list of the excluded product categories:

- Portable, rechargeable personal care appliances (e.g., shavers, toothbrushes, massagers)
- Portable, rechargeable motorized kitchen appliances (e.g., blenders, can openers, electric knives, kitchen cleaning brushes)
- Portable, rechargeable floor care products (e.g., handheld vacuum cleaners, stick vacuums)
- Portable, rechargeable power tools (e.g., drills, screwdrivers)

As always, manufacturers are strongly encouraged to contact EPA with questions or uncertainties about ENERGY STAR eligibility.

- A. Single Voltage External Ac-Dc Power Supply: For the purposes of this specification, a single voltage external ac-dc power supply:
- a) is designed to convert line voltage ac input into lower voltage dc output;
 - b) is able to convert to only one dc output voltage at a time;
 - c) is sold with, or intended to be used with, a separate end-use product that constitutes the primary load;
 - d) is contained in a separate physical enclosure¹ from the end-use product;
 - e) is connected to the end-use product via a removable or hard-wired male/female electrical connection, cable, cord or other wiring;
 - f) does not have batteries or battery packs that physically attach directly (including those that are removable) to the power supply unit;
 - g) does not have a battery chemistry or type selector switch **AND** an indicator light or state of charge meter (e.g., a product with a type selector switch AND a state of charge meter is excluded from this specification; a product with only an indicator light is still covered by this specification); and
 - h) has nameplate output power less than or equal to 250 watts.
- B. Single Voltage External Ac-Ac Power Supply: For the purpose of this specification, a single voltage external ac-ac power supply:
- a) is designed to convert line voltage ac input into lower voltage ac output;
 - b) is able to convert to only one ac output voltage at a time;
 - c) is sold with, or intended to be used with, a separate end-use product that constitutes the primary load;
 - d) is contained in a separate physical enclosure¹ from the end-use product;
 - e) is connected to the end-use product via a removable or hard-wired male/female electrical connection, cable, cord or other wiring;
 - f) does not have batteries or battery packs that physically attach directly (including those that are removable) to the power supply unit;
 - g) does not have a battery chemistry or type selector switch **AND** an indicator light or state of charge meter (e.g., a product with a type selector switch AND a state of charge meter is excluded from this specification; a product with only an indicator light is still covered by this specification); and
 - h) has nameplate output power less than or equal to 250 watts.

Note: To complement the definitions above, EPA has attached a flowchart to graphically depict the scope of the specification and test methodology.

External power supplies are often referred to as “adapters” and/or “chargers” in marketing literature and trade publications. EPA’s ac-dc and ac-ac definitions are intended to cover many of these adapters and chargers, except where explicitly excluded on page 2 of these Eligibility Criteria.

- C. Active Mode: The condition in which the input of a power supply is connected to line voltage ac and the output is connected to a dc or an ac load drawing a fraction of the power supply’s nameplate power output greater than zero.
- D. No-Load Mode: The condition in which the input of a power supply is connected to an ac source consistent with the power supply’s nameplate ac voltage, but the output is not connected to a product or any other load.

¹ “Physical enclosure” refers to the housing of the products themselves, not their retail packaging.

- 2) **Qualifying Products:** In order to qualify as ENERGY STAR, an external power supply model must meet the definition in Section 1.A or 1.B and the specification requirements provided in Section 3, below.
- 3) **Energy-Efficiency Specifications for Qualifying Products:** Only those products in Section 2 that meet the following criteria for both Active and No-Load Modes may qualify as ENERGY STAR.

A. Active Mode

1. Tier 1: To be eligible for ENERGY STAR qualification, an external power supply model must meet or exceed a minimum average efficiency for Active Mode, which varies based on the model's nameplate output power. Table 1 below outlines the equations for determining minimum average efficiency where P_{no} stands for nameplate output power and \ln refers to the natural logarithm. Efficiency shall be expressed in decimal form and rounded to the hundredths place.

Table 1: Energy-Efficiency Criteria for Active Mode

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal) ²
0 to \leq 1 watt	$\geq 0.49 * P_{no}$
> 1 to \leq 49 watts	$\geq [0.09 * \ln (P_{no})] + 0.49$
> 49 watts	≥ 0.84

Examples to Illustrate the Active Mode Approach: Average Active Mode efficiency and ENERGY STAR qualification shall be determined as follows:

- Calculate the model's single average Active Mode efficiency value by testing at 100%, 75%, 50%, and 25% of rated current output and then computing the simple arithmetic average of these four values, as specified in the Test Method.
- Based on the model's nameplate output power, select the appropriate equation from Table 1 and calculate the minimum average efficiency.
- Compare the model's actual average efficiency to the minimum average efficiency required by ENERGY STAR. If actual average efficiency is greater than or equal to the minimum average efficiency, the model has satisfied ENERGY STAR's Active Mode requirement.

To provide an example using the criteria in Table 1, the minimum average efficiencies required of three sample power supplies are provided in Table 2 below. As shown in the last column, power supplies 1, 2, and 3 would meet the ENERGY STAR Active Mode requirement if they had average efficiencies of at least 25%, 76%, and 84%, respectively. Therefore, if Power Supply 1 in Table 2 had an actual average efficiency of 30%, it would satisfy the Active Mode requirement because it surpassed the ENERGY STAR minimum average efficiency of 25%.

Table 2: Examples of Minimum Average Efficiency in Active Mode

Sample	Nameplate Output Power (P_{no})	Average Efficiency in Active Mode (expressed as a decimal)
Power Supply 1	0.5 watts	$0.49 * 0.5 = 0.25$
Power Supply 2	20 watts	$[0.09 * \ln (20)] + 0.49 = 0.759616$ or 0.76
Power Supply 3	75 watts	0.84

² (a) "Ln" refers to the natural logarithm. The algebraic order of operations requires that the natural logarithm calculation be performed first and then multiplied by 0.09, with the resulting output added to 0.49. (b) An efficiency of 0.84 in decimal form corresponds to the more familiar value of 84% when expressed as a percentage.

Note: As a voluntary program committed to recognizing the more efficient products on the market, ENERGY STAR does not expect all external power supplies to meet the specification and strives to recognize approximately the top 25 percent. EPA understands that it takes time to redesign models to meet energy-efficiency specifications, safety standards, and other requirements. As such, manufacturers may voluntarily introduce qualifying external power supplies at any time during the life of the ENERGY STAR agreement and are not required to have qualifying models on the specification's effective date.

As background and in response to one stakeholder question, EPA has defined efficiency as the useful ac or dc output power provided by a power supply based on its total ac input power. By basing its specification on nameplate output power, EPA uses readily available data (on the UL label) that can be easily verified.

2. Tier 2: To continually recognize the most efficient models on the market and reflect forthcoming improvements in technology, EPA plans to implement a Tier 2 Active Mode specification on July 1, 2006. Approximately one year before the Tier 2 effective date, EPA will: 1) collect efficiency data (based on the ENERGY STAR Test Methodology) on a wide range of external power supplies (varying in terms of size, efficiency, manufacturer, cost, and other parameters) sold in markets throughout the world; 2) analyze the data to identify the top 25 percent in terms of energy efficiency; 3) release the proposed Tier 2 specification for stakeholder review and comment (focusing on the technical elements of Tier 2 and not on all programmatic details); and 4) finalize the specification by late 2005 so partners have adequate time to transition to the new levels.

Note: Regarding Tier 2 Active Mode, please note the following:

- For existing ENERGY STAR end-use product categories (e.g., Telephony, Audio/DVD, Set-top Boxes, Imaging, Computers/Laptops, Monitors, Water Coolers, etc.) the new external power supply specification (Tiers 1 and 2) will be phased in as an additional eligibility requirement (i.e., end-use products must incorporate an ENERGY STAR qualified external power supply), where appropriate, and when those specifications are revised. Once the external power supply requirement is added, end-use product manufacturers must meet the external power supply specification (e.g., Tier 1 or 2) in effect at that time. For some end-use products, depending on the specification revision schedule, EPA may transition directly to specifying compliance with the Tier 2 power supply levels after the Tier 2 specification goes into effect. (In addition, see note in Section 5, Effective Date.)
- To the extent that cost data is available or provided by stakeholders, EPA will consider the costs associated with higher efficiency power supplies when developing the Tier 2 specification. Consistent with the ENERGY STAR guiding principles, EPA strives to set specifications that can be cost effectively achieved by several manufacturers. If ENERGY STAR qualifying models have a higher purchase price than conventional models, consumer investments in increased energy efficiency should be recoverable within a reasonable time period.
- During the ENERGY STAR product qualification process, EPA will ask manufacturers to indicate whether their qualifying power supplies use power factor correction (PFC). This information will be analyzed to see what impact PFC has on the power supply's power consumption and whether any special allowances for power supplies with PFC are needed under the Tier 2 performance levels (for both Active and No-Load).

B. No-Load Mode

1. Tier 1: The second half of the ENERGY STAR specification is the No-Load power requirement, which specifies the maximum ac power that may be used by a qualifying external power supply in the No-Load condition. Maximum power consumption levels for No-Load Mode are provided in Table 3, below.

Table 3: Energy Consumption Criteria for No Load

Nameplate Output Power (P _{no})	Maximum Power in No-Load
0 to < 10 watts	≤ 0.5 watts
≥ 10 to ≤ 250 watts	≤ 0.75 watts

Note: EPA believes that the 0.5-watt and 0.75-watt specification levels are based on the best available information to date. EPA may need to further evaluate the Tier 1 No-Load levels in the future, particularly where nameplate output power is greater than 100 watts, pending the submittal of test data and market research from interested stakeholders.

Executive Order 13221 requires federal agencies to purchase where possible end-use products that use minimal standby power. Employing an ENERGY STAR qualified external power supply in end-use product designs will help end-use product manufacturers to achieve low standby power consumption. Please note, however, that use of an ENERGY STAR qualified external power supply will not automatically or solely ensure compliance with the Executive Order, as it is based on the standby power consumption of the product system (the power supply and all other components).

2. **Tier 2:** To continually recognize the most efficient models on the market and reflect forthcoming improvements in technology, EPA plans to implement a Tier 2 No-Load Mode specification on July 1, 2006. While subject to change based on analysis of new data, EPA believes that 0.3 watts (nameplate output power less than 10 watts) and 0.5 watts (nameplate output power from 10 to 250 watts) represent reasonable Tier 2 targets for manufacturers. Approximately one year before the Tier 2 effective date, EPA will: 1) collect efficiency data (based on the ENERGY STAR Test Methodology) on a wide range of external power supplies (varying in terms of size, efficiency, manufacturer, cost, and other parameters) sold in markets throughout the world; 2) analyze the data to identify the top 25 percent in terms of energy efficiency; 3) release the proposed Tier 2 specification for stakeholder review and comment (focusing on the technical elements of Tier 2 and not on all programmatic details); and 4) finalize the specification by late 2005 so partners have adequate time to transition to the new levels.

Note: In recognition of stakeholder support for a 0.3-watt specification and given EPA's interest in harmonizing with other international specifications, EPA is strongly considering a Tier 2 No-Load level of less than or equal to 0.3 watts for the less than 10-watt external power supply category and less than or equal to 0.5 watts for the 10-watt and greater products. Any measurement accuracy issues associated with a 0.3-watt level will be considered and analyzed during the Tier 2 development process.

Please see note on page 5 regarding Tier 2 Active Mode. All information provided in that note also applies to Tier 2 No-Load Mode.

4) **Test Methodology**

The specifics for testing the energy efficiency of an external power supply model are outlined in a separate document titled "Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies (August 11, 2004)," which is available on the ENERGY STAR Web site. The test results produced by this procedure shall be used to determine if a model qualifies as ENERGY STAR. In addition, below are five ENERGY STAR-specific testing requirements.

Note: For a copy of the revised test methodology, visit www.energystar.gov/powersuppliesdevelopment.

- A. **Safety Standards:** ENERGY STAR qualified external power supplies shall comply with applicable safety standards from UL, CSA, and other global standards organizations. Relevant standards include, but are not limited to:
 - UL 1012, Standard for Power Units Other Than Class 2, Edition 6, June 28, 1994
 - UL 1310, Standard for Class 2 Power Units, Edition 4, July 28, 1994

It is the Partner's responsibility to ensure that its products meet applicable local safety standards based on where the product will be sold.

Note: Section 4.A conveys ENERGY STAR's guiding principle that product quality and safety should never be compromised for energy efficiency. Rather than list all potentially applicable safety standards, EPA has incorporated them by general reference in the text above.

- B. **Number of Units Required for Test:** Testing shall be conducted by the manufacturer or its authorized representative on three randomly chosen units of the same model. Manufacturers shall report Active and No-Load Mode values for all three units as well as the average values. To qualify as ENERGY STAR, all three units must meet the ENERGY STAR specification; only the average values will be displayed on ENERGY STAR's qualifying product list (see Section 4.E below).

Note: Testing to determine ENERGY STAR qualification may be conducted by the manufacturer or by its authorized representative, such as an independent testing laboratory. Manufacturers must then attest to EPA (i.e., self-certify) that their product model meets the ENERGY STAR guidelines (i.e., EPA does not individually test each model).

- C. **Models Capable of Operating at Multiple Voltage/Frequency Combinations:** For switchmode power supplies capable of operating at multiple voltages and frequencies, testing shall be conducted at both 115 volts @ 60 Hz and 230 volts @ 50 Hz, with the least efficient set of test values used to determine if products qualify for the Active Mode and No-Load specifications.

Note: This ENERGY STAR specification requires switchmode power supplies capable of operating at multiple voltages and frequencies to be tested at both 115 volts and 230 volts. ENERGY STAR qualifying external power supplies will be sold into a global marketplace and will be used in numerous countries by international travelers. By qualifying models under the least efficient set of test values, this approach ensures that models meet the ENERGY STAR performance levels in multiple markets and mitigates any potential variations in tested values across markets.

- D. **Multiple Tap or Switch Selectable Models:** Manufacturers shall test a multiple tap or switch selectable model at the highest and the lowest voltage outputs of the power supply. If the model meets or exceeds the ENERGY STAR requirements at both the highest and the lowest voltage outputs, then it qualifies as ENERGY STAR.
- E. **Submission of Qualified Product Data to EPA:** Partners are required to self-certify those product models that meet the ENERGY STAR guidelines and report information to EPA. ENERGY STAR qualifying product lists, including information about new models as well as notification of discontinued models, must be provided on a quarterly basis, or more frequently if desired by the manufacturer. If no new models are introduced during a particular quarter, manufacturer should notify EPA to ensure its partnership status is maintained.
- 5) **Effective Date:** The date that manufacturers may begin to qualify and promote products as ENERGY STAR will be defined as the *effective date* of the agreement. The Tier 1 ENERGY STAR single voltage external ac-dc and ac-ac power supplies effective date is January 1, 2005. The second phase of the specification, Tier 2, shall commence on July 1, 2006.

Note: EPA is making plans to promote ENERGY STAR for External Power Supplies at several upcoming industry events, including the 2005 Consumer Electronics Show (CES) and the Applied Power Electronics Conference and Exposition (APEC) 2005. Interested manufacturers are encouraged to start testing their external power supplies, so they can join ENERGY STAR and qualify their energy-efficient models once the specification is finalized. Participating manufacturers and their ENERGY STAR qualified models will be featured/promoted at both events.

Finally, for existing ENERGY STAR end-use product categories (e.g., Telephony, Audio/DVD, Set-top Boxes, Imaging, Computers/Laptops, Monitors, Water Coolers, etc.) the new external power supply specification will be phased in as an additional eligibility requirement (i.e., end-use products must incorporate an ENERGY STAR qualified external power supply), where appropriate, and when those specifications are revised. The implementation date for the new external power supply requirement may be different for each applicable end-use product category (based on its product design/manufacturing cycles and specification revision process) and as always, will be informed by stakeholder comments and discussions. Please note that the first product category to incorporate the external power supply specification will be Telephony (cordless phones, answering machines, and combination units).

- 6) **Future Specification Revisions:** EPA reserves the right to change the 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 that ENERGY STAR qualification is not automatically granted for the life of a product model. To qualify as ENERGY STAR, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.
- 7) **International Efficiency Marking Protocol:** ENERGY STAR partners shall follow the international efficiency marking protocol to indicate the energy performance of their ENERGY STAR qualified power supplies. (See Figure 1 for an illustration of the international efficiency mark.) In addition, the efficiency level, as denoted by a Roman numeral under the protocol, shall be reported to EPA as part of the qualified product data submission process. Further information about the endorser of the marking protocol and its intent is available at www.energystar.gov/powersuppliesdevelopment.

ENERGY STAR partners shall clearly and permanently mark (e.g., imprint, label, etc.) the nameplate of their qualifying external power supplies with the appropriate Roman numeral (I – VI) that corresponds to specific minimum Active and No-Load efficiency levels. (See www.energystar.gov/powersuppliesdevelopment and click on "International Efficiency Marking Protocol" for energy performance requirements at each Roman numeral.) Partners shall determine the appropriate Roman numeral by: 1) comparing the unit's Active and No-Load test data (when tested in accordance with the ENERGY STAR Test Method and at each relevant test voltage and frequency value) with the performance requirements at each level of the Roman numeral scale; and 2) choosing the highest Roman numeral where the power supply meets the Active and No-Load requirements.

Figure 1: Illustration of International Efficiency Mark



When applied by a manufacturer, the mark shall conform to the following characteristics:

- Format:** Roman numeral: I, II, III, IV, V, or VI.
- Font:** Times Roman preferred (or other plain serif fonts).
- Size:** Legible and indelible.
- Color:** Text to contrast with the nameplate background.
- Placement:** On the power supply nameplate; however, the exact location is at the discretion of the manufacturer. The text "Efficiency Level" shown above is optional.
- Example:** Any external power supply meeting the performance requirements for level III and above would qualify as ENERGY STAR. Power supplies with performance levels at I or II would not qualify.

Partners shall begin to implement the international efficiency marking protocol no later than January 1, 2006.

Note: *The international efficiency marking protocol will provide a system for power supply manufacturers to designate the minimum efficiency performance of an external power supply, so that finished product manufacturers and government representatives can easily determine a unit's efficiency. This mark will not serve as a consumer information label, but rather will demonstrate the performance of the external power supply when tested to the internationally supported test method (i.e., the test method referenced in Section 4 of this document). The international efficiency mark will consist of a Roman numeral (I – VI) that corresponds to specific minimum Active and No-Load efficiency levels and will be printed/applied by the manufacturer on the external power supply nameplate (exact location will be left to the manufacturer's discretion).*

Given that external power supplies are a globally manufactured and marketed product, EPA has coordinated with representatives in China, Australia, and other countries throughout the ENERGY STAR specification development process. This international efficiency marking protocol will provide further opportunities for coordination as the specification is finalized and implemented in the marketplace. The benefits for manufacturers include:

- The marking system will be adopted and recognized around the world. As such, power supply manufacturers will not have to use different marks for each market into which they sell their products.*
- The mark will not require much space on the nameplate and was intentionally selected to avoid confusion with other non-energy related markings that already appear on external power supplies.*

This requirement, which was introduced late in the specification development process, will take effect on January 1, 2006.