



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

Eligibility Criteria

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Eligibility Criteria (Version 1.1)

Below is the product specification (Version 1.1) 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.

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. This specification along with its complement, the specification for products with battery charging systems (BCSs), intends to comprehensively cover the full range of energy conversion products. Manufacturers shall carefully examine their product designs and compare them to the detailed definitions (Section 1) and qualifying product descriptions (Section 2) for an external power supply and battery charging system (visit http://www.energystar.gov/index.cfm?c=battery_chargers.pr_battery_chargers) to determine the appropriate specification for ENERGY STAR qualification. Manufacturers may only qualify individual models under the one specification (i.e., external power supply OR battery charging system) that best reflects the power supply and product design.

- 1) **Definitions:** 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.
 - 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

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

- this specification); and
 h) has nameplate output power less than or equal to 250 watts.

- 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.

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%.

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.

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. 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. 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 appropriate levels of 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 based on stakeholder comments. EPA has a target effective date of January 1, 2008 for a Tier 2 specification.

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

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. 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 appropriate power levels; 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 based on stakeholder comments. EPA has a target effective date of January 1, 2008 for a Tier 2 specification.

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.

- 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.

- 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).
- 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.
- 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. **Submittal 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 target effective date for Tier 2 requirements is January 1, 2008.
- 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 www.energystar.gov/powersupplies.

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/powersupplies 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.