



ENERGY STAR[®] Program Requirements

Product Specification for Battery Charging Systems

Eligibility Criteria

Draft 1 Version 2.0

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

3 1 DEFINITIONS

4 A) Product Types and Components:

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

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

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

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

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

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

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

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

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

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

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

44 B) Operating Modes:

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

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

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

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

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

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

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

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

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

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

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

65 C) Test/Measurement Terminology:

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

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

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

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

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

- 85 5) Rated Battery Voltage: The output voltage specified by the manufacturer and typically printed
86 on the Battery label. If there are multiple Batteries that are connected in series, the Rated
87 Battery Voltage of the Batteries is the total voltage of the series configuration; that is, the
88 Rated Battery Voltage of each Battery multiplied by the number of Batteries connected in
89 series. Connecting multiple Batteries in parallel does not affect the Rated Battery Voltage.
- 90 6) Rated Charge Capacity: The Battery capacity specified by the manufacturer, usually
91 measured in ampere-hours (Ah) or milliampere-hours (mAh) and typically printed on the
92 Battery label. If there are multiple Batteries that are connected in parallel, the Rated Charge
93 Capacity of the Batteries is the total charge capacity of the parallel configuration; that is, the
94 Rated Charge Capacity of each Battery multiplied by the number of Batteries connected in
95 parallel. Connecting multiple Batteries in series does not affect the Rated Charge Capacity.
- 96 7) Rated Energy Capacity: The product (in watt-hours) of the Rated Battery Voltage and the
97 Rated Charge Capacity.

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

105 2 SCOPE

106 2.1 Included Products

107 2.1.1 The following products are eligible for ENERGY STAR qualification under this specification, with
108 the exception of products listed in Section 2.2:

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

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

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

117 2. BCSs embedded in cordless telephones.

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

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

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

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

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

136 4. BCSs intended to replace standard sized primary alkaline cells, including: AAA, AA, C, D,
137 9-volt, etc. (i.e., universal battery chargers).

138 2.2 Excluded Products

139 2.2.1 BCSs for products that are covered under other ENERGY STAR product specifications are not
140 eligible for qualification under this specification. The list of specifications currently in effect can be
141 found at www.energystar.gov/products.

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

150 2.2.2 The following products are not eligible for qualification under this specification:

151 1. BCSs with Inductive Coupling;

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

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

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

- 161 4. BCSs for on-road electric vehicles.

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

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

169 3 QUALIFICATION CRITERIA

170 3.1 Significant Digits and Rounding

171 3.1.1 All calculations shall be carried out with actual measured or observed values. Only the final result
172 of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant
173 digit as expressed in the corresponding specification limit.

174 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact
175 values without any benefit from further rounding.

176 3.2 Unit Energy Consumption Requirements for BCSs with Battery Energy 177 Less than or Equal to 3 Kilowatt-hours

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

182 3.2.1 Unit Energy Consumption: The unit energy consumption (UEC), as calculated per Equation 1,
183 shall be less than or equal to the maximum UEC (UEC_{MAX}), as specified in Table 2, plus any
184 allowances for the elimination of nonactive power, as specified in section 3.2.2.

186 Equation 1: Unit Energy Consumption

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

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Where:

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- 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.

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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).

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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.

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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.

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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:

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

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

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

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

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

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

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

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

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

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$$\begin{aligned} UEC &= \frac{365}{1000} \times ([E_C - E_B] \times N_C + P_{NB} \times t_{NB} + P_O \times t_O) \\ &= \frac{365}{1000} \times ([E_C - E_B] \times (0.56) + P_{NB} \times (5 \text{ hr}) + P_O \times (0 \text{ hr})) \\ &= \frac{365}{1000} \times ([E_C - E_B] \times (0.56) + P_{NB} \times (5 \text{ hr}) + 0). \end{aligned}$$

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

247 **Equation 2: Charge Energy**

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

249 *Where:*

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- 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.

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Equation 3: Charge Time

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

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Where:

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

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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.

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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 $P_M \times (t_{AM} - t_C \times N_C)$.

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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 Product Class	Battery Energy, E_B , as Measured in the Test Method (watt-hours)	Rated Battery Voltage, V_B , (volts)	Active and Maintenance Time, t_{AM} (hr/day)	No-Battery Time, t_{NB} (hr/day)	Unplugged Time, t_U (hr/day)	Off Time, t_O (hr/day)	Number of 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

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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.

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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 ≤ 100	V _B ≤ 4	1.9
3	E _B ≤ 100	4 < V _B ≤ 10	1.5
4	E _B ≤ 100	V _B > 10	10.2
5	100 < E _B ≤ 3000	V _B ≤ 20	58.1
6	100 < E _B ≤ 3000	V _B > 20	30.8

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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.

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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.

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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 ≤ 100	0.5	0.5
100 < E _B ≤ 3000	5	5

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292 **Note:** This incentive is intended to encourage manufacturers to develop and implement products with
293 automatic disconnection of the transformer primary winding once the Battery has achieved full charge or
294 has been removed from the charger. For instance, a BCS with Battery Energy equal to 45 watt-hours and
295 Rated Battery Voltage equal to 18 volts (i.e., DOE product class 4), that successfully eliminates power
296 draw in both Maintenance and No-battery Modes is eligible for a Nonactive Power Allowance of $0.5 + 0.5$
297 $= 1.0$ kWh/yr, as specified per Table 3. This allowance would be applied to the UEC requirements in Table
298 2, such that this BCS could qualify for ENERGY STAR with a higher UEC of $10.2 + 1.0 = 11.2$ kWh/yr.

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

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

308 **3.3 Unit Energy Consumption Requirements for BCSs with Battery Energy**
309 **Greater than 3 Kilowatt-hours and Less than of Equal to 10 Kilowatt-hours**

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

315 **3.4 Modal Limit Requirements for BCSs with Battery Energy Greater than 10**
316 **Kilowatt-hours**

317 3.4.1 Charge Return Factor: The charge return factor (CRF) of the BCS, as measured according to the
318 test method, shall be within the limits at each depth of discharge specified in Table 4.

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

Depth of Discharge	Charge Return Factor, CRF
40%	$1.05 \leq \text{CRF} \leq 1.20$
80%	$1.05 \leq \text{CRF} \leq 1.15$
100%	$1.05 \leq \text{CRF} \leq 1.15$

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321 3.4.2 Modal Limits: The performance of the BCS in each mode, as indicated by the relevant metric
322 measured in the test method shall be less than or equal to the maximum limits or greater than or
323 equal to the minimum limits, as specified in Table 5.

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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

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4 TESTING REQUIREMENTS

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4.1 Test Methods

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

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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

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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.

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4.2 Number of Units Required for Test

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

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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;

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340

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

341

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

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

345 4.2.3 All tested units shall meet ENERGY STAR qualification requirements.

346 **4.3 International Market Qualification**

347 4.3.1 Single-phase products with Battery Energy less than or equal to 10 kilowatt-hours shall be tested
 348 for qualification at the relevant input voltage/frequency combination for each market in which they
 349 will be sold and promoted as ENERGY STAR, as specified in Table 7.

350 4.3.2 Three-phase products and products with Battery Energy greater than 10 kilowatt-hours shall be
 351 tested for qualification at the relevant input voltage/frequency combination for each market in
 352 which they will be sold and promoted as ENERGY STAR, as specified in Table 7, or if not
 353 intended to operate at any of the voltages in Table 7, then at the highest allowable input voltage.

354 **Table 7: Input Power Requirements for Single-Phase BCSs with Battery Energy Less than or Equal**
 355 **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 %

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

362 **5 EFFECTIVE DATE**

363 5.1.1 Effective Date: The Version 2.0 ENERGY STAR BCS specification shall take effect on the dates
 364 specified in Table 8. To qualify for ENERGY STAR, a product model shall meet the ENERGY
 365 STAR specification in effect on its date of manufacture. The date of manufacture is specific to
 366 each unit and is the date (e.g., month and year) on which a unit is considered to be completely
 367 assembled.

Table 8: Specification Effective Date

BCS End-Use Application	Effective Date
<ul style="list-style-type: none"> • Industrial equipment, • Golf cars, and • Any consumer products not eligible for qualification under the Version 1.1 ENERGY STAR specification for BCS. 	June 1, 2011
<ul style="list-style-type: none"> • All products currently covered by Version 1.1 ENERGY STAR specification for BCS, and • Cordless phones. 	March 1, 2012

369 5.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
 370 technological and/or market changes affect its usefulness to consumers, industry, or the
 371 environment. In keeping with current policy, revisions to the specification are arrived at through
 372 industry discussions. In the event of a specification revision, please note that the ENERGY STAR
 373 qualification is not automatically granted for the life of a product model.
 374

375 5.1.3 EPA intends to investigate the following topics during the next revision of the BCS specification:

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