ENERGY STAR® Program Requirements for Products with Battery Charging Systems (BCSs)

DRAFT 2 Eligibility Criteria

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Eligibility Criteria

Below is the specification for ENERGY STAR qualified battery charging systems. Battery charging systems consist of the combination of a battery charger and battery as defined below. Covered systems may be either a battery charger with a detachable battery pack or a battery charger system functioning with a product or appliance that is powered by an integral battery. A battery charging system must meet all of the identified criteria if it is to be qualified as ENERGY STAR by its manufacturer.

While addressing a different set of product designs, this specification is intended to complement the existing ENERGY STAR external power supply specification. Manufacturers shall carefully examine their product designs and compare them to the detailed definitions (Section 1) and qualifying product descriptions (Section 2) for a battery charging system and external power supply (visit www.energystar.gov/powersupplies) 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. Note that a qualified battery charging system may use an ENERGY STAR qualified external power supply, but this is not sufficient or necessary to qualify the battery charging system as ENERGY STAR.

> ***Note**: EPA decided to cover the majority of battery charging systems, such as those found in small household appliances and power tools, under a specification separate from external power supplies so that power consumption needs unique to battery charging systems, including battery maintenance, could be addressed. For some products, including cell phones and PDAs, the energy use profiles are such that EPA saw significant energy savings potential by focusing exclusively on the external power supply.*
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> *The external power supply specification applies to separable external power supplies designed to convert line voltage ac into lower voltage ac or dc output. See www.energystar.gov/powersupplies for the full definition. Product models meeting this definition shall be tested under the ENERGY STAR External Power Supply Test Method and, where appropriate, qualified as ENERGY STAR under the external power supply specification.*
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> *The battery charging systems specification, on the other hand, applies to: motor-driven battery charged products; products whose principal output is heat, light, or motion; battery charging systems intended to replace standard sized primary alkaline cells (e.g., AAA, AA, C, 9-volt, etc.); and other products (e.g., some digital cameras and camcorders) with detachable batteries and stand-alone battery chargers whose designs are not covered by the external power supply specification. In the battery charging systems specification, the battery may be either separable from or integral to the end-use product. Please see below for the complete definition. Product models meeting this definition shall be tested under the ENERGY STAR Battery Charging System Test Methodology (see Section 4) and, where appropriate, qualified as ENERGY STAR under the battery charging systems specification.*
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> *Manufacturers are strongly encouraged to contact EPA with questions or uncertainties about ENERGY STAR eligibility.*

1) **Definitions**: Below are detailed definitions of battery charging systems and other related terms as relevant to ENERGY STAR.

General

A. Battery (also Battery Pack): An assembly of one or more rechargeable cells intended to provide electrical energy to an end-use product. Rechargeable cells are any of a number of established cell chemistries intended for repetitive charge/discharge cycles. Primary alkaline cells are not considered rechargeable. Batteries may be in one of the following forms:

a) Detachable Battery: A battery that is contained in a separate enclosure from the end-use product and is intended to be removed or disconnected from the end-use product for recharging.
b) Integral Battery: A battery that is contained within the end-use product and is not removed from the end-use product for charging purposes. A battery that is to be removed from the end-use product for disposal or recycling purposes only is considered to be an integral battery.

B. Battery Charger: A device intended to replenish the charge in a rechargeable battery. The battery charger will connect to the mains at the power input and connect to the battery at the output. The charger may be comprised of multiple components, in more than one enclosure, and may be all or partially contained in the end-use product.
a) A La Carte Charger: A separable battery charger that is individually packaged without batteries. Batteries that the a la carte charger is designed to charge should be listed on the packaging, battery, and/or in the user materials.
b) Multi-Voltage Charger: A battery charger that, by design, may charge a variety of batteries that are of different nominal voltages.
c) Multi-Port Charger: A battery charger that, by design, is capable of simultaneously charging two or more batteries. These chargers also may have multi-voltage capability, allowing two or more batteries of different voltages to charge simultaneously or sequentially.
d) Stand-Alone Charger: A battery charger that, by design, charges separable batteries disconnected from the end-use product.

C. Battery Charging System: A combination of battery charger and battery, detachable or integral, which is intended to power a cordless product.

Device Types

D. Battery Operated End-use Product: Product or appliance fully powered by the battery at least part of the time.

E. Cord/Cordless: Product or appliance that is designed to run on battery power, but also is designed such that the product or appliance can run with a discharged battery when connected to the mains.

F. Inductive Coupling: A system in which power is transferred between windings in two *separate enclosures* through magnetic induction rather than metal-to-metal contact. This design limits the possibility of electric shock or a short circuit and is often used in certain small household appliances, such as cordless toothbrushes and shavers.

Operational Modes

G. Active Mode: The condition in which the battery is receiving the main charge, equalizing cells, and performing other one-time or limited-time functions necessary for bringing the battery to the fully charged state.

H. Battery Maintenance Mode: The condition in which the battery is still connected to the charger, but has been fully charged. This mode may persist for an indefinite period of time.

I. Standby (No-Load) Mode: Lowest power consumption mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when an appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions. Note: The standby mode is usually a non-operational mode when compared to the intended use of the appliance's primary function.[1] For the purposes of this specification, standby mode is the condition in which no battery is present in the charger, or where the battery is integral to a product, the product is not attached to the charger, but the charger is plugged in and drawing power.

[1] This definition is consistent with IEC 62301: Household Electrical Appliances – Measurement of Standby Power.

***Note**: The above standby definition is consistent with IEC 62301. The standard is available at www.iec.ch.*

Test/Measurement Terminology

J. Accumulated Nonactive Energy (Ea): The energy, in watt-hours (Wh), consumed by the battery charger in battery maintenance and standby modes of operation over a defined period. For the purposes of this specification, the 48-hour period consists of 36 hours of maintenance mode operation followed by 12 hours of standby mode operation. The accumulated nonactive energy is the sum of the energy used in these two modes.

K. Battery Capacity: The quantity of charge, measured in ampere-hours (Ah), capable of being provided by a battery during discharge, the conditions of discharge being specified.

L. Battery Energy (Eb): The energy deliverable by the battery under known discharge conditions. For the purposes of this specification and test methodology, the battery energy shall be measured at a constant current discharge rate of 0.1 C. The test shall begin with a fully charged battery, and the energy shall be measured until the battery reaches its manufacturer specified cutoff voltage, with the cumulative total at the cutoff voltage being the battery energy. This value shall be reported by the manufacturer and is subject to verification by EPA.

M. Nominal Battery Voltage (Vb): Industry standard cell voltage multiplied by the number of cells in the battery pack. Nominal battery voltage is typically similar to measured open circuit terminal voltage of a battery in a steady, fully charged state. Industry accepted nominal battery voltages for applicable chemistries include: 1.2 volts for Nickel Cadmium and Nickel Metal Hydride; 2.0 volts for sealed lead acid; and 2.5-4.2 volts for Lithium Ion (depending on material used for the positive electrode and other factors).

N. Nonactive Energy Ratio (ER): The ratio of the accumulated nonactive energy (Ea) divided by the battery energy (Eb). ER = Ea / Eb.

***Note**: Based on stakeholder feedback, several additions and revisions have been made to Section 1, Definitions. The key changes include:*

- *Providing new definitions for battery charging systems, a la carte chargers, multi-voltage chargers, multi-port chargers, and stand-alone chargers;*
- *Narrowing the scope of the inductive coupling definition to emphasize inductive coupling systems used to transfer energy between two separate enclosures, as found in cordless toothbrushes and similar products;*
- *Moving cell equalization from the battery maintenance mode definition to the active mode definition;*
- *Deleting the rated battery capacity definition, as the term is not used in the specification and/or the test methodology;*
- *Revising the nominal battery voltage definition for added clarity and to provide industry accepted nominal battery voltages for applicable chemistries;*
- *Deleting the nominal battery energy definition and replacing it with a new battery energy definition; and*
- *Changing the cord/cordless definition to account for devices powered by a dc wall plug transformer.*

2) **Qualifying Products**: This ENERGY STAR specification applies to:

   a) Battery charging systems packaged with portable, rechargeable products whose principal output is mechanical motion, light, the movement of air, or the production of heat (e.g., small home appliances, personal care products, power tools, flashlights, and floor care products); and

   b) Products sold with a detachable battery and stand-alone battery charger (e.g., some digital camera and camcorder designs, and battery charging systems intended to replace standard sized primary alkaline cells including: AAA, AA, C, D, 9-volt, etc.).

In addition, battery charging systems must meet the following conditions:

1. Chargers must be intended for rechargeable battery chemistries (e.g., Nickel Cadmium, Lead Acid, Lithium Ion, and Nickel Metal Hydride) and not for primary cell chemistries (e.g., alkaline "dry" cells);
2. Chargers may not rely on an inductive coupling system used to transfer energy between two separate enclosures;
3. Batteries must have voltages less than 42 volts;
4. Chargers must have nameplate input power between 2 and 150 watts. (Nameplate power is either the input power marked on the nameplate or the product of the nameplate voltage and the nameplate current);
5. Charging systems must exclusively draw power for the purpose of charging a battery (i.e., chargers may not have a secondary functionality that draws power). These systems may, however, draw power to provide a simple clock function;
6. All products must meet the ENERGY STAR requirements as packaged for sale. A la carte chargers, which also may be multi-voltage and/or multi-port, may qualify as ENERGY STAR if they meet the requirements when tested using all batteries identified/listed as usable with the unit, as described in the ENERGY STAR Test Methodology.[2] If the same a la carte battery charger model also is packaged for sale with end-use products using batteries, these systems may only qualify if the specific charger and battery combinations also meet the ENERGY STAR requirements; and
7. Multi-port chargers may qualify if they meet the ENERGY STAR requirements with multiple identical batteries as outlined in the ENERGY STAR Test Methodology. Similarly, multi-voltage chargers may qualify if they meet the ENERGY STAR requirements with all applicable batteries of differing voltages as outlined in the ENERGY STAR Test Methodology.

The following types of battery charging systems are not covered by this ENERGY STAR specification:

1. Inductively coupled devices used to transfer energy between two separate enclosures;
2. Chargers with nameplate input power less than 2 watts; and
3. Charging systems that draw additional power to support added functionality such as radios, CD players, and GFI AC outlets.

In order to qualify as ENERGY STAR, a model must meet the above parameters and the energy performance criteria provided in Section 3, below.

Please note that single voltage external power supplies (including some that use the power supply's dc output to charge batteries) and the end-use products they power are covered under separate ENERGY STAR agreements ("ENERGY STAR Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies" and "ENERGY STAR Program Requirements for End-Use Products Using External Power Supplies"). Visit www.energystar.gov/powersupplies for additional information.

[2] See Section 4 for "Test Method for Determining the Energy Performance of Battery Charging Systems (Draft, October 2005)."

***Note**: Section 2 has been rewritten and reformatted to more carefully distinguish between products covered by the battery charging systems specification and those that are not. Language has been specifically added to allow multi-voltage, multi-port, and a la carte chargers to qualify as ENERGY STAR when tested and evaluated as outlined in Section 5.1 of the ENERGY STAR Test Methodology. Further, in this Draft 2 specification, EPA has excluded battery charging systems that draw additional power for added functions outside of battery charging (e.g., radios, CD players, and GFI AC outlets).*

As suggested by stakeholders, EPA is proposing to exclude products with very low power consumption, since the savings potential from such products would be very modest. EPA believes an exclusion based on steady input power is preferred over one based on battery voltage. With this approach, products designed for lower energy consumption will fit the exclusion, rather than products designed to simply operate at a lower voltage, which are inherently less efficient.

Under this Draft 2 specification, EPA will continue to cover battery chargers intended to be unplugged after charging. EPA understands that the instructions manual for these products advises consumers to unplug them after recharging. However, this does not preclude EPA from recognizing the better energy performers with an ENERGY STAR specification.

As suggested by a stakeholder, EPA revised the fourth bullet in Section 2 to refer to nameplate input power rather than maximum input power, which would require a measurement method.

3) **Energy Performance Specifications for Qualifying Products**: To be eligible for ENERGY STAR qualification, a battery charging system must not exceed a maximum Nonactive Energy Ratio, which is based on the nominal battery voltage (Vb). The maximum allowed Nonactive Energy Ratios are provided in Table 1 below for select battery voltages. For intermediate voltages, the battery charging system must not exceed the maximum Energy Ratio associated with the next highest voltage represented in the table. (Example: A product using a battery with a nominal voltage of 14.0 volts would need to meet a maximum Energy Ratio of 3.7, consistent with the requirements for the next highest voltage of 14.4, to qualify as ENERGY STAR.)

Table 1: Energy Performance Criteria for Common Battery Voltages

Vb	**1.2**	**2.4**	**3.6**	**4.8**	**6.0**	**7.2**	**8.4**	**9.6**	**10.8**	**12.0**	**13.2**	**14.4**	**15.6**	**16.8**	**>18.0**
ER	26.0	21.0	16.0	13.3	10.7	8.0	7.0	6.0	5.9	5.7	4.7	3.7	3.5	3.2	3.0

Given that multi-voltage and multi-port chargers require testing more than one battery pack, their Nonactive Energy Ratios must be calculated differently. For these chargers, the Nonactive Energy Ratio is calculated by taking the total accumulated energy from all tests and dividing by the sum of all the tested battery capacities. The reference voltage used to identify the maximum allowable Nonactive Energy Ratio is determined by averaging the battery voltages of all batteries tested. For single-voltage, multi-port chargers, this calculation method leads to taking the total accumulated energy from charging identical batteries and dividing by the sum of their capacities. The nominal voltage of a single identical battery pack is then used to identify the maximum allowable Nonactive Energy Ratio. Please refer to the ENERGY STAR Test Method for additional details.

***Note**: In this Draft 2 specification, EPA has determined the energy performance requirements for several reference battery voltages and calculated the Nonactive Energy Ratio for other voltages through linear interpolation. EPA has provided a table with typical battery voltages (in multiples of 1.2 volts, as is typical in Nickel Cadmium and Nickel Metal Hydride cells), and proposes that batteries with voltages that fall in between these typical values use the Nonactive Energy Ratio associated with the next highest voltage in the table. The advantages of this approach are: 1) it allows the Nonactive Energy Ratio to vary with the battery voltage; 2) it will be able to accommodate future battery voltages that may not be built in increments of 1.2 volts; and 3) it simplifies the qualification process by eliminating any calculations needed to determine the qualifying Nonactive Energy Ratio.*

Language has been added to Section 3 to briefly describe the Nonactive Energy Ratio calculation for multi-voltage and multi-port chargers. Additional details are provided in the ENERGY STAR Test Methodology.

Consistent with the ENERGY STAR guiding principles, the proposed specification represents the top 25.7% of models from EPA's data set (26 out of 101), which includes 101 new power tool, small household appliance, yard care, and personal care models.

A few stakeholders suggested that EPA add a power factor correction requirement to the specification for chargers above 75 watts. To do so would require EPA to collect power factor data on all tested models and then to likely redraw the specification levels. As such, EPA has decided not to implement this change at this time. However, once the specification is finalized, power factor data will be collected on qualifying models and analyzed for inclusion in a potential Tier 2 specification. This same approach is currently being employed for external power supplies.

EPA has decided to focus on Nonactive modes (i.e., battery maintenance and standby) because they offer the largest potential for energy savings and can be consistently measured through a robust and easy-to-use test method. While a total energy approach including Active mode has the benefit of addressing all operational modes, it also would require usage scenarios/assumptions per product area and may introduce measurement inconsistencies. EPA remains interested in addressing Active mode and will continue to support research in this area.

EPA has chosen Energy Ratio as its performance metric because it allows data to be normalized based on battery energy. EPA believes the proposed approach treats all product categories equitably.

4) **Test Methodology**: The specifics for testing the energy performance of a battery charging system are outlined in a separate document titled "Test Methodology for Determining the Energy Performance of Battery Charging Systems (Draft, October 2005)," 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 the ENERGY STAR Web site at* http://www.energystar.gov/index.cfm?c=new_specs.batterychargerdevelopment.

A. Safety Standards: ENERGY STAR qualified battery charging systems shall comply with applicable local product safety requirements in the market(s) in which the product is to be sold. It is the Partner's responsibility to ensure that its products meet acceptable standards of safety for battery charging systems.

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 Energy Ratio 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; however, the average of the three test values will be displayed on ENERGY STAR's qualifying product list (see Section 4.D below).

C. Models Capable of Operating at Multiple Voltage/Frequency Combinations: Manufacturers shall test their products based on the market(s) in which the models will be sold and promoted as ENERGY STAR qualified. EPA and its ENERGY STAR Country Partners have developed the following table with three voltage/frequency combinations for testing purposes:

Supply Voltage:	North America/Taiwan:	115 volts ac, 60 Hz
	Europe/Australia/New Zealand:	230 volts ac, 50 Hz
	Japan:	100 Volts AC, 50 Hz or 60 Hz (either frequency is acceptable)

For products that are sold as ENERGY STAR in multiple international markets and therefore rated at multiple input voltages, the manufacturer must test at and report the required power consumption, energy performance, or efficiency values at all relevant voltage/frequency combinations. For example, a manufacturer that is shipping the same model to the United States and Europe must measure, meet the specification, and report test values at both 115 volts, 60 Hz and 230 volts, 50 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR at only one voltage/frequency combination (e.g., 115 volts, 60 Hz), then it may only be qualified and promoted as ENERGY STAR in those regions that support the tested voltage/frequency combination (e.g., North America and Taiwan).

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 new models as well as notification of discontinued models, must be provided at least semi-annually. If no new models are introduced during a six-month timeframe, manufacturer should notify EPA to ensure its partnership status is maintained.

***Note**: In response to stakeholder feedback, EPA has revised the test methodology for battery charging systems. The document is available for review at* http://www.energystar.gov/index.cfm?c=new_specs.batterychargerdevelopment.

The following minor changes to Section 4 are reflected in this Draft 2 specification:

- *Rewording of Section 4.A, Safety Standards; and*
- *Modification of the Japanese frequencies to make it more clear that testing may be performed at either 50 or 60 Hz.*

EPA recognizes that the North American standard is set at 120 volts, 60 Hz per the National Electric Code and the Canadian Electric Code. However, 115 volts, 60 Hz was deliberately chosen for two reasons: 1) IEC Standard 62301 (standby power measurement methodology for household appliances) uses this same voltage/frequency combination. As such, this combination has been specified in other ENERGY STAR product specifications; and 2) EPA carefully vetted this combination with its counterparts in Taiwan. Taiwan's government is a regional ENERGY STAR program implementer whose voltage/frequency combination is 110 volts, 60 Hz. The combination of 115 volts, 60 Hz was chosen to reduce the testing burden on manufacturers who wish to qualify their products in both North America and Taiwan.

5) **Effective Date**: The date that manufacturers may begin to qualify and promote battery charging systems as ENERGY STAR will be defined as the *effective date* of the agreement. The ENERGY STAR battery charging systems effective date is January 1, 2006.

> ***Note**: No changes have been made to Section 5, Effective Date in this Draft 2 specification.*
>
> *Battery charging systems typically found in household appliances and power tools are currently excluded from qualifying as ENERGY STAR under the external power supply specification; the temporary exclusion ends on December 31, 2005. EPA is proposing that the new battery charging systems specification take effect on January 1, 2006, which is immediately following the expiration date for the exclusion. Once the battery charging systems specification is finalized, EPA will update the external power supply specification to remove any references to the exclusion and to add language directing stakeholders to the new battery charging systems specification.*

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.