# ENERGY STAR® Program Requirements
# Product Specification for Battery Charging Systems

## Eligibility Criteria
## Draft 1 Version 2.0

Following is the Version 2.0 ENERGY STAR Product Specification for Battery Charging Systems (BCSs). A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

EPA hosted a webinar on the Draft 1 Version 2.0 ENERGY STAR® specification for Battery Charging Systems (BCSs) on December 14, 2010. During the webinar, several stakeholders expressed concern regarding the proposed timeline for development of the ENERGY STAR BCSs specification and requested that EPA delay its process until DOE completed portions of its standard development work.

Following a discussion with DOE, EPA is acting on stakeholder comments by adjusting its proposed timeline for the development of an ENERGY STAR specification for BCS with the intention of aligning more closely with DOE's standard development work for the consumer BCS product category. In particular, EPA proposes to delay development of portions of the specification that would be impacted by the DOE test procedure and standard. These portions have been grayed-out in the draft below.

**Note:** Specification development relating to definitions, scope, nonactive power allowance, additional environmental benefits, and industrial BCSs (portions that have not been grayed-out) will continue as scheduled, with comments due by **January 15, 2011.**

# 1 DEFINITIONS

A) Product Types and Components:

1) Batch Charger: A Battery Charger that charges two or more identical Batteries simultaneously in a series, parallel, series-parallel, or parallel-series configuration. A Batch Charger does not have separate voltage or current regulation, nor does it have separate status indicators for each Battery in the batch. When testing a Batch Charger, the term ''Battery'' is understood to mean, collectively, all the Batteries in the batch that are charged together. A charger can be both a Batch Charger and a Multi-port Charger or Multi-voltage Charger.

2) Battery or Battery Pack: An assembly of one or more rechargeable cells and any integral protective circuitry intended to provide electrical energy to a Battery-operated End-use Product, that may be in one of the following forms:

a) Detachable Battery: A Battery that is contained in a separate enclosure from the Battery-operated End-use Product and is intended to be removed or disconnected from the Product for recharging; or

b) Integral Battery: A Battery that is contained within the Battery-operated End-use Product and is not removed from the Product for recharging.

3) Battery Charger: A device intended to replenish the charge in a Battery. A Battery Charger connects to the mains at the power input and connects to the Battery at the output. The charger may be comprised of multiple components, in more than one enclosure, and may be fully or partially contained in a Battery-operated End-use Product.

4) Battery Charging System: A combination of a Battery Charger and a Detachable or Integral Battery that is designed to power a Battery-operated End-use Product.

5) Battery-operated End-use Product: A cordless product or appliance fully powered by the Battery at least part of the time.

6) Inductive Coupling: Power transfer between windings in two separate enclosures through magnetic induction rather than metal-to-metal (i.e., galvanic) contact. Inductive Coupling is typically used in small household appliances, such as cordless toothbrushes and shavers.

7) Multi-port Charger: A Battery Charger that charges two or more Batteries (which may be identical or different) simultaneously. The Batteries are not connected in series or in parallel. Rather, each port has separate voltage and/or current regulation. If the charger has status indicators, each port has its own indicator(s). A charger can be both a Batch Charger and a Multi-port Charger if it is capable of charging two or more batches of Batteries simultaneously and each batch has separate regulation and indicator(s).

8) Multi-voltage Charger: A Battery Charger that, by design, can charge a variety of Batteries (or batches of Batteries, if also a Batch Charger) that are of different Rated Battery Voltages. A Multi-voltage Charger can also be a Multi-port Charger if it can charge two or more Batteries simultaneously with independent voltage and/or current regulation.

**Note:** According to the proposed DOE test procedure, multi-voltage and multi-port chargers shall be tested multiple times with different combinations of batteries. EPA is still considering how to combine and evaluate the results of these tests against the relevant energy consumption limits to determine qualification, and welcomes stakeholder comment on this issue.

B) Operating Modes:

1) Active Mode or Charge Mode: The state in which the Battery Charger system is connected to the main electricity supply, and the Battery Charger is delivering current, equalizing the cells, and performing other one-time or limited-time functions in order to bring the Battery to a fully charged state.

2) Battery Maintenance Mode or Maintenance Mode: The state in which the Battery Charger is connected to the main electricity supply and the Battery is fully charged, but is still connected to the charger.

3) Manual On-off Switch: A switch that is manually activated by an end-user to control input power to the Battery Charger. This term does not include any mechanical, optical, or electronic switches that automatically disconnect input power from the Battery Charger when a Battery is removed, or switches that control power to the Battery-operated End-use Product rather than the Battery Charger.

4) Off Mode: The state, applicable only to units with Manual On-off Switches, in which:

a) The Battery Charger is connected to the main electricity supply;

b) The Battery Charger is not connected to the Battery; and

c) All Manual On-off Switches are turned off.

5) Standby Mode or No-battery Mode: The state in which:

a) The Battery Charger is connected to the main electricity supply;

b) The Battery Charger is not connected to the Battery; and

c) For Battery Chargers with Manual On-off Switches, all such Switches are turned on.

C) Test/Measurement Terminology:

1) Battery Energy: The energy, in watt-hours, delivered by a Battery under discharge conditions specified in the ENERGY STAR Test Method.

2) C-rate: The rate of Battery charge or discharge, calculated by dividing the charge or discharge current by the Rated Charge Capacity of the Battery.

3) Charge Return Factor: The charge (in ampere-hours) returned by the Battery Charger to the Battery during the charge cycle divided by the charge delivered by the Battery during discharge.

4) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a Product Family. For Battery Charging Systems, acceptable variations within a Product Family include:

a) Color

b) Housing.

**Note:** EPA anticipates limited use of this product family provision. EPA is aware of chargers that deliver a charge in two different voltages. EPA seeks feedback on the prevalence of such chargers and the appropriateness of the above family provision for them.

5) Rated Battery Voltage: The output voltage specified by the manufacturer and typically printed on the Battery label. If there are multiple Batteries that are connected in series, the Rated Battery Voltage of the Batteries is the total voltage of the series configuration; that is, the Rated Battery Voltage of each Battery multiplied by the number of Batteries connected in series. Connecting multiple Batteries in parallel does not affect the Rated Battery Voltage.

6) Rated Charge Capacity: The Battery capacity specified by the manufacturer, usually measured in ampere-hours (Ah) or milliampere-hours (mAh) and typically printed on the Battery label. If there are multiple Batteries that are connected in parallel, the Rated Charge Capacity of the Batteries is the total charge capacity of the parallel configuration; that is, the Rated Charge Capacity of each Battery multiplied by the number of Batteries connected in parallel. Connecting multiple Batteries in series does not affect the Rated Charge Capacity.

7) Rated Energy Capacity: The product (in watt-hours) of the Rated Battery Voltage and the Rated Charge Capacity.

**Note:** The majority of proposed definitions are based on those in the proposed amendments to Appendix Y to 10 CFR Part 430 (i.e., the proposed DOE test procedure), with some additional clarifications. These are being proposed as replacements for the current ENERGY STAR definitions to harmonize the testing of BCS products with DOE. However, the definitions for Battery Charger and Battery Charging System have been retained from the Version 1.1 ENERGY STAR specification to reflect the difference in scope between the EPA and DOE efforts, most notably the proposed inclusion of industrial product BCS in this ENERGY STAR specification.

# 2 SCOPE

## 2.1 Included Products

2.1.1 The following products are eligible for ENERGY STAR qualification under this specification, with the exception of products listed in Section 2.2:

1. BCSs using either integral or detachable Batteries for consumer and industrial uses, including handheld tools and appliances, mobile communication devices, and motive equipment.

**Note:** This broad scope is intended to include the widest practical range of galvanically connected, AC input, DC output BCSs, since EPA has found that this scope presents the greatest energy savings opportunity. This includes products within the scope of the original specification, i.e., low-power BCSs for Detachable Batteries, standard-size Batteries, and heat, light, and motion products.

For clarity, certain product types are explicitly included in the paragraphs below.

2. BCSs embedded in cordless telephones.

**Note:** Because of the high savings potential of BCSs for cordless telephones in Battery Charging (Active) Mode, EPA is proposing to cover these products under the Battery Charger specification in place of the ENERGY STAR Telephony specification, which primarily targets telephone Standby Mode (as defined in the Telephony specification; equivalent to Battery Maintenance Mode here).

3. BCSs embedded in cellular telephones, personal data assistants, electronic book readers, and mobile computing products.

**Note:** EPA is considering covering under this specification BCSs for products formerly covered as End-Use Products Using External Power Supplies (EPSs), including cellular telephones and handheld computers.

EPA does not intend to include notebooks and netbooks, which are currently covered by the ENERGY STAR Computers specification. EPA also expects to discuss with Computer stakeholders the appropriate specification for addressing slates and other computing products that run almost exclusively on battery power. EPA expects to determine placement of these products in concert with stakeholders early in specification development for BCS and Computers.

EPA welcomes comment on the typical usage of portable computing products so that it can evaluate the comparative savings potential of covering these products under the BCSs specification versus the Computers specification. EPA also seeks further comment on any internal divisions between different types of portable computing products (e.g., slates versus electronic book readers).

4. BCSs intended to replace standard sized primary alkaline cells, including: AAA, AA, C, D, 9-volt, etc. (i.e., universal battery chargers).

## 2.2 Excluded Products

2.2.1 BCSs for products that are covered under other ENERGY STAR product specifications are not eligible for qualification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/products.

**Note:** EPA will cover products under only one specification, whether it be the BCS specification or a specification particular to the product (e.g., the Computer specification for notebook computers). Of the products that currently have dedicated ENERGY STAR specifications, EPA is proposing to address cordless telephones and combination telephone/answering machine products and handheld computers up to and excluding netbooks under the BCS specification, replacing their current specifications. Under this proposal, notebook and netbook computers, uninterruptible power supplies, and portable imaging equipment will remain under their respective product-specific specifications. EPA seeks comment on how to differentiate netbooks from smaller handheld computers.

2.2.2 The following products are not eligible for qualification under this specification:

1. BCSs with Inductive Coupling;

2. BCSs that do not draw power from the AC mains, or that do not ship with a wall adapter that allows them to do so. This includes MP3 players, in-car GPS systems, and any other products that are not intended to be charged primarily from the AC mains.

**Note:** EPA is proposing to exclude these products due to their low energy savings potential caused by: efficient lithium-ion battery chemistry, low battery energy, lack of AC/DC conversion (and associated losses), and infrequent use.

3. BCSs intended for primary cell chemistries (e.g., alkaline “dry” cells) and not for rechargeable battery chemistries (e.g., nickel cadmium, lead acid, lithium ion, and nickel metal hydride).

4. BCSs for on-road electric vehicles.

**Note:** This exclusion applies only to BCSs for the main motive battery of fully electric or plug-in hybrid-electric vehicles. BCSs intended to recharge or maintain a lead-acid starting battery are included.

5. BCSs intended for stationary, backup, or emergency uses. This includes any consumer or industrial product that uses a BCS primarily in Maintenance Mode, relying on the Battery in case of emergency. Examples include solar photovoltaic power systems, uninterruptible power supplies, emergency lighting, and emergency power systems for signaling and electric power distribution equipment.

# 3 QUALIFICATION CRITERIA

## 3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with actual measured or observed values. Only the final result of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact values without any benefit from further rounding.

## 3.2 Unit Energy Consumption Requirements for BCSs with Battery Energy Less than or Equal to 3 Kilowatt-hours

**Note:** EPA has divided the covered BCSs into three categories (reflective of portable consumer chargers, golf cars, and industrial motive equipment) using Battery Energy. EPA welcomes comment on the appropriateness of this metric for differentiating the three categories, and whether the proposed divisions at 3 and 10 kilowatt-hours are representative of the markets for these products.

3.2.1 Unit Energy Consumption: The unit energy consumption (UEC), as calculated per Equation 1, shall be less than or equal to the maximum UEC ($UEC_{MAX}$), as specified in Table 2, plus any allowances for the elimination of nonactive power, as specified in section 3.2.2.

**Equation 1: Unit Energy Consumption**

$$UEC = \begin{cases} \frac{365}{1000} \times \left( \left[ E_C - E_B \right] \times N_C + P_M \times \left[ t_{AM} - t_C \times N_C \right] + P_{NB} \times t_{NB} + P_O \times t_O \right), & t_C \times N_C \le t_{AM} \\ \frac{365}{1000} \times \left( \left[ E_C - E_B \right] \times N_C + P_{NB} \times t_{NB} + P_O \times t_O \right), & t_{AM} < t_C \times N_C \le t_{AM} + t_U \\ \frac{365}{1000} \times \left\{ \left( E_C - E_B \right) \times N_C + P_{NB} \times \left( t_{NB} - \left[ t_C \times N_C - t_{AM} - t_U \right] \right) \right\} + P_O \times t_O, & t_C \times N_C > t_{AM} + t_U \end{cases}$$

*Where:*

- *UEC is the unit energy consumption, in kilowatt-hours per year (kWh/yr);*
- *$E_C$ is the Charge Mode energy, in watt-hours (Wh), as estimated per Equation 2;*
- *$E_B$ is the Battery Energy, in Wh, as measured in the test method;*
- *$N_C$ is the number of charges, as specified in Table 1;*
- *$P_M$ is the Maintenance Mode power, in watts, as measured in the test method;*
- *$t_{AM}$ is the time in Maintenance and Active Modes, in hours, as specified in Table 1;*
- *$t_C$ is the charge time, in hours, as estimated per Equation 3;*
- *$P_{NB}$ is the No-battery Mode power, in watts, as measured in the test method;*
- *$t_{NB}$ is the time in No-Battery Mode, as specified in Table 1;*
- *$P_O$ is the Off Mode power, in watts, as measured in the test method, or if not applicable, the No-battery Mode power;*
- *$t_O$ is the time in Off Mode, as specified in Table 1;*
- *$t_U$ is the time in Unplugged Mode, as specified in Table 1.*

**Note:** The above equation is used to calculate the UEC using the test results and appropriate usage profile (i.e., average time spent in each mode) specified in Table 1. Note that one of three equations is to be used, depending on the duration of the charge mode ($t_C$) multiplied by the number of charges per day ($N_C$).

The methodology as well as the following example is based on Chapter 7 of the "Preliminary Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Battery Chargers And External Power Supplies," published by the U.S. Department of Energy in September 2010. As described in the Preliminary Technical Support Document, usage profiles are estimates of the average or typical use within each Battery Energy and voltage product class, and there may be BCSs that require more time to charge than this average. In those cases, the second and third lines of the equation shall apply, as illustrated in the example below.

Assume two BCSs, similar in Battery Energy and Rated Battery Voltage (e.g., 3 watt-hours and 3.6 volts; both in DOE product class 2), but differing in end-use application. The first is a fast charger intended for use with a cellular telephone, while the second is a slow charger intended for use with a shaver. The steps for calculating the UEC of each are outlined below.

1. The fast charger has a C-rate of 0.5 C, resulting in an estimated charge time ($t_C$) of 4 hours, per Equation 3. Therefore, the first line of Equation 1 applies as:

$$t_C \times N_C = (4\,\text{hr}) \times (0.56) = (2.24\,\text{hr}) \le t_{AM} = (9.7\,\text{hr}),$$

where $N_C$ and $t_{AM}$ are specified per Table 1. The UEC is then calculated as follows:

$$\begin{aligned} UEC &= \frac{365}{1000} \times \left( [E_C - E_B] \times N_C + P_M \times [t_{AM} - t_C \times N_C] + P_{NB} \times t_{NB} + P_O \times t_O \right) \\ &= \frac{365}{1000} \times \left( [E_C - E_B] \times (0.56) + P_M \times [(9.7\,\text{hr}) - (4\,\text{hr}) \times (0.56)] + P_{NB} \times (5\,\text{hr}) + P_O \times (0\,\text{hr}) \right) \\ &= \frac{365}{1000} \times \left( [E_C - E_B] \times (0.56) + P_M \times [7.46\,\text{hr}] + P_{NB} \times (5\,\text{hr}) + 0 \right), \end{aligned}$$

where $E_B$, $P_M$, $P_{NB}$ are measured according to the test method and $E_C$ is calculated per Equation 3.

2. Contrast this with the UEC calculation for a slow charger. Such a slow charger typically has a C-rate of 0.1 C, resulting in an estimated charge time ($t_C$) of 20 hours, per Equation 3. The first line of Equation 1 no longer applies:

$$t_C \times N_C = (20\,\text{hr}) \times (0.56) = (12.1\,\text{hr}) > t_{AM} = (9.7\,\text{hr}).$$

The amount of time spent in Active Mode exceeds the usage profile allowance for Active and Maintenance Modes; as specified in Chapter 7 of DOE's Preliminary Technical Support Document, the additional time should be subtracted from time in Unplugged Mode, if sufficient.

$$t_{AM} = (9.7\,\text{hr}) < t_C \times N_C = (20\,\text{hr}) \times (0.56) = (12.1\,\text{hr}) \le t_{AM} + t_U = (9.7\,\text{hr}) + (9.4\,\text{hr}) = (19.1\,\text{hr})$$

The above calculation demonstrates that it is; therefore, the second line of Equation 1 applies and the UEC is calculated as follows:

$$UEC = \frac{365}{1000} \times \left( \left[ E_C - E_B \right] \times N_C + P_{NB} \times t_{NB} + P_O \times t_O \right)$$

$$= \frac{365}{1000} \times \left( \left[ E_C - E_B \right] \times (0.56) + P_{NB} \times (5\,\text{hr}) + P_O \times (0\,\text{hr}) \right)$$

$$= \frac{365}{1000} \times \left( \left[ E_C - E_B \right] \times (0.56) + P_{NB} \times (5\,\text{hr}) + 0 \right).$$

It is further possible in some cases that the unplugged time is not sufficient for the charger to complete the typical charge cycle according to the usage profile. In this case, additional time would be subtracted from time in No-battery Mode, per the third line of Equation 1.

**Equation 2: Charge Energy**

$$E_C = E_{24} - P_M \times 24,$$

*Where:*

- *$E_C$ is the Charge Mode energy, in watt-hours (Wh);*
- *$E_{24}$ is the 24-hour Charge and Maintenance energy, in Wh, as measured in the test method;*
- *$P_M$ is the Maintenance Mode power, in watts, as measured in the test method.*

**Equation 3: Charge Time**

$$t_C = \frac{2}{C},$$

*Where:*

- *$t_C$ is the charge time, in hours;*
- *C is the C-rate of the charger, in units of C or 1/hours.*

**Note:** The proposed DOE test procedure does not differentiate between the Active and Maintenance portions of the 24-hour energy consumption, as doing so is subjective in some cases and therefore not always repeatable. To permit calculation of energy consumption in Maintenance Mode, EPA proposes estimating the charge time ($t_C$) according to Equation 3, based on a charger's C-rate, as reported by the manufacturer. Although ideally $t_C$ = 1/C, in practice the charge time is extended due to Battery inefficiency and lower-current (constant-voltage) operation as the Battery approaches full charge. EPA therefore proposes extending the ideal charge time by a factor of two, and welcomes comment on this proposal.

Once $t_C$ has been calculated, the estimated daily energy consumption of the charger in Maintenance Mode (if the charger enters Maintenance Mode during typical use), can be calculated as $P_M \times (t_{AM} - t_C \times N_C)$.

**Table 1: Usage Profile Parameters for Calculation of Unit Energy Consumption (UEC) for BCSs with Battery Energy Less than or Equal to 3 Kilowatt-hours**

| DOE | Battery Energy, | Rated | Active and | No-Battery | Unplugged Time, | Off Time, | Number of |
|---|---|---|---|---|---|---|---|

| Product Class | $E_B$, as Measured in the Test Method (watt-hours) | Battery Voltage, $V_B$, (volts) | Maintenance Time, $t_{AM}$ (hr/day) | Time, $t_{NB}$ (hr/day) | $t_U$ (hr/day) | $t_O$ (hr/day) | Charges Per Day, $N_C$ |
|---|---|---|---|---|---|---|---|
| 2 | $E_B \leq 100$ | $V_B \leq 4$ | 9.7 | 5 | 9.4 | 0 | 0.56 |
| 3 | $E_B \leq 100$ | $4 < V_B \leq 10$ | 5.6 | 0.2 | 18.1 | 0.1 | 0.22 |
| 4 | $E_B \leq 100$ | $V_B > 10$ | 19.8 | 0.3 | 6.9 | 0.1 | 0.88 |
| 5 | $100 < E_B \leq 3000$ | $V_B \leq 20$ | 7.7 | 0.5 | 15.8 | 0 | 0.55 |
| 6 | $100 < E_B \leq 3000$ | $V_B > 20$ | 15.4 | 8.6 | 0 | 0 | 0.46 |

**Note:** The proposed usage profiles for each category have been drawn from the "Preliminary Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Battery Chargers And External Power Supplies," published by the U.S. Department of Energy in September 2010. Please see Chapter 7 and specifically Table 7.16 in the Preliminary Technical Support Document for further detail. EPA welcomes comment on these usage assumptions.

**Table 2: Maximum Unit Energy Consumption ($UEC_{MAX}$) for BCSs with Battery Energy Less than or Equal to 3 Kilowatt-hours**

| DOE Product Class | Battery Energy, $E_B$, as Measured in the Test Method (watt-hours) | Rated Battery Voltage, $V_B$, (volts) | $UEC_{MAX}$ (kWh/yr) |
|---|---|---|---|
| 2 | $E_B \leq 100$ | $V_B \leq 4$ | 1.9 |
| 3 | $E_B \leq 100$ | $4 < V_B \leq 10$ | 1.5 |
| 4 | $E_B \leq 100$ | $V_B > 10$ | 10.2 |
| 5 | $100 < E_B \leq 3000$ | $V_B \leq 20$ | 58.1 |
| 6 | $100 < E_B \leq 3000$ | $V_B > 20$ | 30.8 |

**Note:** Although EPA is proposing UEC levels for all DOE product classes with Battery Energy less than or equal to 3000 watt-hours, the Agency welcomes further assistance with assembling a larger efficiency dataset for all products, and in particular products in DOE classes 4, 5, and 6. EPA has attached data collection sheets and will include in its analysis all test results added to its dataset by January 15, 2011.

3.2.2 Nonactive Power Allowance: Products that completely eliminate energy consumption in Maintenance or No-battery Modes are eligible for allowances that can be added to the maximum unit energy consumption limit ($UEC_{MAX}$), as specified in Table 2.

**Table 3: Nonactive Power Allowance for BCSs with Battery Energy Less than or Equal to 3 Kilowatt-hours**

| Battery Energy, $E_B$, as Measured in the Test Method (watt-hours) | Nonactive Power Allowance if Maintenance Mode Power Equals 0 watts, as Measured in the Test Method (kWh/yr) | Nonactive Power Allowance if No-battery Mode Power Equals 0 watts, as Measured in the Test Method (kWh/yr) |
|---|---|---|
| $E_B \leq 100$ | 0.5 | 0.5 |
| $100 < E_B \leq 3000$ | 5 | 5 |

**Note:** This incentive is intended to encourage manufacturers to develop and implement products with automatic disconnection of the transformer primary winding once the Battery has achieved full charge or has been removed from the charger. For instance, a BCS with Battery Energy equal to 45 watt-hours and Rated Battery Voltage equal to 18 volts (i.e., DOE product class 4), that successfully eliminates power draw in both Maintenance and No-battery Modes is eligible for a Nonactive Power Allowance of 0.5 + 0.5 = 1.0 kWh/yr, as specified per Table 3. This allowance would be applied to the UEC requirements in Table 2, such that this BCS could qualify for ENERGY STAR with a higher UEC of 10.2 + 1.0 = 11.2 kWh/yr.

EPA welcomes comment on the form of this incentive as well as any other method of promoting the reduction of nonactive energy use. Further, EPA seeks feedback on the prevalence of such functionality now, its expected growth, and any barriers to the broad adoption of such functionality in BCSs.

**Note:** EPA is also considering accounting for non-use phase environmental impacts of BCSs, including Battery disposal impacts. EPA welcomes comment on Battery recycling and lifetime issues including discussion of recycling infrastructure currently in place and the performance of such infrastructure, especially for lead-acid Batteries and products falling into DOE product classes 5 and 6. EPA welcomes stakeholder comments and suggestions.

## 3.3 Unit Energy Consumption Requirements for BCSs with Battery Energy Greater than 3 Kilowatt-hours and Less than of Equal to10 Kilowatt-hours

**Note:** This range of Battery capacity includes Battery Chargers for golf cars. Neither DOE nor other organizations have performed broad testing of BCSs in this range to date; therefore, EPA is requesting assistance with assembling a dataset that characterizes the range of efficiency in the market and could serve as a basis for an ENERGY STAR specification. EPA has attached a data collection sheet and will include in its analysis all data received by January 15, 2011.

## 3.4 Modal Limit Requirements for BCSs with Battery Energy Greater than 10 Kilowatt-hours

3.4.1 Charge Return Factor: The charge return factor (CRF) of the BCS, as measured according to the test method, shall be within the limits at each depth of discharge specified in Table 4.

**Table 4: Charge Return Factor Limits for BCSs with Battery Energy Greater than 10 Kilowatt-hours**

| Depth of Discharge | Charge Return Factor, CRF |
|---|---|
| 40% | 1.05 ≤ CRF ≤ 1.20 |
| 80% | 1.05 ≤ CRF ≤ 1.15 |
| 100% | 1.05 ≤ CRF ≤ 1.15 |

3.4.2 Modal Limits: The performance of the BCS in each mode, as indicated by the relevant metric measured in the test method shall be less than or equal to the maximum limits or greater than or equal to the minimum limits, as specified in Table 5.

**Table 5: Modal Limits for BCSs with Battery Energy Greater than 10 Kilowatt-hours**

| Mode | Metric | Minimum Limit | Maximum Limit |
|---|---|---|---|
| Active | Power Conversion Efficiency | 0.84 | N/A |
| | Power Factor | 0.85 | N/A |
| Maintenance | Maintenance Power | N/A | 40 W |
| No-battery | No-battery Power | N/A | 20 W |

# 4 TESTING REQUIREMENTS

## 4.1 Test Methods

4.1.1 When testing BCSs, the test methods identified in Table 6 shall be used to determine ENERGY STAR qualification:

**Table 6: Test Methods for ENERGY STAR Qualification**

| Product Type | Test Method |
|---|---|
| BCS with Battery Energy Less than or Equal to 10 Kilowatt-hours | "Uniform Test Method for Measuring the Energy Consumption of Battery Chargers," in Appendix Y to Subpart B of 10 CFR Part 430. |
| BCS with Battery Energy Greater than 10 Kilowatt-hours | Part 2 of "Energy Efficiency Battery Charger Test Procedure," Version 2.2. Available at www.efficientproducts.org |

**Note:** DOE proposed amendments to Appendix Y to Subpart B of 10 CFR Part 430 in a notice of proposed rulemaking (NOPR) published in the Federal Register on April 2, 2010. 75 FR 16958. It is EPA's intention to use this new test method, which includes Active Mode measurement, for BCSs with Battery Energy Less than or Equal to 10 Kilowatt-hours.

## 4.2 Number of Units Required for Test

4.2.1 Representative Models shall be selected for testing per the following requirements:

i. For qualification of an individual product model, a product configuration equivalent to that which is intended to be marketed and labeled as ENERGY STAR is considered the Representative Model;

ii. For qualification of a Product Family, any product configuration within the family may be considered the Representative Model.

4.2.2 Testing shall be conducted on three randomly chosen units of the same Representative Model.

**Note:** The above requirement was retained from the Version 1.1 specification. EPA welcomes comment on how it can best maintain the validity of test data while harmonizing with any reporting requirements proposed for adoption by DOE.

4.2.3 All tested units shall meet ENERGY STAR qualification requirements.

## 4.3 International Market Qualification

4.3.1 Single-phase products with Battery Energy less than or equal to 10 kilowatt-hours shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR, as specified in Table 7.

4.3.2 Three-phase products and products with Battery Energy greater than 10 kilowatt-hours shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR, as specified in Table 7, or if not intended to operate at any of the voltages in Table 7, then at the highest allowable input voltage.

**Table 7: Input Power Requirements for Single-Phase BCSs with Battery Energy Less than or Equal to 10 Kilowatt-hours**

| Market | Voltage | Voltage Tolerance | Maximum Total Harmonic Distortion | Frequency | Frequency Tolerance |
|---|---|---|---|---|---|
| North America, Taiwan | 115 Vac | +/- 1.0 % | 2.0 % | 60 Hz | +/- 1.0 % |
| Europe, Australia, New Zealand | 230 Vac | +/- 1.0 % | 2.0 % | 50 Hz | +/- 1.0 % |
| Japan | 100 Vac | +/- 1.0 % | 2.0 % | 50 Hz/60 Hz | +/- 1.0 % |

**Note:** The proposed DOE test procedure in Appendix Y to 10 CFR Part 430 limits testing of consumer Battery Chargers to the US line voltage (115 volts/60 hertz). The requirements in Table 7 shall supersede those in the DOE test procedure in the case of BCSs marketed for sale outside the United States. These requirements (typical of other ENERGY STAR test methods for consumer electronics) limit the number of tests to be performed by standardizing frequency and voltage combinations across regions.

# 5 EFFECTIVE DATE

5.1.1 Effective Date: The Version 2.0 ENERGY STAR BCS specification shall take effect on the dates specified in Table 8. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

**Table 8: Specification Effective Date**

| BCS End-Use Application | Effective Date |
|---|---|
| • Industrial equipment,<br>• Golf cars, and<br>• Any consumer products not eligible for qualification under the Version 1.1 ENERGY STAR specification for BCS. | June 1, 2011 |
| • All products currently covered by Version 1.1 ENERGY STAR specification for BCS, and<br>• Cordless phones. | March 1, 2012 |

5.1.2 Future Specification Revisions: EPA reserves the right to change this 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 industry discussions. In the event of a specification revision, please note that the ENERGY STAR qualification is not automatically granted for the life of a product model.

5.1.3 EPA intends to investigate the following topics during the next revision of the BCS specification:

1. Prevalence of automatic disconnection of the transformer primary winding once the Battery has achieved full charge or has been removed from the charger;
2. The continued need for incentives to encourage the transfer of this technology to a greater mix of BCS; and
3. The appropriateness of more rigorous UEC requirements to account for the progress BCS manufacturers have made in significantly reducing Maintenance and No-battery power use.