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

DRAFT 2 Eligibility Criteria

Below is the DRAFT 2 product specification for ENERGY STAR qualified single voltage external ac-dc power supplies. A product must meet all of the identified criteria if it is to be qualified as ENERGY STAR by its manufacturer.

1) **Definitions**: Below is a brief description of a single voltage external ac-dc power supply and other terms as relevant to ENERGY STAR. Additional terms defined in the "Test Method for Calculating the Energy Efficiency of Single Voltage External Ac-Dc Power Supplies" also apply (see Section 4).

   A. Single Voltage External Ac-Dc Power Supply: For the purpose of this specification, a single voltage external ac-dc power supply: 1) is designed to convert line voltage ac input into low voltage dc output; 2) is able to convert to one dc output voltage at a time; 3) is sold with, or intended to be used with, a product that constitutes the primary load; 4) is contained in a separate enclosure from the end-use product; 5) is connected to the end-use product via a cable, cord or other wiring even when that wiring is permanent; 6) does not have batteries or battery packs attached directly to the power supply unit; 7) has only two output wires; 8) does not have a battery chemistry or type selector switch and indicator light or state of charge meter; and 9) has wattage ratings less than or equal to 180 watts.

> ***Note**: To complement the definition above, EPA has attached a flowchart to graphically depict the proposed scope of the specification and test methodology. As such, EPA is suggesting that some products that use the power supply's dc output to charge different types of batteries at varying rates in varying operating modes may be eligible to qualify as ENERGY STAR. Products with multiple simultaneous voltage output and industrial power supplies (e.g., units mounted to the exterior of large industrial equipment) are not included in this specification.*
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> *Consistent with Draft 1, the power supply definition covers models with wattage ratings less than or equal to 180 watts. EPA remains open to expanding the scope of the specification, but has selected 180 for the following reasons: 1) EPA needs more test data for the high end models in order to determine if the efficiency levels are appropriate—interested manufacturers are encouraged to voluntarily provide data; and 2) stakeholder feedback on this issue has ranged from suggesting that EPA use 150 watts to be consistent with the European Code of Conduct to suggesting 200 or higher watts to keep pace with market trends.*

   B. 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 load drawing a fraction of the power supply's nameplate power output greater than zero.

   C. 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 and the specification requirements provided in Section 3, below. While this specification does not cover discrete battery chargers, some products that use the power supply's dc output to charge different types of batteries at varying rates in varying operating modes are eligible based on the definition in Section 1.A. The goal of this ENERGY STAR external power supply specification is to recognize those models with an efficient ac-dc conversion process. EPA is not currently attempting to address the efficiency of the battery charging and monitoring circuitry.

***Note**: In response to Draft 1, some stakeholders have asked EPA to include ac-ac power supplies as well as power supply devices with 3 or 4 output wires in this specification. Since these product types are not currently addressed in the test procedure, EPA welcomes and will consider proposals from industry that outline any needed adjustments to the test procedure and efficiency levels so that these products could qualify.*

3) **Energy-Efficiency Specifications for Qualifying Products**: Only those products listed 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 proposed 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: Proposed Energy-Efficiency Criteria for Active Mode

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal) [1]
0 to <1 watt	≥ 0.5 * P_{no}
1 to 51 watts	≥ [0.09 * Ln (P_{no})] + 0.5
>51 watts	≥ 0.85

Examples to Illustrate the Proposed Active Mode Approach: Average Active Mode efficiency and ENERGY STAR qualification would 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 Procedure.
- 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 proposed 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%, 77%, and 85%, 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	0.5 * 0.5 = 0.25
Power Supply 2	20 watts	[0.09 * Ln (20)] + 0.5 = 0.769616 or 0.77
Power Supply 3	75 watts	0.85

[1] (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 0.5. (b) An efficiency of 0.85 in decimal form corresponds to the more familiar value of 85% when expressed as a percentage.

***Note**: Regarding Draft 2 Active Mode, please note the following:*

- *The Tier 1 Active Mode specification has not changed and remains consistent with Draft 1.*
- *The proposed specification represents the top 26.4% of models in Active Mode from EPA's data set, which includes 20 new data points since Draft 1 was released.*
- *The Tier 1 specifications for both Active and No Load represent the top 17.5% of models in the data set.*
- *EPA designs its ENERGY STAR specifications to be performance-based. This means that it strives to recognize the better performing external power supplies in terms of energy efficiency without differentiating based on technology. Of note, there are both linear and switch mode models in EPA's data set that would currently qualify as ENERGY STAR under the proposed Tier 1 specification. This indicates that energy-efficient designs based upon more than one type of technology are achievable and available in today's marketplace.*
- *Language has been added to address fractional measurement values to ensure that any rounding is consistently handled in the same manner across manufacturers.*

While some stakeholders would prefer to measure efficiency only at 100% of rated load, EPA has maintained the average of multiple loading rates approach in Draft 2. The benefits of this approach are twofold: 1) it better reflects usage patterns as many electronic products with external power supplies are rarely operating at 100% of rated load, and 2) it recognizes that efficiency often varies across load conditions and rather than favor one load condition, it provides an average value for determining ENERGY STAR qualification.

The Draft 2 specification continues to be based on nameplate power as opposed to measured power, which was suggested by one stakeholder. Using measured power would require EPA to create a new protocol rather than simply refer to nameplate power on the UL label (for easy verification). Where possible, EPA's preferred approach is to leverage widely-accepted industry practices and methods.

No changes have been made to the specification to account for output voltage. Research conducted to date on EPA's behalf has indicated that output voltage has a limited effect on the efficiency of better performing power supplies (and is a less significant factor than wattage). Our analysis indicates that high current, low voltage power supplies are relatively less efficient designs and represent a small subset of the market, and as such, do not warrant a special allowance in the ENERGY STAR specification. As indicated at the May 24 Stakeholder Meeting, EPA is open to hearing more on this matter and encourages interested stakeholders to provide specific examples and data to better inform the discussion and analysis.

Regarding power factor correction (PFC), a few stakeholders recommended that EPA adopt the same approach and goals as the European Code of Conduct, which provides two power allowances for PFC capability. Through research on this issue, EPA has learned: 1) there are no automatic or inherent efficiency penalties associated with power factor correction if it is taken into account in the initial design stages of a power supply; and 2) there are designs available that meet PFC requirements and the proposed ENERGY STAR performance thresholds.

2. Tier 2: To continually recognize the most efficient models on the market and reflect anticipated improvements in technology, EPA plans to implement a Tier 2 Active Mode specification in early 2007. Approximately one year before the Tier 2 implementation 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, 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 mid 2006 so partners have adequate time to transition to the new levels.

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.

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 ≤180 watts	≤ 0.75 watts

***Note**: Regarding Draft 2 No-Load Mode, please note the following:*

- *Tier 1 has been revised to include two levels, as opposed to the previous four, based on the nameplate output power.*
- *The proposed specification represents the top 38% of models in No-Load Mode from EPA's data set.*

2. Tier 2: To continually recognize the most efficient models on the market and reflect anticipated improvements in technology, EPA plans to implement a Tier 2 No-Load Mode specification in early 2007. Approximately one year before the Tier 2 implementation 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, 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 mid 2006 so partners have adequate time to transition to the new levels.

***Note**: As of the writing of this Draft 2 specification, EPA is considering one Tier 2 No-Load level of less than or equal to 0.5 watts for all external power supplies. Stakeholders are welcome to comment on this proposal.*

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 Power Supplies (February 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 four ENERGY STAR-specific testing requirements.

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

A. Number of Units Required for Test: Testing shall be conducted on three randomly chosen units of the same model. Manufacturers shall report Active and No-Load Mode values for all three units.

B. 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.

C. 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 exceed the ENERGY STAR requirements at both the highest and the lowest voltage outputs, then it qualifies as ENERGY STAR.

D. 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 as well as discontinued models, must be provided on an annual basis, or more frequently if desired by the manufacturer.

> ***Note**: Section 4.C has been added in response to stakeholder comments on Draft 1. Since the test methodology does not specifically address switch selectable models, language is being proposed in the specification that allows for testing at the highest and lowest voltage outputs of the switch selector power supply. EPA believes that this approach ensures that the power supply is energy-efficient while minimizing the manufacturers' testing requirements (i.e., manufacturers are not asked to test at every switch-selectable voltage).*

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 proposed ENERGY STAR external power supply effective date is October 1, 2004.

> ***Note**: The proposed effective date is in the same timeframe as PowerChina2004, the 10th China International Power Supply Exhibition in Beijing, China on September 27-29, 2004. If appropriate, EPA and the China Certification Center for Energy Conservation Products (CECP) plan to attend this industry event and jointly announce the final external power supply specification. Manufacturers who sign the ENERGY STAR Partnership Agreement prior to the show will be recognized by EPA and CECP and allowed to promote their partnership at the show.*
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> *EPA plans to implement a Tier 2 specification in early 2007. A more specific date will be proposed during the development process.*
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> *Finally, for existing ENERGY STAR end-use product categories, the new external power supply specification will be phased in as an additional eligibility requirement when those specifications are revised. As always, transition times and effective dates will be informed by stakeholder discussions.*

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.