



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

DRAFT 4 Eligibility Criteria

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DRAFT 4 Eligibility Criteria

Below is the **DRAFT 4** 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 *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 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 proposed 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)

EPA plans to have a more detailed list of excluded product categories by the time the specification is finalized. As always, manufacturers are strongly encouraged to contact EPA with questions or uncertainties about ENERGY STAR eligibility.

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- 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 proposed scope of the specification and test methodology. The following is a summary of the key substantive changes made to the ac-dc and ac-ac definitions from Draft 3 to Draft 4:

- Added examples in part “g” that clarify EPA’s intent with regard to products with battery charging switches, lights, and other similar features.

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 1 of this specification.

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- 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.

103 2) **Qualifying Products:** In order to qualify as ENERGY STAR, an external power supply model must
104 meet the definition in Section 1.A or 1.B and the specification requirements provided in Section 3,
105 below.

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107 3) **Energy-Efficiency Specifications for Qualifying Products:** Only those products listed in Section 2
108 that meet the following criteria for both Active and No-Load Modes may qualify as ENERGY STAR.

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110 A. Active Mode

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

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119 **Table 1: Proposed 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

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121 **Examples to Illustrate the Proposed Active Mode Approach:** Average Active Mode efficiency and
122 ENERGY STAR qualification would be determined as follows:

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

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

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140 **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: The Tier 1 Active Mode specification has **not** been modified in this Draft 4 specification and remains consistent with the previous Draft 3.

The Tier 1 specifications for both Active and No-Load represent the top 23% of models in the data set. While the specification has not changed, the qualifying percentage of models has increased modestly from 21.6% to almost 23% because the data in EPA's data set has continued to expand throughout the specification development process.

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 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.

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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:

- EPA has **not** changed the Tier 2 effective date for external power supplies.
- **For end-use products where an existing ENERGY STAR specification is in place (e.g., printers and cordless phones), manufacturers will not necessarily need to meet the Tier 2 requirements for their respective products on July 1, 2006.** All effective dates, including dates for the various tiers within the external power supply specification, will be determined independently for each applicable end-use product category. Where possible, however, an attempt will be made to coalesce around a few dates, so as to lessen any potential for confusion. Another option for some product categories, depending on the specification revision schedule, may be to go directly to the Tier 2 specification. (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.
- As indicated in Draft 3, EPA agrees that power factor correction (PFC) data should be collected during the ENERGY STAR product qualification process and then later analyzed when determining Tier 2 performance levels (for both Active and No-Load).

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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. Proposed maximum power consumption levels for No-Load Mode are provided in Table 3, below.

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Table 3: Proposed 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

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Note: In this Draft 4 version, the maximum power allowed in No-Load Mode has **not** changed and remains consistent with Draft 3.

A few stakeholders suggested changes to the Tier 1 No-Load specification. However, EPA has decided to continue with the 0.5-watt and 0.75-watt specification levels. Absent any new data from industry, EPA believes that the suggested levels are based on the best available information to date.

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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.

Please see note on page 4 regarding Tier 2 Active Mode. All information provided in that note also applies to Tier 2 No-Load Mode.

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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 13, 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.

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- A. **Safety Standards:** ENERGY STAR qualified external power supplies shall comply with applicable safety standards. Within the United States at the time of drafting this specification, for example, some relevant standards might include:

- 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

Given the volume of standards in the United States and worldwide (for both external power supplies and the end-use products they power) and the likelihood that they will be revised over time, it is beyond the scope of this document to enumerate all of them; rather, they are incorporated by general reference.

Note: EPA has revised Section 4.A to more generally convey its guiding principle that product quality and safety should never be compromised for energy efficiency. While specific safety standards and dates would be helpful, they would also require frequent updating of this document, which could lead to stakeholder confusion and significant administrative costs.

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- 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: Language has been added to Section 4.B to clarify how EPA plans to handle the measured data from three test samples.

In addition, please note that 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).

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- 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: Draft 4 continues to require 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.

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- 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.
- 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: In order to properly vet all stakeholder comments, EPA issued this Draft 4 specification for final review. Accordingly, the effective date has also been delayed to January 1, 2005. As noted earlier in this document, EPA plans to implement a Tier 2 specification on July 1, 2006.

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 will 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).

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- 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 endorsers of the marking protocol and its intent is available at <To be announced and inserted in final specification>.
- ENERGY STAR partners shall clearly and permanently mark 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 <Web site to be announced> 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.

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Figure 1: Illustration of International Efficiency Mark



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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: EPA plans to incorporate a new requirement of the international efficiency marking protocol into its external power supply specification. The 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.

Since the details for implementing the marking protocol are still being discussed, EPA does not expect this requirement to take effect on January 1, 2005. Rather, EPA wishes to gather feedback from manufacturers and other stakeholders on the proposed implementation date of January 1, 2006. Other comments on the international efficiency marking protocol and/or suggestions for best implementing it will also be considered.