DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket No. EERE–2009–BT–TP–0019]

RIN 1904–AC03

Energy Conservation Program: Test Procedures for Battery Chargers and External Power Supplies

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Notice of proposed rulemaking and public meeting.

SUMMARY: The U.S. Department of Energy (DOE) proposes major revisions to its test procedures for battery chargers and external power supplies. In particular, DOE proposes to insert a new active mode energy consumption test procedure for battery chargers, to assist in the development of energy conservation standards as directed by the Energy Independence and Security Act of 2007. DOE also proposes to amend portions of its existing standby and off mode battery charger test procedure to shorten the measurement time. DOE is also considering amending its existing active mode single-voltage external power supply test procedure to permit testing of certain types of external power supplies that the existing test procedure may be unable to test. Additionally, DOE proposes to insert a new procedure to address multiple-voltage external power supplies, which are not covered under the current single-voltage external power supply test procedure. Finally, DOE is announcing a public meeting to receive comment on the issues presented in this notice of proposed rulemaking.

DATES: DOE will hold a public meeting in Washington, DC on Friday, May 7, 2010, beginning at 9 a.m. DOE must receive requests to speak at the meeting before 4 p.m., Friday, April 23, 2010. DOE must receive a signed original and an electronic copy of statements to be given at the public meeting before 4 p.m., Friday, April 30, 2010.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before or after the public meeting, but no later than June 16, 2010. *See* Section V, "Public Participation," of this NOPR for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue, SW., Washington, DC 20585–0121. To attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals participating in the public meeting are subject to advance security screening procedures, requiring a 30-day advance notice. If a foreign national wishes to participate in the workshop, please inform DOE of this fact as soon as possible by contacting Ms. Brenda Edwards at (202) 586–2945 so that the necessary procedures can be completed.

Any comments submitted must identify the Battery Charger Active Mode Test Procedure NOPR, and provide the docket number EERE–2009–BT–TP–0019 and/or Regulation Identifier Number (RIN) 1904–AC03. Comments may be submitted using any of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
- *E-mail: BC&EPS_Test_Proc@ee.doe.gov.* Include the docket number EERE–2009–BT–TP–0019 and/or RIN 1904–AC03 in the subject line of the message.
- *Postal Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please submit one signed paper original.
- *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 6th Floor, 950 L'Enfant Plaza, SW., Washington, DC 20024. Telephone: (202) 586–2945. Please submit one signed paper original.

For detailed instructions on submitting comments and additional information on the rulemaking process, *see* section V., "Public Participation," of this document.

Docket: For access to the docket to read background documents or comments received, visit the U.S. Department of Energy, 6th Floor, 950 L'Enfant Plaza, SW., Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards at (202) 586–2945 for additional information regarding visiting the Resource Room. Please note: DOE's Freedom of Information Reading Room no longer houses rulemaking materials.

FOR FURTHER INFORMATION CONTACT: Mr. Victor Petrolati, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–4549. E-mail: *Victor.Petrolati@ee.doe.gov.* In the Office of General Counsel, contact Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–72, 1000 Independence Avenue, SW., Washington, DC 20585. Telephone: (202) 586–9507. E-mail: *Michael.Kido@hq.doe.gov.*

For additional information on how to submit or review public comments and on how to participate in the public meeting, contact Ms. Brenda Edwards, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–2945. E-mail: *Brenda.Edwards@ee.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291 *et seq.;* EPCA or the Act) sets forth a variety of provisions designed to improve energy efficiency. Part A of title III (42 U.S.C. 6291–6309) establishes the "Energy Conservation Program for Consumer Products Other Than Automobiles," which covers consumer products and certain commercial products (all of which are referred to below as "covered products"), including battery chargers (BCs) and external power supplies (EPSs).

Under EPCA, the overall program consists essentially of the following parts: Testing, labeling, and Federal energy conservation standards. The testing requirements consist of procedures that manufacturers of covered products must use to certify to the U.S. Department of Energy (DOE) that their products comply with EPCA energy conservation standards and to quantify the efficiency of their products. Also, these test procedures must be used whenever testing is required in an enforcement action to determine whether covered products comply with EPCA standards.

Section 323 of EPCA (42 U.S.C. 6293) sets forth generally applicable criteria and procedures for DOE's adoption and amendment of such test procedures. It states, for example, that test procedures for covered products should measure energy use, energy efficiency, or annual operating cost during a period that is representative of typical use. The test procedure should not be "unduly burdensome." (42 U.S.C. 6293(b)(3)) In addition, consistent with 42 U.S.C. 6293(b)(2) and Executive Order 12899, 58 FR 69681 (Dec. 30, 1993), if DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them, with a comment period of not less than 75 days. Finally, in any rulemaking to amend a test procedure, DOE must determine "to what extent the proposed test procedure would alter the measured energy efficiency as determined under the existing test procedure." (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

Relevant to today's notice, section 135 of the Energy Policy Act of 2005 (EPACT), Public Law 109–58, amended sections 321 and 325 of EPCA by providing definitions for BCs and EPSs and directing the Secretary to prescribe "definitions and test procedures for the power use of battery chargers and external power supplies." (42 U.S.C. 6295(u)(1)(A)) DOE complied with this requirement by publishing a test procedure final rule, 71 FR 71340, on December 8, 2006 (EPACT 2005 En Masse final rule). In that notice, DOE codified the test procedure for BCs in appendix Y to subpart B of part 430 in title 10 of the Code of Federal Regulations (CFR) ("Uniform Test Method for Measuring the Energy Consumption of Battery Chargers"; hereafter referred to as "appendix Y") and the test procedure for EPSs in appendix Z to subpart B of 10 CFR part 430 ("Uniform Test Method for Measuring the Energy Consumption of External Power Supplies"; hereafter referred to as "appendix Z").

On December 19, 2007, the Energy Independence and Security Act of 2007 (EISA 2007), Public Law 110–140, further amended sections 321, 323, and 325 of EPCA, prompting DOE to propose and promulgate amendments to its test procedures for BCs and EPSs.

Section 301 of EISA 2007 amended section 321 of EPCA by modifying definitions concerning EPSs. EPACT had amended EPCA to define an EPS as "an external power supply circuit that is used to convert household electric current into DC current or lower-voltage AC current to operate a consumer product." [1] (42 U.S.C. 6291(36)(A)) Section 301 of EISA 2007 further amended this definition by creating a subset of EPSs called Class A EPSs. EISA 2007 defined this subset as those EPSs that, in addition to meeting several other requirements common to all EPSs, are "able to convert to only 1 AC or DC output voltage at a time" and have "nameplate output power that is less than or equal to 250 watts." [2] (42 U.S.C. 6291(36)(C)(i))

Section 301 also amended EPCA to establish minimum standards for these products, which became effective on July 1, 2008 (42 U.S.C. 6295(u)(3)(A)), and directed DOE to publish a final rule by July 1, 2011, to determine whether to amend these standards. (42 U.S.C. 6295(u)(3)(D)) Section 301 further directed DOE to issue a final rule that prescribes energy conservation standards for BCs or determine that no "standard is technically feasible or economically justified." (42 U.S.C. 6295(u)(1)(E)(i)(II))

In satisfaction of this requirement, DOE is bundling BCs and Class A EPSs together in a single rulemaking proceeding to consider appropriate energy conservation standards for these products. DOE published a notice of Public Meeting and Availability of Framework Document for Battery Chargers and External Power Supplies on June 4, 2009. 74 FR 26816. DOE then

[1] The terms "AC" and "DC" refer to the polarity (*i.e.,* direction) and amplitude of current and voltage associated with electrical power. For example, a household wall socket supplies alternating current (AC), which varies in amplitude and reverses polarity. In contrast, a battery or solar cell supplies direct current (DC), which is constant in both amplitude and polarity.

[2] EISA 2007 defines a Class A EPS as an EPS that converts AC line voltage to only 1 lower AC or DC output, is intended to be used with an end-use product, is in a different enclosure from the end-use product, is wired to the end-use product, and has rated output power that is less than 250 watts. (42 U.S.C. 6291(36)(C)(i)).

held a public meeting to receive comment on the framework document [3] on July 16, 2009 (hereafter referred to as the framework document public meeting). During this public meeting, DOE also received comments on the BC active mode test procedure and other test procedure issues, some of which will be discussed in today's notice.

Under Section 302 of EISA, Congress instructed DOE to review its test procedures every seven (7) years. As needed, DOE must either amend the test procedure to (1) Improve its measurement representativeness or accuracy or (2) reduce its burden, or (3) determine that such amendments are unnecessary. DOE considers this rulemaking to constitute a 7-year review for both BC and EPS test procedures as required under EPCA, as modified by section 302 of EISA. (42 U.S.C. 6293(b)(1)(A)) Because DOE's existing test procedures for BCs and EPSs were in place on December 19, 2007, when the 7-year test procedure review provisions of EPCA were enacted (42 U.S.C. 6293(b)(1)(A)), DOE would have to review these test procedures by December 2014. But because DOE is conducting this rulemaking, the Department has satisfied this review requirement in advance of this date.

Section 309 of EISA further amended section 325(u)(1)(E) of EPCA, instructing DOE to issue no later than two years after EISA's enactment a final rule "that determines whether energy conservation standards shall be issued for external power supplies or classes of external power supplies." (42 U.S.C. 6295(u)(1)(E)(i)(I)) However, as section 301 of EISA simultaneously set standards for Class A external power supplies, DOE interprets sections 301 and 309 jointly as a requirement to determine, no later than two years after EISA's enactment, whether additional energy conservation standards shall be issued for EPSs that are outside the scope of the current Class A standards, *e.g.,* multiple-voltage EPSs.

Finally, section 310 of EISA 2007 amended section 325 of EPCA to establish definitions for active mode, standby mode, and off mode. (42 U.S.C. 6295(gg)(1)(A)) This section also directed DOE to amend its existing test procedures by December 31, 2008, to measure the energy consumed in standby mode and off mode for both BCs and EPSs. (42 U.S.C. 6295(gg)(2)(B)(i)) Further, it authorized DOE to amend, by rule, any of the definitions for active, standby, and off mode (42 U.S.C. 6295(gg)(2)(A)) The Department presented its then-proposed amendments during a public meeting on September 12, 2008 (hereafter referred to as the standby and off mode test procedure public meeting) and published them in the Test Procedures for Battery Chargers and External Power Supplies (Standby Mode and Off Mode) Final Rule on March 27, 2009. 74 FR 13318.

Today's notice proposes (1) the adoption of new test procedures for the active mode of BCs and all modes of multiple-voltage EPSs and (2) the modification of existing parts of the BC and EPS test procedures (*e.g.,* BC standby and off mode test duration). In doing so, it proposes to amend both appendices Y and Z in multiple places. Furthermore, although DOE proposes to retain the current language of certain sections of appendices Y and Z, in selecting proposed amendments for inclusion in today's notice, DOE considered all aspects of the existing BC and EPS test procedures. Nonetheless, DOE seeks comment on the entirety of the BC and EPS test procedure to ensure that no additional amendments are needed at this time to further improve the procedures' representativeness or reduce its burden.

In the absence of comments on issues beyond those discussed in today's notice, DOE expects to issue a final rule adopting these proposals in a timely manner. In this case, DOE would expect this rulemaking to satisfy the 7-year review requirement and would not expect any further review of the test procedures until 7 years after the effective date of the proposals in this notice—*i.e.,* no sooner than 2017.

To the extent that DOE receives comments on issues beyond those discussed in today's notice, DOE may address these comments in a separate test procedure rulemaking, which would allow DOE to finalize today's proposed BC active mode test procedure in time to support the corresponding standards rulemaking but allow sufficient time to take into consideration all comments from interested parties as required by the 7-year review provisions of 42 U.S.C. 6293(b)(1)(A).

II. Summary of the Proposal

In this notice of proposed rulemaking (NOPR), DOE proposes to:

(1) Insert a new test procedure to measure the energy consumption of BCs in active mode to assist in the development of energy conservation standards;

(2) Amend the BC test procedure to decrease the testing time of BCs in standby and off modes;

(3) Potentially amend the single-voltage EPSs test procedure to accommodate EPSs with Universal Serial Bus (USB) outputs and others that may not currently be tested in accordance with the test procedure; and

(4) Insert a new test procedure for multiple-voltage EPSs, a type of non-Class A EPS that DOE will evaluate in the non-Class A determination analysis.

Table 1 lists the sections of 10 CFR part 430 potentially affected by the amendments proposed in this NOPR. The left-hand column in the table cites the locations of the potentially affected CFR provisions, while the right-hand column lists the proposed changes.

TABLE 1—SUMMARY OF PROPOSED CHANGES AND AFFECTED SECTIONS OF 10 CFR PART 430

Existing section in 10 CFR Part 430	Summary of proposed modifications
Section 430.23 of Subpart B—Test procedures for the measurement of energy and water consumption.	• Modify '(aa) battery charger' to include energy consumption in active mode.
Appendix Y to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Battery Chargers.	• Renumber the existing sections to ease referencing and use by testing technicians.
1. Scope	• Limit scope to only include BCs intended for operation in the United States.

[3] "Energy Conservation Standards Rulemaking for Battery Chargers and External Power Supplies." May 2009. Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/bceps_frameworkdocument.pdf.*

TABLE 1—SUMMARY OF PROPOSED CHANGES AND AFFECTED SECTIONS OF 10 CFR PART 430—Continued

Existing section in 10 CFR Part 430	Summary of proposed modifications
2. Definitions	• Add definitions for: ○ Active power or real power (P). ○ Ambient temperature. ○ Apparent power (S). ○ Batch charger. ○ Battery rest period. ○ C-rate. ○ Crest factor. ○ Equalization. ○ Instructions or manufacturer's instructions. ○ Measured charge capacity. ○ Power factor. ○ Rated battery voltage. ○ Rated charge capacity. ○ Rated energy capacity. ○ Total harmonic distortion (THD). ○ Unit under test (UUT). • Remove definitions for: ○ Accumulated nonactive energy. ○ Energy ratio or nonactive energy ratio. • Modify definitions for: ○ Active mode. ○ Multi-port charger. ○ Multi-voltage a la carte charger. ○ Standby mode.
3. Test Apparatus and General Instructions	• Insert apparatus and instructions to measure energy consumption in active mode.
4. Test Measurement	• Insert procedures to measure energy consumption in active mode. • Modify 4(c) to change standby mode measurement time. • Modify 4(d) to change off mode measurement time.
Appendix Z to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of External Power Supplies.	
1. Scope	• No change.
2. Definitions	• Modify definition of active power.
3. Test Apparatus and General Instructions	• Modify 3(b) to accommodate multiple-voltage EPSs.
4. Test Measurement	• Potentially modify 4(a) to accommodate EPSs that communicate with the load, perform current limiting, or have output power greater than 250 watts. • Modify 4(b) to accommodate multiple-voltage EPSs.

In developing today's proposed test procedure amendments, DOE considered comments received from interested parties following the standby and off mode test procedure and framework document public meetings. Numerous comments dealt with testing new modes. In order to incorporate such changes, DOE reviewed the existing test procedures for BCs and EPSs, and found that, with some modifications, they could be used as a basis for updating DOE's test procedures. This issue is discussed in greater detail later in this notice.

DOE also examined whether the proposed amendments to its test procedures would significantly change the measured energy consumption or efficiency of the BC or EPS. This question is particularly important for Class A EPSs, which are subject to the EISA minimum efficiency standard that took effect on July 1, 2008. (42 U.S.C. 6295(u)(3)(A))

The amendments under consideration to the single-voltage EPS test procedure (used to test compliance with Class A EPS standards) would affect the measured efficiency of EPSs with USB output and others that communicate with their loads—the subset of Class A EPSs to which these amendments would apply.[4] As described in section III.D., these amendments are presented in today's notice because of DOE's concern that the current single-voltage EPS test procedure may not measure the efficiency of these EPSs in a manner representative of their typical use, resulting in a lower measured efficiency than achievable under typical operating conditions. Because the single voltage test procedure amendments discussed in section III.D. would modify the test conditions to make them more representative of typical use, the measured efficiency of these EPSs would likely increase. Nonetheless, DOE does not expect any commensurate increase in the standards level for these EPSs. EPSs that communicate with their loads should be held to the same standard as the remainder of EPSs, which do not communicate with their loads, as long as they are measured in a representative fashion.

The remaining amendments included in today's notice, if adopted, would have the following impacts on measured energy consumption or efficiency:

(1) The BC active mode test procedure amendment would change the measured energy consumption of BCs by eliminating the nonactive energy ratio metric and replacing it with a new metric that measures energy consumption in active mode;

(2) The standby and off mode test procedure amendment would not change the measured energy consumption of BCs or EPSs; and

[4] The term "communicating" with a load refers to an EPS's ability to identify or otherwise exchange information with its load (*i.e.*, the end-use product to which it is connected). While most EPSs provide power at a fixed output voltage regardless of what load is connected to their outputs, some EPSs will only provide power once they have "communicated" with the load and identified it as the intended load.

(3) The multiple-voltage EPS amendment would insert a new test procedure for these products,

A. Battery Charger Active Mode Test Procedure

The current DOE BC test procedure, first created by the EPACT 2005 En Masse final rule, 71 FR 71340, and amended by the standby and off mode final rule, 74 FR 13318, does not measure BC energy consumption in all modes. Instead, it excludes the energy consumed by the BC while charging a battery. The procedure measures energy consumption only in maintenance, standby (no battery), and off modes, when the battery has either been fully charged or removed from the BC.

The BC active mode test procedure proposal in today's notice, if adopted, would remove the inactive mode measurement (section 4(a) of appendix Y—which is a composite of different operational modes that would be measured separately under today's proposal), add active mode measurement to section 4(b), amend the scope, definitions, and test apparatus and general instructions (sections 1, 2, and 3) in support of the new active mode test procedure, as well as rearrange and renumber the sections to ease referencing and use by testing technicians. The active mode amendment is based on the optional battery charger system test procedure adopted by the California Energy Commission (CEC),[5] but has been modified to decrease testing burden (*e.g.,* by considering a shorter test period and more efficient use of equipment) and increase clarity (*e.g.,* by dividing complex procedures into discrete steps). These and other details of the proposal are discussed further in section III.B.

B. Review of Battery Charger and External Power Supply Standby Mode and Off Mode Test Procedures

DOE addressed the EPCA requirements to prescribe definitions and test procedures for measuring the energy consumption of EPSs and BCs in standby and off modes (42 U.S.C. 6298(gg)(A) and (B)) in the Test Procedures for Battery Chargers and External Power Supplies (Standby Mode and Off Mode) Final Rule. 74 FR 13318. This final rule incorporated standby and off mode measurements as well as updated definitions into appendices Y and Z.

In today's notice, DOE proposes amending the BC test procedure to require the use of a 30-minute warm-up period followed by a 10-minute measurement period. Currently, the DOE test procedure requires a 1-hour measurement period. This amendment would harmonize DOE's standby and off mode measurement for BCs with that contained in section IV of part 1 of the CEC BC test procedure. DOE anticipates that harmonizing its procedure with the CEC BC test procedure will produce a test procedure that decreases the testing burden on manufacturers while preserving testing accuracy. No changes are proposed to the standby and off mode test procedures for EPSs. Detailed discussion of the changes under consideration can be found in section III.C., below.

C. Review of Single-Voltage External Power Supply Test Procedure

DOE is also considering amending the test procedure for single-voltage EPSs to accommodate several classes of EPSs that cannot be tested in a representative or repeatable manner under the current test procedure. These EPSs include (1) Those that communicate with their loads through USB and other protocols,[6] (2) limit their output current below the maximum listed on their nameplate, and (3) have output power in excess of 250 watts. However, because these EPSs do not exist in significant numbers in the market, DOE has not been able to analyze them in depth and develop a general approach to testing them under the single-voltage EPS test procedure. Therefore, DOE will only be presenting the general outline of the test procedure changes under consideration, and will proceed in developing and promulgating a procedure covering these EPSs if it receives comments from interested parties verifying the approaches presented (*e.g.,* custom test fixtures in the case of EPSs that communicate with their loads). The three types of EPSs that could be affected are briefly described below, while the test procedure changes under consideration can be found in section III.D.

USB-Based EPSs

USB EPSs typically power portable electronic products such as cellular telephones and portable media players that frequently receive power and data from a personal computer through its USB port. In contrast to most EPSs, which only provide one pair of output conductors (for power), the USB interface provides two pairs—for data and power, respectively. Although DOE's current single-voltage EPS test procedure accommodates testing single-voltage EPSs that have more than one pair of output conductors, it may not result in measurements representative of typical use if the other pairs of conductors are necessary for the specified operation of the EPS.

EPSs That Communicate With Loads

In addition to USB-based EPSs, other EPSs exist that also communicate with loads (*e.g.,* notebook computers) using proprietary protocols. To address these designs, DOE is considering amending the single-voltage EPS test procedure to permit communication between the EPS and the load during testing. Any changes to the EPS test procedure to address this issue would affect only USB-compliant EPSs and other EPSs that cannot operate in a representative fashion without communication with the load. Additional details regarding this possible change are presented in section III.D.1., below.

Output Current Limiting EPSs

Similarly, DOE has encountered EPSs that may not be tested due to "output current limiting," *i.e.,* a mode of operation in which the EPS significantly lowers its output voltage once an internal limit on the output current has been exceeded. Although all EPSs limit their output current to provide additional safety during short-circuit conditions, some EPSs have been found to limit current to a value below the maximum specified on their nameplate. Because DOE's single-voltage EPS test procedure does not provide for this possibility, DOE is considering adding language specifying the correct loading points in this case. The changes under consideration are detailed in section III.D.2.

EPS with Nameplate Output Exceeding 250 Watts

Finally, the current DOE single-voltage EPS test procedure may not sufficiently accommodate the testing of single-voltage EPSs with nameplate output power greater than 250 watts. In contrast to EPSs with output power less than 250 watts, high-power EPSs may have several maximum output currents, something the test procedure does not take into consideration. DOE is therefore considering clarifying the current regulatory language to account for this configuration. The changes under

[5] Ecos Consulting, Electric Power Research Institute (EPRI) Solutions, Southern California Edison (SCE). "Energy Efficiency Battery Charger System Test Procedure." Version 2.2. November 12, 2008. *http://www.energy.ca.gov/appliances/2008rulemaking/2008-AAER-1B/2008-11-19_BATTERY_CHARGER_SYSTEM_TEST_PROCEDURE.PDF.*

[6] Some EPSs feature circuitry that allows them to communicate with their loads. This is used to tailor operation to the needs of the load as well as prevent use with incompatible loads.

consideration are detailed in section III.D.3.

D. Multiple-Voltage External Power Supply Test Procedure

Section 309 of EISA amended section 325 of EPCA by directing DOE to conduct a determination analysis for EPSs such as those EPSs equipped with multiple simultaneous output voltages. DOE is not aware of any existing test procedure developed specifically to measure the efficiency or energy consumption of multiple-voltage EPSs. To develop such a procedure, DOE reviewed related test procedures currently in use and proposed a test procedure for multiple-voltage EPSs based on the Environmental Protection Agency (EPA) single-voltage EPS [7] and internal power supply (IPS) [8] test procedures. 73 FR 48054. In today's notice, DOE is proposing a test procedure generally consistent with its August 2008 proposal, but with some changes to accommodate the concerns of interested parties.

Incorporating this amendment into the EPS test procedure would enable DOE to evaluate power consumption for multiple-voltage EPSs in all modes of operation: active, standby (*i.e.,* no-load), and off. A detailed discussion of DOE's proposed test procedure for multiple-voltage EPSs can be found in section III.E., below.

III. Discussion

A. Effective Date for the Amended Test Procedures

If adopted, the amendments proposed today would become effective 30 days after the publication of the final rule. As of this effective date, manufacturers (and DOE) would be required to use the amended appendices when testing to determine if BCs and EPSs comply with energy conservation standards. In addition, any representations made regarding energy use or the cost of energy use for such products manufactured on or after the effective date would have to be based on the amended test procedures in appendices Y and Z.

However, absent new standards, only the amendments to the single-voltage EPS test procedure would be binding after the effective date, since DOE does not yet have standards for non-Class A EPSs or BCs. DOE has initiated work on standards for non-Class A EPSs and BCs, with a framework document published on June 4, 2009. The amendments to the BC and non-Class A test procedures would become binding following publication of a final rule that establishes these standards.

B. Battery Charger Active Mode Test Procedure

The BC test procedure was inserted into appendix Y by the EPACT 2005 En Masse final rule, 71 FR 71368, and amended by the standby and off mode final rule 74 FR 13334. It is composed of four parts: (1) Scope, (2) definitions, (3) test apparatus and general instructions, and (4) test measurement. The test measurement section is further subdivided into:

(a) Inactive mode energy consumption measurement,[9] which incorporates by reference section 5 of the EPA ENERGY STAR BC test procedure [10];

(b) Active mode energy consumption measurement, which is currently reserved;

(c) Standby mode energy consumption measurement; and

(d) Off mode energy consumption measurement.

During the standby and off mode test procedure rulemaking, numerous interested parties commented that the current DOE test procedure is insufficient as a basis for the development of energy conservation standards, as it does not measure energy consumption during active (charge) mode. Many of these interested parties also recommended that DOE adopt the optional BC test procedure then under consideration in draft form at the CEC. As mentioned in the standby and off mode test procedure final rule, DOE was unable to act on these comments, as it had not proposed any active mode changes in the standby and off mode test procedure NOPR, 73 FR 48054 (August 15, 2008). 74 FR 13322.

On December 3, 2008, CEC adopted version 2.2 of the test procedure developed by Ecos, EPRI Solutions, and SCE, as an optional test procedure for the measurement of BC energy consumption in charging (active), maintenance, no-battery (standby), and off modes. The test procedure was incorporated by reference into section 1604(w) of title 20 of the California Code of Regulations,[11] alongside the DOE test procedure from appendix Y.

In its framework document, DOE mentioned its desire to amend the BC test procedure in appendix Y to measure energy consumption in each of the modes of operation of a BC (including active mode). During and after the framework document public meeting, interested parties expressed their general desire for DOE to adopt the CEC test procedure as the Federal test procedure for measuring the active mode energy consumption of BCs. In particular, Pacific Gas and Electric (PG&E), CEC, and Appliance Standards Awareness Project (ASAP) commented that DOE should expedite the rulemaking for an active mode test procedure, harmonizing with the CEC BC test procedure. (Pub. Mtg. Tr., No. 14 at pp. 40–41,[12] PG&E *et al.,* No. 20 at p. 7,[13] CEC *et al.,* No. 19 at p. 1 [14]). The

[7] "Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies," August 11, 2004, previously incorporated by reference into appendix Y. *http://www.energystar.gov/ia/partners/prod_development/downloads/power_supplies/EPSupplyEffic_TestMethod_0804.pdf.*

[8] "Proposed Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies, Rev. 6.4.3," October 26, 2009. *http://efficientpowersupplies.epri.com/pages/Latest_Protocol/Generalized_Internal_Power_Supply_Efficiency_Test_Protocol_R6.4.3.pdf.*

[9] The inactive mode energy consumption consists of the energy measured over 36 hours in maintenance mode, followed by 12 hours in standby (no-battery) mode, with the possibility of abbreviating the measurement to 6 hours and 1 hour, respectively.

[10] Environmental Protection Agency (EPA). "Test Methodology For Determining the Energy Performance of Battery Charging Systems." December 2005. *http://www.energystar.gov/ia/partners/prod_development/downloads/Battery_Chargers_Test_Method.pdf.*

[11] California Energy Commission (CEC), "2009 Appliance Efficiency Regulations," August 2009.

[12] A notation in the form "Pub. Mtg. Tr., No. 14 at pp. 40–41" identifies an oral comment that DOE received during the July 16, 2009, framework document public meeting. This comment was recorded in the public meeting transcript in the docket of the BC and EPS energy conservation standards rulemaking (Docket No. EERE–2008–BT–STD–0005, RIN 1904–AB57), maintained in the Resource Room of the Building Technologies Program and available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/bceps_standards_meeting_transcript.pdf.* This particular notation refers to a comment (1) recorded in document number 14, which is the public meeting transcript filed in the docket, and (2) appearing on pages 40–41 of document number 14.

[13] A notation in the form "PG&E *et al.,* No. 20 at p. 7" identifies a written comment that DOE has received and included in the docket of the BC and EPS energy conservation standards rulemaking (Docket No. EERE–2008–BT–STD–0005, RIN 1904–AB57). This comment was submitted by Pacific Gas and Electric Company, Southern California Edison Design & Engineering Services, Southern California Gas Company San Diego Gas and Electric Company, Appliance Standards Awareness Project, and American Council for an Energy-Efficient Economy. For referencing purposes, throughout this notice, comments submitted from these groups will be referred to as "PG&E *et al.*" This particular notation refers to (1) A comment submitted by Pacific Gas and Electric (PG&E) *et al.,* (2) in document number 20 in the docket, and (3) appearing on page 7 of document number 20.

[14] This comment was submitted by California Energy Commission, Pacific Gas and Electric Company, Southern California Edison Design & Engineering Services, Southern California Gas Company, San Diego Gas and Electric Company, American Council for an Energy-Efficient Economy, Appliance Standards Awareness Project, Consumer Federation of America, National Consumer Law Center, on behalf of its low-income clients, Midwest Energy Efficiency Alliance, Northwest Power and

Continued

Association of Home Appliance Manufacturers (AHAM) similarly requested that DOE harmonize its test procedure for battery chargers with other jurisdictions, but consider changes in methodology where appropriate. (AHAM, No. 16 at p. 2)

DOE researched existing worldwide test procedures for measuring BC energy consumption in active mode and found that there are currently three test procedures for measuring the energy consumption of consumer battery chargers: (1) The EPA ENERGY STAR BC test procedure, (2) the Canadian Standards Association (CSA) C381.2 test procedure,[15] and (3) the CEC test procedure.[5] No energy efficiency standards-setting or promoting organizations in Europe, Australia, or China have developed or adopted additional BC test procedures.

The EPA ENERGY STAR test procedure was adopted by ENERGY STAR in 2005 and has remained unchanged since then. This is the same test procedure incorporated by reference by DOE into sections 3 and 4(a) of appendix Y by the EPACT 2005 En Masse final rule, 71 FR 71340. Although it has been used to test numerous BCs (over 135 BCs qualified for the ENERGY STAR mark following testing in accordance with the test procedure),[16] this test procedure does not measure energy consumption of these products in active mode.

Similarly, the CSA 381.2 test procedure, adopted in 2008, does not measure BC active mode consumption. Instead, the procedure relies on the same inactive mode energy consumption measurement as the EPA ENERGY STAR BC test procedure and the current DOE test procedure.

The CEC test procedure, in contrast, includes active mode energy consumption through its 24-hour active and maintenance mode test. This test procedure was developed over six years through a collaborative process between energy efficiency advocates and industry experts, including multiple meetings and revisions (PG&E, No. 13 at p. 2). The result, according to PG&E, has been a test procedure that applies to the full spectrum of consumer battery chargers, regardless of input voltage (AC or DC), battery chemistry, and battery type (detachable or integral). PG&E provided test results from the application of the test procedure to over 142 consumer BCs (PG&E, No. 13 at p. 6).[17]

DOE has conducted further tests using this procedure and considers its measurement metrics, accuracy, and variability to be appropriate for the product being tested. Consequently, DOE is proposing to adopt part 1 of the CEC test procedure (for consumer products with input power under 2 kilowatts) to measure (1) BC energy consumption in active and maintenance modes and (2) the amount of energy recovered from the battery during discharge. DOE would, however, make several modifications to constrain its application to BCs sold in the United States, improve its clarity, and decrease its testing burden. DOE expects the resulting test procedure, explained in detail below, to produce equivalent results as the test procedure adopted by the CEC, while reducing the required technician and equipment time to perform the tests.

Finally, although part 1 of the CEC test procedure also contains instructions for measuring energy consumption in standby and off modes, DOE previously adopted standby and off mode test procedures in its March 2009 final rule. 74 FR 13334. Today's proposal retains these test procedures, which would be incorporated into sections 4(c) and 4(d) of appendix Y, and be modified as described in section III.B, in lieu of adopting their equivalents from the CEC test procedure (part 1, section IV). A summary of the CEC test procedure follows, along with specific modifications that DOE would make prior to incorporation in appendix Y. As with all other sections in this proposal, DOE seeks comment regarding all aspects of its proposed approach.

1. Summary of the CEC Test Procedure

The lengthy stakeholder consultation process conducted by the CEC led to the development of a test procedure for measuring the energy consumption of both consumer (part 1) and industrial (part 2) chargers.[18] Both parts of the test procedure measure the input energy to the battery charger when recharging a battery that had previously been conditioned (if necessary) and discharged to a specified depth. (Part 2 also requires measurement of the charger output energy.) Both parts of the test procedure then require measurement of the energy recoverable from the battery during discharge. Finally, the test procedure requires measurement of the charger input power with (1) The battery fully charged and connected to the charger (maintenance mode), (2) the battery removed from the charger (standby mode), and (3) the battery removed from the charger and the charger turned off, if a manual on-off switch is present (off mode). The number of tests, their duration, and other specifics vary between the two parts and also from charger to charger, depending on its capabilities.

The test procedure provides a set of definitions needed to test a wide variety of BCs. While some of these definitions are necessary for testing the larger industrial chargers, others are used in both parts of the test procedure and provide additional specificity beyond the definitions currently incorporated in section 2 of appendix Y.

Part 1 of the test procedure continues with specification of the test conditions in section I. Like the test conditions section of the EPA BC test procedure (which is incorporated into section 3 of appendix Y), this section of the CEC test procedure sets a variety of requirements, including limits on the input voltage to the charger, the speed and temperature of the air surrounding the unit under test (UUT), and measurement precision and accuracy. The AC input voltage waveform characteristics and ambient airspeed and temperature requirements of the CEC test procedure are equivalent to those of the EPA test procedure. The remaining requirements are stricter, however, specifying tighter limits on some parameters (*e.g.,* measurement resolution, etc.) and limits on additional parameters that may affect measurement results (*e.g.,* uncertainty, materials on which the BC may rest, characteristic of input voltage waveform for DC chargers, etc.). These tighter specifications on testing conditions should result in a more repeatable test procedure.

Following the test condition section, the CEC test procedure proceeds to specify the selection and setup of the battery and charger in section II. The age of the UUT is specified, as in the EPA test procedure. However, the CEC test procedure also specifies the mode of operation of the BC for chargers with several charge modes and/or additional functionality. Finally, the CEC test procedure specifies which batteries

Conservation Council, Southeast Energy Efficiency Alliance, and Southwest Energy Efficiency Project. For referencing purposes, throughout this notice, comments submitted from these groups will be referred to as "CEC *et al.*"

[15] Canadian Standards Association (CSA). C381.2–08. "Test Method for Determining the Energy Efficiency of Battery-Charging Systems." November 2008.

[16] EPA ENERGY STAR. "Qualified Product (QP) List for ENERGY STAR Qualified Battery Charging Systems ." October 1, 2009. Available at: *http://www.energystar.gov/ia/products/prod_lists/BCS_prod_list.pdf.*

[17] The above discussion applies to part 1 of the CEC test procedure; in addition, the test procedure also includes a part 2, which applies to larger (greater than 2000 watt output) BCs intended for transport and industrial applications.

[18] Part 2 of the CEC test procedure also applies to BCs for golf carts and other motive equipment that DOE considers to be consumer products. This issue is discussed further in section III.B.2.

should be used for the test, how to access their terminals, and how to estimate the energy capacity (used later in the test procedure to calculate the discharge rate) of the battery in case the battery is not labeled. The battery selection procedure is particularly helpful when testing BCs not packaged with batteries. Again, these additional specifications allow the test procedure to return repeatable results when testing a wider variety of BCs beyond those included in the EPA ENERGY STAR program.

Once the BC has been set to the correct mode or modes and the test battery or batteries have been identified, the measurements can begin. The measurement instructions are contained in section III of part 1, and specify how to condition, prepare, rest, charge, and discharge the battery, as well as which quantities to measure during each of these steps. Section III.A requires the tester to condition nickel-based batteries that have not been previously tested by charging them three times and discharging twice. This step is necessary because nickel-based batteries must be cycled several times before their capacity stabilizes and the test results become representative of typical use. The next step, preparation, consists of a controlled discharge to the end-of-discharge voltage. This step ensures that the battery has been fully discharged and that the energy consumed by the charger as it takes the battery from a fully discharged to a fully charged state can be compared to the energy recovered from the battery. Finally, the battery is rested, allowing it to return to the ambient temperature. Since many battery parameters depend on temperature, this step further improves the repeatability of the test procedure. All three of these initial steps are required for ensuring the repeatability of the test procedure, and are incorporated into today's proposal, with the minor modifications presented in sections III.B.5.(c) and III.B.5.(d) of this notice.

Section III of part 1 of the CEC test procedure requires measuring the energy consumed by the charger (as an integral of input power samples) when recharging the fully discharged and rested battery, but with any special charging functions (*e.g.,* equalization) turned off. This requirement is a significant departure from the EPA test procedure because the EPA procedure does not record the energy consumed during charging. The CEC test procedure also requires testers to record further parameters such as temperature, power factor, and current crest factor.

The CEC test procedure also specifies that the test must run for 24 hours or longer, as required by the manufacturer or as determined by the tester through observation of the charger (*see* section II.E of the part 1). Although BCs work at different rates, the CEC test procedure subjects them all to a full 24-hour charge and maintenance test. This is done to (1) obtain a uniform metric for comparisons and (2) increase the likelihood that the input power to the charger measured at the end of the 24-hour period is representative of the maintenance-mode power usage that a user will encounter when he or she leaves a battery connected to the charger for an extended period of time, which is the case for BCs used in handheld vacuum cleaners and cordless telephones, among others. While DOE believes these procedural requirements have merit, DOE seeks comment from interested parties on whether it is possible to shorten the measurement period that the CEC procedure currently requires while preserving the accuracy and completeness of that procedure's measurements. This method is described further in section III.B.5.(b) of this notice.

Finally, section IV of part 1 of the CEC test procedure describes the no-battery (standby) and off mode tests, while section V specifies the reporting requirements. Because DOE has already adopted standby and off mode test procedures for battery chargers, and because it specifies reporting requirements separately in section 430.22, it is not proposing today to incorporate these sections of the CEC test procedure into appendix Y.

Part 2 of the CEC test procedure follows a similar structure to part 1, but adds requirements to measure the output of the charger, test the charger with the battery at three different depths-of-discharge, and ensure charger-test battery compatibility, among others. These requirements may be needed to fully characterize the energy consumption of large lead-acid BCs for industrial applications; however, because DOE's current scope covers chargers for consumer products, DOE focused primarily on part 1, though the differences between the two parts are discussed in further detail in III.B.2. of this notice.

As the above summary shows, the CEC test procedure is a complete and detailed energy efficiency test procedure that can serve as a basis for a DOE test procedure. The steps outlined above contribute to the accurate measurement of the energy efficiency of battery chargers and have been incorporated into today's proposal, except where a less burdensome or more accurate alternative exists. These departures are presented in more detail in the subsequent sections.

2. Scope

The scope of the current DOE test procedure encompasses all BCs,[19] regardless of input voltage. However, following the framework document public meeting, a member company of the Information Technology Industry (ITI) Council submitted a comment requesting that DOE limit testing to U.S. line-voltage AC input (115 volts at 60 hertz).[20] (ITI member,[21] No. 17 at p. 1)

Limiting the scope of the test procedure to encompass BCs with DC or U.S. line-voltage AC input would ensure that all consumer battery chargers intended for use in the U.S. will be covered, while preventing unnecessary testing of industrial BCs or consumer BCs intended for use outside of the U.S. Such a modification to the scope would also be consistent with DOE's treatment of EPSs, which are not only defined as a circuit "used to convert household [line-voltage AC] electric current" in the statute (42 U.S.C. 6291(36)), but are also tested at 115 volts at 60 hertz, as specified in section 3 of appendix Z part 430 of title 10 of the CFR.

This limitation on input voltage would differentiate the proposed scope from that in the CEC BC test procedure. The proposed scope further differs from the CEC BC test procedure by including only BCs for consumer products. (42 U.S.C. 6291(32)) The CEC BC test procedure, on the other hand, covers not only BCs for consumer products, but also BCs for commercial and industrial applications such as forklifts and emergency egress lighting.

Even though the CEC test procedure covers BCs for applications from all market segments, it is divided by input and output parameters and intended application, among other criteria. For example, part 1 of the CEC BC test procedure applies to consumer chargers with input power under 2 kilowatts, while part 2 applies primarily to larger industrial chargers and chargers for golf carts and other consumer motive equipment.

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[19] "The term 'battery charger' means a device that charges batteries for consumer products, including battery chargers embedded in other consumer products. (42 U.S.C. 6291(32))

[20] AC line voltage in the U.S. is nominally 120 volts at 60 hertz. However, several international test procedures specify testing at 115 volts, as that test condition will also be applicable to devices used in several South and Central American countries, where the AC line voltage is nominally 110 volts at 60 hertz.

[21] ITI submitted comments on behalf of one of its member companies, who wishes to remain anonymous. The comments submitted do not reflect the opinion of ITI.

Chargers for golf carts and other motive equipment were covered by part 2 of the CEC test procedure due to their similarity to large industrial BCs—both typically charge flooded lead-acid batteries. Part 2 addresses the particular concerns of testing these flooded lead-acid systems, such as different charger and battery manufacturers, high charger efficiency (necessary due to high output power), and an unsealed battery construction permitting measurements of the temperature and specific gravity of the acid electrolyte to determine battery state.

While these test procedure provisions may be necessary to accurately measure the energy efficiency of large industrial BCs, chargers for golf carts and other types of consumer motive equipment (collectively, consumer motive equipment) fall at the low-power end of the lead-acid BC range, where the need for a specialized test procedure is not as clear. For example, high-power industrial chargers are already highly efficient, so part 2 requires a series of tests under various conditions to detect any differences in energy consumption. On the other hand, there is sufficient efficiency variation in the consumer motive equipment BC market such that a less burdensome test procedure will suffice for energy consumption measurements. To accommodate consumer motive equipment within the BC test procedure, DOE has two options:

(1) Include BCs for consumer motive equipment batteries with those for all other consumer products, in a single test procedure based on part 1 of the CEC BC test procedure; or

(2) Include BCs for consumer motive equipment in one test procedure based on part 2 of the CEC BC test procedure, while including BCs for all other consumer products in a second test procedure based on part 1 of the CEC BC test procedure.

Approach 2, above, would result in an additional DOE test procedure based on part 2 of the CEC test procedure. However, because DOE's scope does not extend to large industrial chargers, this additional test procedure would only cover chargers for golf carts and other consumer motive equipment. Under this approach, separate test setup and measurement requirements would need to be established to test a class of products with few models and limited shipments.

However, a previous draft of the CEC test procedure included consumer motive equipment together with smaller consumer BCs, simplifying the testing requirements. Although the testing requirements for consumer motive equipment and the remaining consumer BCs were later separated into the two parts of the test procedure, an integrated test procedure remains valid for testing the efficiency of both classes of BCs.

Therefore, rather than proposing a separate procedure that would cover only a single class of BCs (consumer motive equipment), DOE proposes to follow approach 1 above and include consumer motive equipment chargers under a general test procedure for all consumer products. The particulars of this proposed test procedure are discussed at length in the remainder of this section.

For the reasons stated above, DOE proposes to amend section 1 of appendix Y to read as set out in the regulatory text of this NOPR.

Nonetheless, DOE is also considering approach 2—adopting an additional test procedure for consumer motive equipment chargers based on part 2 of the CEC test procedure—given sufficient comment and supporting data from interested parties. DOE invites interested parties to comment on both approaches. In particular, DOE seeks comment on the applicability of part 1 of the CEC test procedure, and today's proposed test procedure, to BCs for golf carts and other consumer motive equipment and the testing burden of part 2 of the CEC test procedure compared to part 1 of the CEC test procedure and today's proposed test procedure. DOE also seeks comment generally on the completeness of the battery chemistries included in its proposal.

3. Definitions

DOE is proposing to incorporate elements of the CEC test procedure into the current version of appendix Y. For example, some of the CEC definitions differed slightly from those in section 2 of appendix Y, while other terms used in the CEC test procedure were undefined in appendix Y. Because of these discrepancies, DOE is proposing to amend section 2 of appendix Y (definitions) by amending, deleting, and incorporating new definitions to prevent potential confusion with respect to today's proposal. Finally, DOE is proposing to remove definitions used only in section 4(a) of appendix Y (inactive mode energy consumption measurement), which DOE also proposes to remove (*see* section III.B.5.(a) of this notice).

The specific changes proposed in today's notice consist of a series of deletions, amendments and additions. First, DOE proposes to remove the definitions of "accumulated nonactive energy" and "energy ratio or nonactive energy ratio." Second, DOE proposes to modify the definitions of "active mode," "multi-port charger," "multi-voltage a la carte charger," and "standby mode." Finally, DOE proposes to add definitions for "active power or real power (P)," "ambient temperature," "apparent power (S)," "batch charger," "battery rest period," "rated energy capacity," "C-rate," "crest factor," "equalization," "instructions or manufacturer's instructions," "measured charge capacity" "power factor," "rated battery voltage," "rated charge capacity," "total harmonic distortion (THD)," and "unit under test (UUT)." By amending, deleting, and incorporating new definitions, DOE aims to improve the clarity and utility of its test procedure for BCs.

(a) Deletions of Existing Definitions

DOE is proposing to delete the definitions of "accumulated nonactive energy" and "energy ratio or nonactive energy ratio." These definitions are no longer useful since they relate only to the inactive energy consumption measurement (section 4(b)), which DOE is proposing to remove from appendix Y in today's notice.

(b) Revisions to Existing Definitions

DOE is proposing to update some of the definitions codified in appendix Y by the EPACT 2005 En Masse final rule, 71 FR 71368, to avoid confusion in their application to the proposed BC active mode test procedure. Specifically, DOE proposes to modify the definition of "active mode" by adding the alternative term "charge mode" to the definition. As these two terms are often used interchangeably, DOE believes that this change will reduce the confusion between the two terms.

Also, DOE proposes to modify the definition of "multi-port charger" and "multi-voltage a la carte charger." The definitions of "multi-port charger" and "multi-voltage a la carte charger" included in appendix Y did not previously specify that they encompassed a batch charger (*see* section III.B.3. (c)). As both the proposed BC active mode test procedure and the CEC test procedure upon which it is based rely on the characteristics of the charger when specifying the batteries to be used for the test, DOE is proposing to replace the current definitions in appendix Y with those in the CEC test procedure to ensure that battery selection for these types of BCs will be performed in the same manner.

Finally, DOE proposes to modify the definition of BC "standby mode," which is synonymous with "no-battery mode." These two terms are already included in the definition; however, DOE proposes to remove the parenthetical and simply present both terms for consistency with its other definitions. DOE is proposing to redefine this term in section 2.24 of appendix Y, as set out in the regulatory text of this NOPR.

(c) Additions of New Definitions

Although the EPACT 2005 En Masse final rule inserted numerous definitions into appendix Y, 71 FR 71368, the expansion of the BC test procedure to include active mode requires DOE to propose additional definitions in today's notice. These proposed definitions (as well as the proposed procedure) are based on those used by the CEC and help clarify the proposed active mode test procedure. Nonetheless, these definitions have broader applicability, as they are based in large part on established international standards (*e.g.,* International Electrotechnical Commission (IEC) standard 62301, Household Electrical Appliances—Measurement of Standby Power, or Institute of Electrical and Electronics Engineers standard 1515–2000, Recommended Practice for Electronic Power Subsystems: Parameter Definitions, Test Conditions, and Test Methods). Furthermore, some of these definitions had previously been incorporated into the DOE EPS test procedure in appendix Z. 74 FR 13335.

By adopting the following definitions, DOE hopes to avoid confusion or inconsistency in the application of its proposed test procedure. Accordingly, DOE is proposing to incorporate definitions that are consistent with the CEC test procedure for the following terms in section 2 of appendix Y: "batch charger," "battery rest period," "equalization," "power factor," "rated energy capacity," and "rated battery voltage." The Department is also proposing new definitions for "active power or real power (P)," "ambient temperature," "apparent power (S)," "C-rate," "crest factor," "instructions or manufacturer's instructions," "measured charge capacity," "rated charge capacity," "total harmonic distortion (THD)," and "unit under test (UUT)." The proposed definitions are detailed below.

DOE is proposing to define "active power or real power (P)" using the definition found in IEEE standard 1515–2000, rather than the definition in the CEC test procedure. The CEC test procedure defines active power as the average of instantaneous power taken over one or more periods of time. In contrast, IEEE Standard 1515–2000 defines active power as the integral over one period of the product of the voltage and current waveforms divided by the period. DOE believes that the approach of IEEE Standard 1515–2000 is preferable because it is clearer and, as the industry standard, more widely accepted. Accordingly, DOE is proposing to define this term in appendix Y, section 2.2, as set out in the regulatory text of this NOPR.

DOE proposes to include a definition for "ambient temperature" in its test procedure based on the CEC definition except for the addition of the word "immediately." The primary reason for this change is to make the proposed DOE definition in appendix Y consistent with appendix Z and IEEE standard 1515–2000. Furthermore, the inclusion of the word "immediately" limits the definition to only the volume of air within close proximity to the unit under test. It is the temperature of this particular volume of air, and not of that elsewhere in the test room—that could potentially impact the test results.[22] DOE is proposing to define this term as set out in the regulatory text of this NOPR.

DOE notes that although it is not proposing to set a specified distance within which this temperature measure must be taken (*e.g.*, 5 feet from the unit under test in all directions), it is considering the inclusion of such a requirement in order to minimize the risks of potential gaming during compliance certification testing. Comments from the public on this particular issue are also sought.

To achieve consistency with the proposed definition of active mode, DOE proposes to include a definition for "apparent power (S)" in its test procedure that would incorporate language from the CEC test procedure (which is the same as that in appendix Z and IEEE standard 1515–2000), with the sole exception of specifying that the measurement be expressed in volt-amperes. This change achieves consistency with the active mode because that definition also specifies the units of measurement. Apparent power is used in the power factor definition and is included for consistency with the CEC test procedure, which includes a similar definition. DOE is proposing to define this term in appendix Y, section 2.4 as set out in the regulatory text of this NOPR.

DOE is also proposing a definition of "batch charger" based on the CEC definition. DOE believes that the CEC definition for "batch charger" is clear and concise, and is proposing that the definition be adopted verbatim. DOE is proposing to define this term in appendix Y, section 2.5 as set out in the regulatory text of this NOPR.

DOE is proposing to include a definition for "battery rest period" in the test procedure, adopted verbatim from the CEC test procedure. "Battery rest period" is the period between preparing the battery and the battery discharge test, as well as the period between the battery discharge test and the charge and maintenance mode test. DOE is proposing to define this term in appendix Y, section 2.9 as set out in the regulatory text of this NOPR.

The proposed "C-rate" definition is based on the CEC test procedure, but has been modified to remove the example C-rate calculation, retaining only the definition. C-rate is used in the test procedure to describe the rate of charge and discharge during testing. DOE is proposing to define this term in appendix Y, section 2.10 as set out in the regulatory text of this NOPR.

The proposed definition for "crest factor" is based on the definition in the CEC test procedure. Crest factor, which refers to the ratio of the peak instantaneous value of a quantity to its root-mean-square (RMS) value, is recorded when performing the charge mode and battery maintenance mode test. IEEE standard 1515–2000 and IEC standard 62301 both define this term in a manner similar to CEC. DOE is proposing to adopt the definition from the two industry standards, as that version is more concise. DOE is proposing to define this term in appendix Y, section 2.12 as set out in the regulatory text of this NOPR.

The proposed definition for "equalization" has been taken verbatim from the CEC test procedure. The equalization charge is not tested under the proposed test procedure, since it is considered one of the "special charge cycles that are recommended only for occasional use to preserve battery health." DOE is proposing to define this term in appendix Y, section 2.13 as set out in the regulatory text of this NOPR.

The proposed definition for "instructions or manufacturer's instructions" is based on the "instructions" definition from the CEC test procedure, which states that " 'instructions' includes any information on the packaging or on the product itself * * * 'Instructions' also includes any service manuals or data sheets that the manufacturer offers for sale to independent service technicians, whether printed or in electronic form." DOE is proposing to expand the scope of this definition by also including information about the product that is

[22] The efficiency of BCs is dependent on temperature. Therefore, the test procedure specifies the ambient temperature to ensure consistent results between tests.

available on the manufacturer's website. These instructions, which only include those materials available at the time of the test, must be followed when setting up the battery charging system, except when in conflict with the requirements of this test procedure. DOE is proposing this change in the definition because the test procedure must be representative of typical use, and users will only be influenced by instructions publicly available at the time of the test. DOE is proposing to define this term in appendix Y, section 2.14 as set out in the regulatory text of this NOPR.

The proposed definition for "measured charge capacity" is based on the "measured charge capacity" definition from the CEC test procedure, but replaces the term "rate" with "current" and "final" with "specified end-of-discharge." These changes were made to clarify the definition by replacing general words with words that are more specific. In the proposed test procedure, the measured charge capacity must be calculated for those batteries that do not have a rated charge capacity. DOE is proposing to define this term in Y, section 2.15, as set out in the regulatory text of this NOPR.

The proposed definition for "power factor" has been taken verbatim from the "power factor" definition in the CEC test procedure. This definition is also present in IEEE standard 1515–2000 as "power factor (true)." The power factor is recorded when performing the charge mode and battery maintenance mode test. DOE is proposing to define this term in appendix Y, section 2.20 as set out in the regulatory text of this NOPR.

The proposed definition for "rated battery voltage" is based on the "rated battery voltage" definition from the CEC test procedure. The definition varies from the CEC definition in that it replaces the phrase "a batch of batteries includes series connections" with "there are multiple batteries that are connected in series," replaces "batch" with "batteries," and replaces "times" with "multiplied by." The rated battery voltage is recorded before testing and is used to calculate rated energy capacity. DOE is proposing to define this term in appendix Y, section 2.21 as set out in the regulatory text of this NOPR.

The proposed definition for "rated charge capacity" is based on the "rated charge capacity" definition from the CEC test procedure. DOE is proposing to add the clause "the manufacturer states the battery can store under specified test conditions," to clarify the definition. DOE is also proposing to replace the phrase "a batch of batteries included parallel connections" with "there are multiple batteries that are connected in parallel," "batch" with "batteries," and "times" with "multiplied by." The rated charge capacity is used in the proposed test procedure to select the battery used for testing when there are no batteries packaged with the charger and there are multiple batteries with the lowest rated voltage. DOE is proposing to define this term in appendix Y, section 2.22 as set out in the regulatory text of this NOPR.

The proposed definition for "rated energy capacity" has been taken verbatim from the "calculated energy capacity" definition in the CEC test procedure. DOE changed the word "calculated" to "rated" to emphasize that the value is computed using only rated values. The definition is proposed to avoid confusion with the term "measured charge capacity." DOE is proposing to define this term in appendix Y, section 2.23 as set out in the regulatory text of this NOPR.

DOE also proposes defining "total harmonic distortion (THD)," clarifying the input voltage requirements of the proposed test procedure. A variation of the definition (with an associated equation) is also present in IEEE standard 1515–2000 as well as in appendix Z. The inclusion of a THD requirement ensures the presence of a sufficiently sinusoidal input voltage waveform, which is necessary for repeatability. This factor is important when measuring the energy use of these products because the energy consumption of BCs depends on the shape of the input voltage waveform. The THD of the input voltage is required to be ≤ 2%, up to and including the 13th harmonic.[23] The proposed definition for this term would appear in appendix Z, section 2.25 and reads as set out in the regulatory text of this NOPR.

DOE proposes defining the term "unit under test (UUT)" in its battery charger test procedure based on the CEC test procedure definition, to clarify the term. The abbreviation "UUT" is defined in IEEE standard 1515–2000 and used throughout the proposed test procedure in place of the terms "battery charger" and "test battery." This proposed change would simplify the test procedure text. DOE is proposing to define this term in appendix Y, section 2.26 as set out in the regulatory text of this NOPR.

4. Test Apparatus and General Instructions

Appendix Y, section 3 currently specifies that the test apparatus, standard testing conditions, and instructions for testing battery chargers shall conform to the requirements specified in section 4, "Standard Testing Conditions," of the EPA's "Test Methodology for Determining the Energy Performance of Battery Charging Systems." As described below, DOE is proposing to remove the existing test apparatus and general instruction, and include sections I and II (the standard test conditions and battery charger system set up) of part 1 of the CEC test procedure, with minor revisions to improve the procedure's clarity.

(a) Confidence Intervals

The CEC test procedure specifies that all "[m]easurements of active power of 0.5 W or greater shall be made with an uncertainty of ≤ 2%. Measurements of active power of less than 0.5 W shall be made with an uncertainty of ≤ 0.01 W." However, the CEC test procedure does not specify any confidence levels to which these uncertainty measurements must adhere. The proposed uncertainty requirements for testing equipment specified are equivalent to those in the current CEC test procedure, with the addition of an explicit confidence qualifier. This qualifier, which is necessary when expressing uncertainty in measurement, is the 95 percent confidence level customarily employed in experimental work, which accounts for errors that fall within two standard deviations of the mean of a normal distribution. The proposed uncertainty requirements would make the test procedure consistent with standard engineering practice.

(b) Temperature

The temperature range currently specified in the CEC test procedure is 20 °C ± 5 °C. However, this low temperature range is difficult to maintain while testing in warmer climates. DOE is proposing raising the temperature specifications to 25 °C ± 5 °C to create a testing environment that is achievable across diverse climates. All of the consumer BC tests conducted to date by parties other than DOE[24] and mentioned at the framework document

[23] Any periodic signal can be decomposed into a sum of sine waves at integer multiples of its fundamental frequency (the inverse of the period of repetition). The signal can be represented by a sine wave at the same frequency as the original, plus a second sine wave at twice the frequency, plus a third sine wave at three times the frequency, and so on. These sine waves are known as "harmonics." Although the number of harmonics are infinite in number, their amplitude tends to decrease precipitously with each subsequent harmonic, such that it is reasonable to stop the measurement at a particular harmonic, and the 13th has been found to be sufficient in practice.

[24] BC efficiency test data submitted by Pacific Gas and Electric (collected by its technical consultant Ecos) are available on DOE's website. Please see: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/battery_external_std_2008.html.*

public meeting (PG&E, No. 13 at p. 6) were performed at temperatures between 20 and 27 degrees Celsius, which would be covered by the higher temperature range proposed in today's notice. By adjusting the temperature control within the test room in this manner, the testing burden will be lessened without sacrificing the accuracy and repeatability of the test procedure.

(c) AC Input Voltage and Frequency

The CEC test procedure requires, when possible, the testing of units that accept AC line-voltage input at two voltage and frequency combinations, 115 volts at 60 hertz and 230 volts at 50 hertz. As mentioned in section III.B.2., above, an ITI member company commented that testing should be limited to the U.S. line voltage (115 volts, 60 hertz) (ITI member, No. 17 at p. 1).

Since DOE's scope of coverage extends only to consumer BCs operating in the United States, DOE is proposing to require that BCs only be tested at the U.S. AC line voltage, 115V at 60Hz, even if they can also be operated at other voltages and frequencies (for worldwide use). This change will harmonize the DOE BC test procedure with the current EPS test procedure, which also specifies that "[t]he UUT shall be tested at 115 V [volts] at 60 Hz [hertz]." Since DOE is already proposing to limit the scope of its test procedure to cover BCs intended for operation at U.S. AC line voltage—whether or not they are also capable of operation at other voltages—limiting the testing to the U.S. input voltage and frequency should reduce the testing burden by half for BCs with universal input voltage (*i.e.,* capable of operating at both 115 and 230 volts) without impacting the representativeness of the test procedure.

(d) Charge Rate Selection

Section II.A (general setup) of part 1 of the CEC test procedure requires that, "If the battery charger has user controls to select from two or more charge rates (such as regular or fast charge) or different charge currents, the test shall be conducted with each of the possible choices." However, this option presents a large burden on manufacturers as each test can take over 24 hours to complete, which could take a manufacturer several days to complete testing of a single unit.

DOE believes that, given a choice, users will opt for the fastest charge that does not impact the battery's long term health, as evidenced by the popularity of successively faster chargers in the market. In light of this observation, to limit the test procedure burden while still maintaining its representativeness, DOE is proposing that, if the battery charger has user controls to select from two or more charge rates, the test shall be conducted at the fastest charge rate that is recommended by the manufacturer for everyday use.

(e) Battery Selection

Section II.C of part 1 of the CEC test procedure requires that multi-voltage, multi-port, and/or multi-capacity chargers be tested numerous times, with a variety of batteries. Again, since each test takes over 24 hours, following this aspect of the CEC procedure will result in more than three days of testing for some BCs. Interested parties also acknowledge the issue: an ITI member suggested that in cases where a battery charger offers multiple outputs, but one output is the primary intended scenario, the BC should only be tested using that output. (ITI member, No. 17 at p. 1)

Since any BC is a "multi-capacity" charger,[25] this burden is not limited to just a few specialty BCs. Manufacturers of products with user-replaceable batteries (*e.g.,* cellular telephones, power tools, etc.) tend to sell high-capacity add-on batteries, and the capacity of the replacement batteries increases gradually as battery technology improves with time. As a result, many BCs would need to be tested twice (once with the lowest and once with the highest capacity battery), which is a step included in the CEC test procedure. Furthermore, these BCs may require re-testing as new higher-capacity batteries are released after the manufacture of the original product. To reduce the number of tests, DOE is focusing on the typical usage scenario—*i.e.,* testing with the battery packaged with the charger. Since most users will not purchase the additional higher-capacity battery, the proposed DOE test procedure would require testing using only the battery packaged with the charger.

If multiple batteries or no batteries are packaged with the charger, DOE proposes selecting batteries for testing from those recommended for use with the BC by the manufacturer. In the absence of any recommendation, the batteries for test would be selected from any suitable for use with the charger. If these batteries vary in voltage or capacity, the charger would be tested with (1) The lowest voltage, lowest capacity battery; (2) the highest voltage, lowest capacity battery; and (3) the highest total energy capacity battery, as applicable. In each case, the term "battery" refers to one or more cells in one or more separate enclosures.

The proposed battery selection procedure described above for chargers packaged either with multiple or no batteries is consistent with section II.C of part 1 of the CEC test procedure. Because this procedure may result in multiple tests spanning several days for a single charger, DOE is also considering an alternative battery selection procedure that would require that the BC only be tested with the most typical battery intended for use with the BC. This alternative approach would attempt to reduce the testing burden while measuring "a representative average use cycle," as required by statute. (42 U.S.C. 6293(b)(3))

Nonetheless, due to insufficient information regarding the typical batteries used with chargers that are packaged with multiple batteries or packaged without batteries, DOE is unable to ensure that tests limited to just one battery (*e.g.,* the lowest capacity battery) would be representative of typical use. Therefore, DOE welcomes comments from interested parties on (1) the typical use of chargers for standard-sized, AA and AAA batteries and 12 volt lead-acid batteries, which are used with a variety of batteries, and (2) the likely burden due to the proposed battery selection method, which is based on the CEC test procedure.

(f) Non-Battery Charging Functions

The proposed active mode BC test procedure retains the instructions concerning additional functionality from section II.D of part 1 of the CEC test procedure, which requires the tester to turn off any user-controlled functions and disconnect all auxiliary electrical connections to the BC. These instructions address the two types of additional functionality typically included with battery chargers, *i.e.,* connections with other systems (*e.g.,* cordless telephone base) and user interaction (*e.g.,* power tool charger radio).

The first type of additional functionality is exemplified by cordless telephone bases that monitor the state of the telephone line and/or store voicemail messages. These types of devices provide an added utility through connection with other systems, *e.g.,* the telephone line. Because the additional functionality relies on the connection to other parts of the system, manufacturers can use a physical disconnection (required by the proposed

[25] Unless controlled by a timer, a BC designed for a specific voltage, chemistry, and physical package can charge all batteries of the same voltage, chemistry, and physical package, regardless of capacity. The only difference will be the charge time, which will increase with battery charge capacity.

BC active mode test procedure) as a signal to the device to disable the additional functionality and reduce power consumption to the level of a BC that is not equipped with that additional functionality.

The second type of additional functionality is exemplified by a power tool charger radio that provides an interface for operation by the user. Because this type of device already relies on users to operate it, a manufacturer should be able to add or repurpose one of the interface elements to allow a user (and tester) to turn off the additional functionality of the device. Doing so would reduce the device's power consumption to a level comparable with BCs and EPSs without the additional functionality. In either case, the energy consumption of the additional functionality can be substantially reduced, if not eliminated, which would reduce the energy consumption of the BC to the level of similar BCs equipped without additional functionality.

If adopted, the instructions in section 4.4 of the proposed test procedure would allow the BC to decrease the energy consumption of any additional functionality to a negligible level. Therefore, DOE does not expect to make any allowances for energy consumption due to additional functionality in the corresponding energy conservation standard. Nonetheless, DOE welcomes suggestions from interested parties on how it should address additional functionality.

(g) Determining the Charge Capacity of Batteries with No Rating

Section II.G of the CEC test procedure requires the use of trial-and-error to estimate the charge capacity [26] of batteries when it is not provided by the manufacturer. Reaching results in this manner would likely not be repeatable. Therefore, the method that DOE is proposing today explicitly lays out the iterative steps required to measure the battery capacity, providing a clear process which will likely limit the time required to determine the charge capacity and produce a more repeatable result than the trial-and-error method.

5. Test Measurement

Appendix Y, section 4 is currently divided into sections (a), (b), (c), and (d), as discussed above. DOE is proposing to: (1) Remove the existing inactive mode energy consumption measurement in section 4(a); (2) retain sections 4(c) and 4(d), which contain the standby and off mode test procedures; and (3) insert section III of part 1 of the CEC test procedure, "Measuring the Battery Charger System Efficiency," into section 4(b) with minor revisions for clarity and the following substantive modifications. Finally, DOE proposes renumbering the resulting section 4 for ease of reference and use by testing technicians.

(a) Removing Inactive Mode Energy Consumption Test Apparatus and Measurement

The inactive mode energy consumption measurement in section 4(a) of appendix Y requires integrating the input power to the BC over numerous hours in maintenance and no-battery modes and dividing it by the battery energy measured during discharge, resulting in a non-active energy ratio. The standby and off mode test procedure final rule added a requirement to measure standby (no-battery) and off mode energy consumption, 74 FR 13334, while today's proposal includes requirements to measure active (charge) and maintenance modes. Because these test procedure updates would collectively result in a BC test procedure that measures battery charger energy consumption in all four modes—active (charge), maintenance, standby (no-battery), and off—there is no longer a continued need for the inactive mode test procedure adopted on December 8, 2006. Therefore, in today's notice, DOE proposes to strike the inactive mode energy consumption measurement from section 4(a).

(b) Charge Test Duration

During the 2009 public meeting, DOE sought comment on shortening the 24-hour test period specified in the CEC procedure. The Power Tool Institute (PTI) saw no problem in shortening the maintenance mode test period (Pub. Mtg. Tr., No. 14 at p. 190), whereas AHAM and Wahl Clipper Corporation (Wahl) commented that a 24-hour charge cycle should be used as the basis for measuring active mode energy consumption. (AHAM, No. 16 at p. 2; Wahl, No. 23 at p. 1) Ecos Consulting (Ecos) added that a shorter test period was considered during the development of the CEC procedure but explained that it was not feasible to incorporate a shorter test period since many batteries have a much longer charge time. (Pub. Mtg. Tr., No. 14 at p. 191–92) PTI specifically cited nickel-cadmium as an example of a battery chemistry that requires charge of at least 16 hours, cautioning that if the active charge window were shortened, only a portion of the charge energy would be captured by the measurement. (Pub. Mtg. Tr., No. 14 at p. 190) Ecos also indicated that although charge indicator lights are reliable determinants of active mode duration, they are only included in roughly one-third of chargers and therefore cannot be relied on to shorten the measurement period in all cases. (Pub. Mtg. Tr., No. 14 at p. 193)

Although a shortened test period would reduce the burden on manufacturers, the 24-hour charge energy metric provides uniformity between tests and enables BCs for cellular telephones to be easily compared with BCs for cordless telephones, regardless of how long each BC spends actually charging a battery. In today's notice, DOE is proposing using a 24-hour charge and maintenance energy measurement consistent with the CEC test procedure, but is inviting interested parties to comment on incorporating an optional, shorter test period, described below.

To accommodate the comments of interested parties, DOE is proposing to retain the 24-hour test period but seeks comment on possibly supplementing it with an optional shortened test period that can be used when feasible. The proposal outlines scenarios where a shorter test period would be appropriate. These scenarios would require that a testing technician must determine that the BC is in steady-state operation in maintenance mode, at which point the input power no longer changes. In other words, continuing the test past this point under this scenario would not yield any new information regarding the energy consumption characteristics of the tested unit.

In the shortened test procedure, the BC would undergo an initial charging period with a duration determined by the state of a charge indicator light, manufacturers' instructions, or, in the absence of the above, a minimum of 4 hours. Following this, the technician would inspect the input power to the BC, and the BC would be in a steady state if its input power does not vary by more than 2 percent over a 1-hour period. A relatively constant input power over a significant length of time indicates that the BC has finished charging the battery and entered maintenance mode. Since, absent user interaction, the BC is expected to remain in this mode for all future time, it should be possible to stop the test early and extrapolate the energy measurement to the full 24-hour period.

[26] This parameter corresponds to the amount of charge a battery can store and is a function of the size and chemical composition of the battery. The testing technician must obtain this parameter to calculate the discharge current necessary to measure the battery energy during the discharge test.

This extrapolation is done by taking the energy consumption from the beginning of the test to the point when the BC entered steady-state operation and adding it to the steady-state maintenance mode power multiplied by the remaining number of hours in the test. This procedure is shown in detail in Eq. 1, below.

$$E_{24\ EXTRAPOLATED} = E_{CHARGE}\Big|_{t_{STEADY\text{-}STATE}}^{t=0} + P_{MAINT.STEADY\text{-}STATE} \times \left(24\text{h} - t_{STEADY\text{-}STATE}\right) \qquad \text{Eq. 1}$$

Where:

$E_{24\ EXTRAPOLATED}$ is the 24-hour energy estimate calculated through extrapolation;

$t_{STEADY\text{-}STATE}$ is the time at which the charger entered steady-state operation;

$E_{CHARGE}|_{t_{STEADY\text{-}STATE}}^{t=0}$ is the energy consumption from the beginning of the test to the point when the BC entered steady-state operation and the test was interrupted;

$P_{MAINT.STEADY\text{-}STATE}$ is the maintenance power measured in steady state.

In this manner, the testing time for some BCs may be shortened, freeing valuable laboratory equipment without impacting the uniformity of the 24-hour metric. DOE evaluated the results of shortening the test method for six "fast" battery chargers (*e.g.,* lithium-ion battery chargers for notebook computer and DVD player applications) by utilizing data from 24-hour tests. DOE had simulated the effects of shortening the test period according to the proposed method described above, from 24 hours to an average of 5.7 hours, resulting in a time savings of 18.3 hours on average. Using only data obtained during these shortened test periods DOE then extrapolated 24-hour energy consumption. The calculated 24-hour energy consumption differed from the measured 24-hour energy consumption by an average of −1.1 percent, but with a range of −0.1 to +6.5 percent.

The 24-hour energy consumption of the fast BC with the greatest variation was calculated to be 6.5 percent lower with the shortened test method than that measured with the full 24-hour test method. This BC met the steady state criteria (meaning the unit was in maintenance mode) that allowed the shortened test period to be used. However, once in maintenance mode, the BC would periodically "wake up," presumably to provide pulses energy to the battery to counteract any self-discharge. Since these pluses happened once the unit was in maintenance mode, they were not captured by the shortened test procedure (which would have terminated the test soon after the BC had entered maintenance mode). Therefore, the extrapolated 24-hour energy consumption was lower than the measured 24-hour energy consumption.

Furthermore, DOE realizes that using the above method to shorten the measurement period for some "slow" chargers may also result in an extrapolated 24-hour energy consumption that differs widely from the measured 24-hour energy. For example, when the above test method was applied to nine slow chargers for nickel-metal hydride and lead-acid batteries, the extrapolated 24-hour energy consumption differs by 11.2 percent from the measured 24-hour energy on average.

In general, the input power to the BC during charging decreases with time, stopping the test early and extrapolating over the full 24 hours will tend to result in a higher calculated 24-hour energy consumption unless the BC has entered steady state.[27] Therefore, it is not in the manufacturer's interest to abuse this method and shorten the test inappropriately, as doing so will typically result in worse measured performance.[28] Furthermore, any DOE enforcement testing will be performed using only the full 24-hour test procedure as the method to determine compliance with the standard.

Because of the potential for significant discrepancies in results between the shortened and full, 24-hour measurement methods, DOE is not proposing to depart from the 24-hour method currently in the CEC test procedure. Nonetheless, DOE would like to invite interested parties to comment on allowing the shortened test method for units that meet the steady state criteria described above. After reviewing the comments DOE will consider incorporating this latter test method into the test procedure in the final rule. In particular, DOE would be interested in (1) a comparison of testing burden for the shortened and full testing methods, as well as (2) an assessment of the measurement variability between the two methods across a wide range of BCs.

(c) Battery Conditioning

Section III.A of part 1 of the CEC test procedure specifies that battery conditioning must be performed on all batteries, with the exception of lead-acid or lithium-based batteries. Battery conditioning is the process by which the battery is cycled several times prior to testing to permit the battery to reach its specified capacity. By conditioning the battery in this manner, any taken measurement will be representative of typical use. DOE's proposed active mode test procedure requires that the battery undergo two full charges followed by two full discharges, ending on a discharge. The third charge present in section III.A of the CEC test procedure has been removed from the proposal pursuant to the reversed testing order described in section III.B.5.(e), below.

(d) Battery Preparation

Section III.B of the CEC test procedure has a provision that requires preparing the battery for testing by performing a controlled discharge to a specified end-of-discharge voltage. This preparatory step ensures that the BC test begins and ends with the battery at the same known state—namely, fully discharged—such that all the energy consumed during the charge test can be fairly compared to the energy obtained from the battery during the discharge test. DOE's proposed active mode test procedure would likewise prepare the battery by bringing it to a known state prior to starting the test. However, the battery preparation would consist of charging the battery instead of discharging due to the proposed reversed testing order described below.

(e) Reversed Testing Order

In DOE's proposed BC active mode test procedure, the discharge test would be performed prior to the charge test, in reverse order of the CEC test procedure: The battery would be (1) Conditioned, if necessary; (2) charged until full by the BC under test, in preparation for the measurement; (3) discharged; and (4) recharged by the BC under test. The discharge energy in step (3) and the input power to the BC in step (4), above, would be measured. The proposed reversal of the test order will have no impact on the measured charge or discharge energy because the BC-battery system is deterministic and will behave in the same manner given the same inputs and environmental conditions.

[27] Of the nine slow chargers mentioned above, all had higher extrapolated than measured 24-hour energy consumption, some by as much as 30 percent.

[28] This generalization does not apply to chargers such as the fast charge mentioned above, which periodically wake up during maintenance mode.

The energy recovered from the battery during discharge will be the same whether it is measured once or many times (ignoring the long-term effects of storage or cycling), as will the charge energy consumed by the charger. Therefore, the order in which these steps are performed does not matter, as long as the measurement encompasses the entirety of a charge-discharge or discharge-charge cycle and all the energy consumed by the charger is accounted for during discharge, and vice-versa.

While reversing the testing order such that the discharge is performed prior to the charge would have no impact on the measurement results, it would allow the preparatory step to be a charge rather than a discharge. This distinction is important because it allows preparation to be conducted in the UUT, rather than a battery analyzer, and require less test equipment time. Thus, the proposed test procedure would further decrease testing burden without impacting accuracy.

(f) End of Discharge for Other Chemistries

Table D in part 1 of the CEC test procedure instructs that the end-of-discharge voltage for any battery chemistry not listed explicitly in the table be found "Per appropriate IEC standard." However, DOE cannot incorporate in its test procedure an open-ended reference to a non-existent standard. To address this concern, DOE spoke with members of industry and reviewed the literature [29] to identify which chemistries are likely to become popular in the near future as well as the end-of-discharge voltages associated with them. These chemistries would be explicitly included in the table of end-of-discharge voltages in the proposed test procedure. The additional chemistries would include nanophosphate lithium-ion and silver-zinc. If batteries of other chemistries are developed in the future, they would be addressed through the waiver process or a revision to the test procedure. DOE invites comments on whether the battery chemistries and associated discharge voltages contained in its proposed list are sufficient or require modification.

C. Review of Battery Charger and External Power Supply Standby and Off Mode Test Procedures

In the March 2009 final rule, DOE adopted a 1-hour test duration for the BC standby and off mode tests, based on the abbreviated test method in the EPA's "Test Methodology for Determining the Energy Performance of Battery Charging Systems, December 2005," previously incorporated by reference into appendix Y. 74 FR 13335. However, during the 2008 standby and off mode public meeting, interested parties suggested that the proposed 1-hour testing period be shortened further. Nonetheless, as mentioned in the March 2009 final rule, the BC standby mode test procedure must take into account equipment warm up and low-frequency pulsed operation to produce accurate and repeatable measurement results. 74 FR 13324.

In today's notice, DOE proposes amending the test period to a 30-minute warm up period followed by a 10-minute measurement period. This proposed modification would harmonize DOE's standby and off mode measurement procedures with sections IV.B and IV.C in part 1 of the optional CEC BC test procedure. Abbreviating the measurement period from 1 hour to 10 minutes will not affect the accuracy of the test because the amended test procedures would retain a 30-minute warm up period. Variations in component efficiency due to temperature are the most common reason for changes in BC energy consumption in standby and off modes, and the 30-minute warm up period would be sufficient to permit the input power of most BCs to stabilize. DOE recognizes that further instabilities (pulses) in energy consumption in standby and off modes may be caused by periodic operation of certain BC functions, as when a BC occasionally checks its output for the presence of the battery. In general, there is always a potential for a limited-time test procedure to fail to capture a behavior occurring at an arbitrary time, such that these pulses might be captured over a 1-hour measurement period but not in a 10-minute period. DOE has not, however, encountered any such cases in practice.

Based on the above reasons, DOE believes that the shortened test measurement will reduce testing burdens on manufacturers while providing an accurate and repeatable test. Further, DOE is proposing to retain the remainder of its BC standby and off mode test procedure. Finally, DOE is not proposing any changes to the standby and off mode test procedures for EPSs. The proposed measurement periods for these test procedures are only as long as necessary to obtain a repeatable result and would not impose an additional burden on manufacturers, as both are based on and incorporate by reference the no-load measurement in the EPA single-voltage EPS test procedure. DOE seeks comment on the merits of this aspect of today's proposal.

D. Review of the Single-Voltage External Power Supply Test Procedure

While DOE is interested in applying its single-voltage EPS test procedure (appendix Z to subpart B of 10 CFR part 430) to all single-voltage EPSs subject to current or potential future standards, DOE recognizes that some EPSs may not be testable under the existing test procedure in a representative or repeatable manner. In particular, the following devices may pose issues for the current procedure: (1) EPSs that communicate with their loads; (2) EPSs that limit their output current below that specified on the nameplate; and (3) high-power EPSs that do not display a clear maximum output power on their nameplates. A discussion of these three types of EPSs follows, along with test procedure changes necessary to accommodate them. DOE is considering adopting these changes pending comment from interested parties. DOE is also proposing to redefine "active power" for consistency with appendix Y and industry standards.

1. EPSs That Communicate With Their Loads

Some EPSs used for powering cellular telephones, notebook computers, and other consumer electronic products use USB and other protocols that require communication between the EPS and its load. Currently, DOE's single-voltage EPS test procedure incorporates by reference sections 4 and 5 of the CEC single-voltage EPS test procedure. Within these incorporated sections, the test procedure requires that "the tests should be conducted on the two output wires that supply the output power * * * [t]he other wires * * * should be left electrically disconnected."

This requirement is problematic, however, because it may interfere with the operation of EPSs that require additional output wires for communication with their loads. For example, the USB specification [30] requires devices to communicate over the data lines prior to transferring significant amounts of power (in excess of 1 "unit load" or approximately 0.5 watts). DOE is concerned that by requiring the disconnection of data lines, the existing single-voltage EPS test procedure may not test EPSs that use interfaces such as a USB in a

[29] See, for example: A123 Systems, "High Power Lithium Ion ANR26650M1A," April 2009, *http://www.a123systems.com/cms/product/pdf/1/ANR26650M1A_Datasheet_APRIL_2009.pdf.*

[30] "Universal Serial Bus Specification, Revision 2.0," April 27, 2000, p. 174. *http://www.usb.org/developers/docs/usb_20_122909-2.zip.*

manner that would be representative of their power consumption when operating.

The communication issue is not limited to EPSs with multiple sets of conductors. In some cases (*e.g.,* EPSs for some notebook computers), the communication between an EPS and its load can occur over the same set of conductors that transfer power, using an AC-coupled signal. Initial evaluations indicate that such communication may be used to set the output voltage of an EPS intended for use with multiple computers made by the same manufacturer. Because these EPSs may need to identify their load prior to operation, measurements conducted in the laboratory without the intended load (as required by the DOE test procedure) may not be representative of typical use.

DOE is uncertain of the extent of this problem in practice. In particular, although the cellular telephone industry is planning to adopt the USB interface as a "universal charging solution" for all handsets by 2012,[31] DOE's analysis of EPSs for cellular applications indicates that the transition to USB-compliant EPSs has not yet begun. Examination of eight mobile phone EPSs with connectors with four or more pins (including mini-USB connectors) revealed that in only one case were these pins connected to any wires in the output cable. Even in the single case of multiple pairs of conductors, the EPS performed as specified when tested according to the DOE test procedure (*i.e.,* with the additional wires disconnected), implying that no communication with the load was necessary for specified operation. Similarly, DOE has only been able to identify two models of EPSs for notebook computers that communicate with their loads. These observations lead DOE to believe that these products are not currently popular.

Even though power supplies that communicate with their loads are a rarity today, DOE does foresee a need for the test procedure to accommodate them in the future. To address this need, DOE is considering amending the single-voltage EPS test procedure by permitting manufacturers to supply additional connection instructions or fixtures for testing EPSs that require communication with the load. Today's notice does not contain a specific proposal for amending the test procedure but solicits comments from interested parties on specific EPSs that cannot be tested in a representative manner according to the DOE single-voltage EPS test procedure, due to the test procedure's requirements that the EPS be tested with a dummy load and that all additional conductors be disconnected. DOE is also seeking comments regarding specific changes that the procedures would need to permit the testing of these devices. Any amendments to the test procedure in this regard would only apply to EPSs that must communicate with their loads and would have no impact on existing standards for Class A EPSs.

2. EPSs With Output Current Limiting

As mentioned in section II.C., some EPSs limit their output current below that which is specified on their nameplate or in manufacturer datasheets. Whether due to manufacturing variation or another cause, this situation can be problematic because the current DOE test procedure may be unable to consistently measure the efficiency of these EPSs. The current DOE single-voltage EPS test procedure incorporates by reference the CEC single-voltage EPS test procedure and requires testing at fixed percentages (0, 25, 50, 75, and 100 percent) of nameplate output current. However, the test procedure does not specify what to do in cases when the EPS limits output current as described above, such that it is unable to output 100 percent or even 75 percent of its nameplate output current—which would prevent one from obtaining one or more efficiency measurements specified under the procedure.

DOE is considering several changes to the single-voltage EPS test procedure that would accommodate EPSs that limit their output current below that listed on the nameplate. In particular, DOE is considering adopting one of three options: (1) Ignore the loading points affected by output current limiting when calculating the average efficiency; (2) shift the loading points affected by output current limiting on a case-by-case basis such that they are no longer affected by current limiting (*i.e.,* if the EPS limits its output current to 90 percent of nameplate output current, calculate the active mode efficiency as the average of efficiencies at 25, 50, 75, and 90 percent load); or (3) record the efficiency as 0 percent for any loading points affected by output current limiting. DOE welcomes comments from interested parties on the prevalence of this issue as well as the above three proposed amendments under consideration.

3. High-Power EPSs

The scope of DOE's single-voltage EPS test procedure already permits the testing of high-power EPSs, as do most of the test setup and test measurement instructions. The only limitation that DOE has encountered while attempting to test high-power EPSs in accordance with the DOE test procedure involved nameplate output current. As mentioned above, the test procedure requires the nameplate output current to calculate the loading points for efficiency measurements. However, some high-power EPSs do not specify the maximum output current on the nameplate.

DOE partially addressed this issue in the standby and off mode test procedure final rule by modifying the definition of nameplate output current to include the output current provided by the manufacturer "if absent from the housing" of the EPS.[32] 74 FR 13335. However, when manufacturers do provide output current information, they may specify two maximum values: one for intermittent output current and another for continuous output current. To enable the testing of high-power EPSs, DOE is considering making changes to the single-voltage EPS test procedure that would detail what to do in cases when more than one maximum output current is specified on the nameplate or provided by the manufacturer.

In particular, DOE welcomes comments from interested parties on whether the situation where both intermittent and continuous output currents are listed on the EPS nameplate or in manufacturer documentation may cause confusion. Furthermore, DOE welcomes comments from interested parties on the potential impact of this confusion on the repeatability or representativeness of the single-voltage EPS test procedure already contained in appendix Z. DOE is considering amending the nameplate output power definition to specify that the maximum continuous current should be used as the nameplate output current when two or more currents are provided but seeks comments regarding the merits of this approach.

4. Active Power Definition

As mentioned in section III.B.3. (c) of this notice, DOE is proposing to define "active power" in section 2 of appendix Y based on the definition in IEEE standard 1515–2000. The definition in IEEE standard 1515–2000 is the widely

[31] GSM Association, "Mobile Industry Unites to Drive Universal Charging Solution for Mobile Phones," *GSM World,* February 17, 2009.

[32] Manufacturers typically specify the performance of an EPS through datasheets and other marketing materials.

accepted industry definition for "active power." However, if adopted, this definition would differ from the one currently in appendix Z. To harmonize the two definitions, DOE is proposing to redefine this term in appendix Z, section 2.c, as set out in the regulatory text of this NOPR.

E. Multiple-Voltage External Power Supply Test Procedure

Section 325 of EPCA, as amended by section 309 of EISA, directs DOE to promulgate a final rule determining whether energy conservation standards shall be issued for EPSs or "classes" of EPSs. (42 U.S.C. 6295(u)(1)(C)) Currently, DOE divides EPSs into Class A and non-Class A. Under section 301 of EISA, Congress required that Class A power supplies meet specifically prescribed standards that became effective on July 1, 2008. DOE is examining the possibility of developing standards for the remaining, non-Class A EPSs that are not covered by the Congressionally mandated standards.

Multiple-voltage EPSs (*i.e.,* EPSs that provide more than one output voltage simultaneously) have the highest shipments and widest range of consumer product applications of the EPSs that fall outside of Class A. Because it must develop test procedures either prior to (or concurrently with) the development of an efficiency standard for a product, DOE reviewed numerous test procedures in 2008 to develop a standardized test procedure for these products. In the standby and off mode NOPR, DOE proposed a multiple-voltage EPS test procedure that generally followed the structure of the CEC single-voltage EPS test procedure with some modifications specific to multiple-voltage power supplies. *See* 73 FR 48064–48068. However, due to the limited time available for review, DOE was unable to address the comments received from interested parties and decided not to incorporate these elements of the proposed test procedure into the March 2009 final rule until such time when DOE could provide a greater opportunity for comment. 74 FR 13322. In today's notice, DOE proposes adopting a test procedure generally consistent with its August 2008 proposal in the standby and off mode NOPR. However, to accommodate the concerns of some interested parties, DOE is also proposing several modifications to the previously proposed approach.

During the 2008 standby and off mode rulemaking, interested parties commented that the proposed loading conditions (25%, 50%, 75%, and 100% of full load) may not be appropriate for all multiple-voltage EPSs, particularly dedicated-use EPSs, because they do not provide a representative measure of energy consumption. On the other hand, when DOE presented a potential loading profile (as opposed to the previous simple average of the efficiencies measured at each of the four active-mode loading points) to incorporate into the test procedure during its framework document public meeting, PG&E commented that multiple voltage EPSs should be tested over their entire output current range to represent the range of loading possible with a variety of applications. (PG&E *et al.,* No. 20 at p. 17)

Therefore, in this notice, DOE is proposing measuring efficiency at no-load, 25%, 50%, 75%, and 100% of nameplate output, but without averaging the results as would have been required under the previous proposal. Instead, the currently proposed test procedure would output five separate efficiency or input power measurements, one for each loading point. The results could then be weighted during the standards phase of the rulemaking to reflect typical usage. This multiple-voltage test procedure, which otherwise remains unchanged from the one DOE proposed in 2008, would be incorporated into sections 3(b) and 4(b) of appendix Z.

By removing equal weighting of active-mode loading conditions (*i.e.,* averaging of efficiency results at each nonzero loading point) from the test procedure and reporting these metrics separately, DOE would be able to maintain a flexible and uniform test procedure. DOE would then tailor the weightings to each product class during the standards-setting phase of the rulemaking. In addition, by deciding on how to address the power supply weighting during the standards rulemaking, DOE will be able to receive additional comments from interested parties on the applications that use multiple-voltage EPSs and their expected usage to help shape the agency's decision on this issue.

F. Test Procedure Amendments Not Proposed in This Notice

As mentioned above, DOE presented potential modifications to the CEC test procedure during the framework document public meeting. After receiving comments, and doing further analysis, DOE is no longer proposing some of these amendments for incorporation into the test procedure. Nonetheless, DOE wishes to document these potential amendments and the comments received on these and other issues. These include:

(1) Accelerating the test procedure schedule
(2) Incorporating usage profiles into the test procedure
(3) Measuring charger output energy
(4) Measuring alternative depths of discharge

1. Accelerating the Test Procedure Schedule

During the framework document public meeting, some interested parties requested an expedited rulemaking schedule for the BC active mode test procedure. In particular AHAM suggested that DOE provide stakeholders with a revised battery charger test procedure, including active mode, by September 30, 2009, and that DOE complete the test procedure updates by the end of 2009 (AHAM, No. 16 at p. 2, Pub. Mtg. Tr., No. 14 at p. 45) AHAM also expressed general concern regarding how the Department can conduct its analyses for BCs without a finalized BC test procedure. (Pub. Mtg. Tr., No. 14 at p. 36)

DOE acknowledges the concerns of interested parties regarding an accelerated schedule; however, due to process requirements, DOE will continue with the current rulemaking schedule. The target date to issue the BC Active Mode Test Procedure remains October 31, 2010.

2. Incorporating Usage Profiles

Battery charging systems consume different amounts of energy while they are in different modes, and the amount of time that the charger spends in each mode varies depending on the applications of the end-use project. Some BCs, such as those for cell phones and media players, spend more time in active mode, while others, such as those for handheld vacuums and electric shavers, remain primarily in maintenance or unplugged mode.

At the framework document public meeting, DOE discussed incorporating BC usage profiles into the test procedure. These usage profiles would weight the energy consumption of the BC in each mode using the time spent in that mode. However, interested parties were opposed to the incorporation of usage profiles into the test procedure, and suggested that the consideration of usage profiles be instead deferred to the standard.

Ecos and PG&E *et al.* did not favor the incorporation of usage profiles. PG&E felt that it would be difficult to incorporate them because of insufficient data to arrive at a "realistic and creditable understanding." (Pub. Mtg. Tr., No. 14 at p. 161, Pub. Mtg. Tr., No. 14 at p. 158–59; PG&E *et al.,* No. 20 at

p. 15) Ecos similarly stated that they are not convinced that usage profiles should be used, especially in the test procedure. (Pub. Mtg. Tr., No. 14 at p. 182) PG&E agreed by stating that usage profiles may be feasible for future rulemakings once more data have been collected. (Pub. Mtg. Tr., No. 14 at p. 178) On the other hand, CEA and Wahl suggested that usage profiles should not be difficult to obtain. (Pub. Mtg. Tr., No. 14 at p. 178–79)

The DOE BC test procedure need not measure the energy consumption over a typical use cycle. It can, for example, measure the efficiency under abstract test conditions like the EPS test procedure. The usage profile can instead be incorporated into the energy conservation standard as part of the routine analysis that DOE applies during the standards rulemaking process. Adopting a test procedure that does not contain usage profiles will allow test results to be comparable across a wider range of products and jurisdictions, as regions with diverse consumer usage of BCs would be able to use the same test procedure. Because of these considerations, DOE is not proposing to incorporate usage profiles at this time.

3. Measuring Charger Output Energy

During the framework document public meeting, DOE suggested measuring the charger output energy rather than the battery output energy in order to calculate the total energy consumed by the BC during charging. DOE felt that measuring at the charger output, thereby bypassing the battery, could remove some of the variability from the measurement. Interested parties were unified in opposition to this change.

PG&E, Ecos, PTI, and AHAM all supported measuring the energy obtained from the battery during discharge (per the methods in the current ENERGY STAR test procedure and Part 1 of the CEC test procedure), rather than directly measuring the output energy of the charger. PG&E further stated that although measuring the output energy of the charger would be more accurate and easier, it will not be "realistic or representative of how things work in the real world" and stressed that this portion of the CEC test procedure should not be altered (Pub. Mtg. Tr., No. 14 at pp. 162–64; PG&E *et al.,* No. 20 at p. 14) An ITI member further stated that testing only be done with the battery supplied by the OEM, not replacement batteries supplied by third parties. (ITI member, No. 17 at p. 1)

Ecos commented that battery variations are not significant enough to warrant amending the CEC test procedure and added that variation in batteries can be averaged out statistically. (Pub. Mtg. Tr., No. 14 at p. 171–72) PTI admitted that even though battery variability may have an effect on the repeatability and reproducibility, "some of that may be addressed through some subsequent mathematics." (Pub. Mtg. Tr., No. 14 at p.166) AHAM, on the other hand, commented that manufacturers should not be required to test multiple units, which would greatly increase testing burden. (Pub. Mtg. Tr., No. 14 at p. 172)

PTI provided further support for measuring battery output energy by stating that it may be difficult to access the battery terminals, making direct measurements of the charger output energy impractical. (Pub. Mtg. Tr., No. 14 at p. 164–65)

Ecos further justified measuring battery discharge energy by noting that manufacturers choose the battery that they include or recommend for testing—*i.e.,* the battery is a design option for increasing efficiency. (Pub. Mtg. Tr., No. 14 at p. 167) PTI disagreed, stating that the needs of the application to a large extent determine the batteries used. (Pub. Mtg. Tr. No. 14 at pp. 174–75) However, because there is little variation between batteries once the appropriate chemistry has been selected, PTI also concluded that measuring the output from the charger would not be worth the added difficulty. (Pub. Mtg. Tr., No. 14 at p. 176)

AHAM and Wahl both recommended that the battery energy be measured and subsequently subtracted from the 24-hour cycle energy (AHAM, No. 16 at p. 4, Wahl, No. 23 at p. 1), whereas PTI suggested that normalizing (*i.e.,* dividing) the battery discharge energy by the charger input energy provides a measurement independent of battery size (which varies with the end-use application) and battery density (which varies with the progress of technology over time). (Pub. Mtg. Tr., No. 14 at pp. 165–66, 174)

FRIWO and Delta-Q offered contrasting comments, with FRIWO voicing general support for separate testing for batteries and BCs, using a dummy load to test the BC, unless the design of the product makes this impractical (as in the case of power tools) (FRIWO, No. 21 at pp. 1–2), while Delta-Q commented that the battery should be considered independent of the battery charging system during testing. (Delta-Q, No. 15 at p. 1)

The goal of the test procedure is to measure energy consumed by the battery charger during typical use, and this energy can be measured directly at the output of the charger or indirectly by measuring the energy recoverable from the battery during discharge. Measuring the discharge energy from the battery combines charger losses with battery losses, resulting in a system-wide measurement that is more representative of typical use. Given that interested parties voiced overwhelming support for system-wide measurements and did not express concern about the impact of battery variability on measurement repeatability, the proposed test procedure does not incorporate measurement at the output of the BC.

4. Alternative Depth-of-Discharge Measurement

At the framework document public meeting, DOE discussed the potential for testing BCs with batteries at 40 percent depth-of-discharge, meaning 60 percent full. (The term "depth-of-discharge" refers to the extent to which a battery's usable capacity has been discharged.) This potential change would model the behavior of consumers who recharge batteries before they are fully discharged and was inspired by part 2 of the CEC test procedure, which requires that batteries be tested at 100, 80, and 40 percent depth-of-discharge. Interested parties provided comments opposing the alternative depth-of-discharge; consequently, DOE is planning to continue using the 100 percent depth-of-discharge as the only condition for testing.

Ecos and PG&E opposed to the incorporation of a 40 percent depth-of-discharge (DOD) measurement and commented that a measurement from additional depths-of-discharge will complicate testing and development of standards. (Pub. Mtg. Tr., No. 14 at p. 195–96) PG&E added that a 40 percent DOD would be a generalization that is difficult to substantiate. (Pub. Mtg. Tr., No. 14 at p. 199–200; PG&E *et al.,* No. 20 at p. 16) Furthermore, Ecos noted that if a new method relying on testing at 40 percent DOD is developed, then many products will need to be re-tested in order to achieve sufficient data to set a standard. (Pub. Mtg. Tr., No. 14 at p. 206) AHAM agreed that establishing a typical depth-of-discharge is difficult; however, it is not going to be 100 percent but between 2 and 80 percent. (Pub. Mtg. Tr., No. 14 at p. 201)

Stakeholders also commented on the difficulty of consistently discharging a battery to an arbitrary depth. Ecos further commented that cutoff voltages may be used rather than a percentage depth-of-discharge (as in the current Part 1 CEC test procedure) to terminate the discharge. (Pub. Mtg. Tr., No. 14 at p. 206) Wahl commented that the appropriate cutoff voltage should depend on the battery chemistry, using IEC standards as a precedent. (Pub. Mtg. Tr., No. 14 at p. 201–02) PTI provided a general statement that normalizing energy consumption by battery energy capacity reduces the effect of depth-of-discharge on test results. (Pub. Mtg. Tr., No. 14 at p. 204)

Due to the lack of support for measurement of BC energy consumption while charging batteries with different depths-of-discharge, DOE is not incorporating such measurement into today's proposal.

IV. Regulatory Review

A. Executive Order 12866

The Office of Management and Budget has determined that test procedure rulemakings do not constitute "significant regulatory actions" under Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993). Accordingly, this action was not subject to review under that Executive Order by the Office of Information and Regulatory Affairs (OIRA) of the Office of Management and Budget (OMB).

B. National Environmental Policy Act

In this proposed rule, DOE proposes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for BCs and EPSs. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) (NEPA) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule establishes or amends test procedures and does not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A6 under 10 CFR part 1021, subpart D, which applies to any rulemaking that is strictly procedural. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis for any rule that, by law, must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *http://www.gc.doe.gov.*

DOE reviewed today's proposed rule under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003. As part of this rulemaking, DOE examined the existing compliance costs already borne by manufacturers and compared them to the revised compliance costs due to the proposed amendments in this NOPR, namely, the adoption of new test procedures for BC active mode and multiple-voltage EPSs and the modification of existing test procedures for BCs operating in standby and off mode and single-voltage EPSs with USB outputs.

Manufacturers are only required to test products subject to standards, and there are currently no standards for BCs or multiple-voltage EPSs. Until energy conservation standards are adopted, no entities, small or large, would be required to comply with the proposed BC and EPS test procedures. Therefore, DOE believes that today's proposed rule would not have a "significant economic impact on a substantial number of small entities," and the preparation of a regulatory flexibility analysis is neither required nor warranted at this point.

Class A EPSs, however, are subject to a standard, and manufacturers, including small entities, are required to perform testing in accordance with the single-voltage EPS test procedure to ensure compliance with the standard. However, the amendments discussed in section III.D. of this notice would not significantly change the existing test procedure, amending only the testing conditions for EPSs with USB outputs. DOE does not expect these amendments to impose a significant new testing and compliance burden and therefore would have no large economic impact on a significant number of small entities.

Tentatively concluding and certifying that this proposed rule would not have a significant impact on a substantial number of small entities, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will provide its certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

D. Paperwork Reduction Act

This rule contains an information collection requirement subject to the Paperwork Reduction Act (PRA) and which has been approved by OMB under control number 1910–1400. Public reporting burden for the collection of test information and maintenance of records on regulated EPSs based on the certification and reporting requirements is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate, or any other aspect of this data collection, including suggestions for reducing the burden, to DOE (*see* **ADDRESSES**) and by e-mail to: *Christine_Kymn@omb.eop.gov.*

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

E. Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) (Pub. L. 104–4) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. For proposed regulatory actions likely to result in a rule that may cause expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish estimates of the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) UMRA also requires Federal agencies to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed "significant intergovernmental mandate." In addition, UMRA requires an agency plan for giving notice and opportunity for timely input to small governments that may be affected before establishing a requirement that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under

UMRA. 62 FR 12820. (This policy is also available at *http://www.gc.doe.gov*). Today's proposed rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

F. Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule that may affect family well-being. Today's proposed rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is unnecessary to prepare a Family Policymaking Assessment.

G. Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

H. Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (February 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the proposed rule meets the relevant standards of Executive Order 12988.

I. Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (Pub. L. 106–554; 44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (February 22, 2002), and DOE's guidelines were published at 67 FR 62446 (October 7, 2002). DOE has reviewed today's proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

J. Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to the Office of Information and Regulatory Affairs of OMB a Statement of Energy Effects for any proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

Today's regulatory action is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

K. Executive Order 12630

Pursuant to Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 15, 1988), DOE has determined that this rule would not result in any takings that might require compensation under the Fifth Amendment to the United States Constitution.

L. Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA.) Section 32 essentially provides in part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition. Because the proposed rule does not incorporate any commercial standards, section 32 does not apply here. However, consistent with its ordinary practice, DOE intends to provide both the Attorney General and the FTC a courtesy copy of this proposed rule.

V. Public Participation

A. Attendance at Public Meeting

The time, date and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this NOPR. To attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945. As explained in the **ADDRESSES** section, foreign nationals visiting DOE headquarters are subject to advance security screening procedures.

B. Procedure for Submitting Requests To Speak

Any person who has an interest in the topics addressed in this notice, or who is a representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the public meeting. Such persons may hand-deliver requests to speak to the address shown in the **ADDRESSES** section at the beginning of this notice between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Requests may also be sent by mail or email to: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121, or *Brenda.Edwards@ee.doe.gov.* Persons who wish to speak should include in their request a computer diskette or CD in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests that those persons who are scheduled to speak submit a copy of their statements at least one week prior to the public meeting. DOE may permit any person who cannot supply an advance copy of this statement to participate, if that person has made alternative arrangements with the Building Technologies Program in advance. When necessary, the request to give an oral presentation should ask for such alternative arrangements.

C. Conduct of Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also employ a professional facilitator to aid discussion. The public meeting will be conducted in an informal, conference style. The meeting will not be a judicial or evidentiary public hearing and there shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws.

DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. A court reporter will record the proceedings and prepare a transcript.

At the public meeting, DOE will present summaries of comments received before the public meeting, allow time for presentations by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant may present a prepared general statement (within time limits determined by DOE) before the discussion of specific topics. Other participants may comment briefly on any general statements. At the end of the prepared statements on each specific topic, participants may clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions from DOE and other participants. DOE representatives may also ask questions about other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of procedures needed for the proper conduct of the public meeting.

DOE will make the entire record of this proposed rulemaking, including the transcript from the public meeting, available for inspection at the U.S. Department of Energy, 6th Floor, 950 L'Enfant Plaza, SW., Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. The official transcript will also be posted on the Webpage at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/battery_external.html.* Anyone may purchase a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding the proposed rule no later than the date provided at the beginning of this notice. Comments, data, and information submitted to DOE's e-mail address for this rulemaking should be provided in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format. Interested parties should avoid the use of special characters or any form of encryption, and wherever possible, comments should include the electronic signature of the author. Comments, data, and information submitted to DOE via mail or hand delivery/courier should include one signed original paper copy. No telefacsimiles (faxes) will be accepted.

According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit two copies: one copy of the document including all the information believed to be confidential, and one copy of the document with the information believed to be confidential deleted. DOE will make its own determination as to the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) a date upon which such information might lose its confidential nature due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

E. Issues on Which DOE Seeks Comment

Although DOE invites comments on all aspects of this rulemaking, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

1. BC Active Mode

DOE seeks comment from interested parties on the proposed approach for testing BCs in active mode, in particular the adoption and modification of the CEC test procedure. (*See* section III.B.)

2. Limiting the Scope of the Test Procedure

DOE seeks comment from interested parties on the proposed limitation of scope of the test procedure to encompass BCs with DC or U.S. line-voltage AC input. (*See* section III.B.1.)

3. BCs for Golf Carts and Other Consumer Motive Equipment

DOE seeks comment on including BCs for golf carts and other consumer motive equipment batteries in a single test procedure based on part 1 of the CEC BC test procedure. (*See* section III.B.2.)

4. Amendments to Definitions

DOE seeks comment from interested parties on the adoption of new definitions, in particular any deviation from those currently in the CEC test procedure. (*See* section III.B.3.)

5. Selecting the Charge Rate for Testing

DOE seeks comment from interested parties on the proposed modifications to section II of the CEC test procedure intended to ease testing burden, and in particular, recommendations on which charge rates are most representative of typical use. (*See* section III.B.4.(d).)

6. Selecting the Batteries for Testing

DOE seeks comment from interested parties on the batteries that are typically used with BCs that are packaged with multiple batteries or packaged without batteries (*e.g.,* AA and AAA and 12 volt lead-acid chargers) as well as the testing burdens associated with testing such chargers multiple times under the battery selection method currently in the CEC test procedure. (*See* part 1, section III.B.4.(e).)

7. Non-Battery Charging Functions

DOE seeks comment from interested parties on the categorization of non-battery charging functions and its intention not to make allowances for energy consumption due to additional functionality. (*See* section III.B.4.(f).)

8. Procedure for Determining the Charge Capacity of Batteries With No Rating

DOE seeks comment from interested parties on the proposed revision to section II.G of the CEC test procedure to explicitly lay out the iterative steps required to measure battery capacity when none is provided. (*See* section III.B.4.(g).)

9. Deletion of the Inactive Mode Energy Consumption Test Procedure

DOE seeks comment from interested parties on the proposal to strike the inactive mode energy consumption measurement from section 4(a) of appendix Y. (*See* section III.B.5.(a).)

10. Shortening the BC Charge and Maintenance Mode Test

DOE seeks comment from interested parties on the optional method of shortening the charge and maintenance mode test period in the proposed active mode amendment to the BC test procedure, in particular its impacts on testing burden and the accuracy and repeatability of the measurement. (*See* section III.B.5.(b).)

11. Reversing Testing Order

DOE seeks comment from interested parties on the proposed reversal of the CEC test procedure order, resulting in: The battery being (1) conditioned (if necessary); (2) charged until full by the BC under test, in preparation for the measurement; (3) discharged; and (4) recharged by the BC under test. The discharge energy in step (3) and the input power to the BC in step (4), above, would be measured. (*See* section III.B.5.(e).)

12. End-of-Discharge Voltages for Novel Chemistries

DOE seeks comment from interested parties on the end-of-discharge voltages for the nanophosphate lithium-ion and silver-zinc chemistries that are proposed for inclusion in Table 5.2 in appendix Y. (*See* section III.B.5.(f).)

13. Standby Mode and Off Mode Duration

DOE also invites comment on the proposed test method for measuring standby mode and off mode energy consumption for EPSs, including whether the duration of the measurement is sufficiently long. (*See* section III.C.)

14. Single-Voltage EPS Test Procedure Amendments To Accommodate EPSs That Communicate With Their Loads

DOE seeks comment on the possible modification of the single-voltage EPS test procedure to accommodate EPSs that must communicate with their loads; in particular the prevalence of such EPSs, the need to amend the test procedure to accommodate them, and suggestions on amendments. (*See* section III.D.1.)

15. Further Single-Voltage EPS Test Procedure Amendments

DOE seeks comment on the possible further modification of the single-voltage EPS test procedure to accommodate EPSs with output current limiting and high output power. (*See* sections III.D.2. and III.D.3.)

16. Loading Conditions for Multiple-Voltage EPSs

DOE seeks comments on all issues pertaining to testing of multiple-voltage EPSs. In particular, DOE invites comments on reporting 5 separate loading conditions (no-load, 25, 50, 75, and 100 percent of nameplate output current) without averaging the results. Additionally, DOE seeks comment on how it should weigh these measurements in an energy conservation standards rulemaking for multiple-voltage EPSs. (*See* section III.E.)

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, on January 29, 2010.

Cathy Zoi,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons stated in the preamble, DOE is proposing to amend part 430 of Chapter II of Title 10, Code of Federal Regulations as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

2. In § 430.23 revise paragraph (aa) to read as follows:

§ 430.23 Test procedures for the measurement of energy and water consumption.

* * * * *

(aa) *Battery Chargers.* The 24-hour energy consumption of a battery charger in active and maintenance modes, expressed in watt-hours, and the power consumption of a battery charger in maintenance mode, expressed in watts, shall be measured in accordance with section 5.10 of appendix Y of this subpart. The power consumption of a battery charger in standby mode and off mode, expressed in watts, shall be measured in accordance with sections 5.11 and 5.12, respectively, of appendix Y of this subpart.

* * * * *

3. Appendix Y to subpart B of part 430 is revised to read as follows:

Appendix Y to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Battery Chargers

1. Scope

This appendix covers the test requirements used to measure battery charger energy consumption for battery chargers operating at either DC or United States AC line voltage (120V at 60Hz).

2. Definitions

The following definitions are for the purposes of understanding terminology associated with the test method for measuring battery charger energy consumption.[1]

2.1. *Active mode* or *charge mode* is 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.

2.2. *Active power* or *real power* (P) means the average power consumed by a unit. For a two terminal device with current and voltage waveforms i(t) and v(t) which are periodic with period T, the real or active power P is:

$$P = \frac{1}{T}\int_0^T v(t)i(t)dt$$

2.3. *Ambient temperature* is the temperature of the ambient air immediately surrounding the unit under test.

2.4. *Apparent power* (S) is the product of root-mean-square (RMS) voltage and RMS current in volt-amperes (VA).

2.5. *Batch charger* is 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 any separate 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.

2.6. *Battery* or *battery pack* is an assembly of one or more rechargeable cells and any integral protective circuitry intended to provide electrical energy to a consumer product, and may be in one of the following forms: (a) Detachable battery: A battery that is contained in a separate enclosure from the consumer product and is intended to be removed or disconnected from the consumer product for recharging; or (b) integral battery: A battery that is contained within the consumer product and is not removed from the consumer product for charging purposes.

2.7. *Battery energy* is the energy, in watt-hours, delivered by the battery under the specified discharge conditions in the test procedure.

2.8. *Battery maintenance mode* or *maintenance mode* is the mode of operation when the battery charger is connected to the main electricity supply and the battery is fully charged, but is still connected to the charger.

2.9. *Battery rest period* is a period of time between discharge and charge or between charge and discharge, during which the battery is resting in an open-circuit state in ambient air.

2.10. *C-rate* is the rate of charge or discharge, calculated by dividing the charge or discharge current by the rated charge capacity of the battery.

2.11. *Cradle* is an electrical interface between an integral battery product and the rest of the battery charger designed to hold the product between uses.

2.12. *Crest factor* for an AC or DC voltage or current waveform, is the ratio of the peak instantaneous value to the root-mean-square (RMS) value.

2.13. *Equalization* is a process whereby a battery is overcharged, beyond what would be considered "normal" charge return, so that cells can be balanced, electrolyte mixed, and plate sulfation removed.

2.14. *Instructions* or *manufacturer's instructions* means the documentation packaged with a product in printed or electronic form and any information about the product listed on a Web site maintained by the manufacturer and accessible by the general public at the time of the test.

2.15. *Measured charge capacity* of a battery is the product of the discharge current in amperes and the time in decimal hours required to reach the specified end-of-discharge voltage.

2.16. *Manual on-off switch* is a switch activated by the user to control power reaching the battery charger. This term does not apply to any mechanical, optical, or electronic switches that automatically disconnect main power from the battery charger when a battery is removed from a cradle or charging base, or for products with non-detachable batteries that control power to the product itself.

2.17. *Multi-port charger* means a battery charger which 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/or indicator(s).

2.18. *Multi-voltage charger* is 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.

2.19. *Off mode* is the condition, applicable only to units with manual on-off switches, in which the battery charger:

(1) Is connected to the main electricity supply;

(2) Is not connected to the battery; and

(3) All manual on-off switches are turned off.

2.20. *Power factor* is the ratio of the active power (P) consumed in watts to the apparent power (S), drawn in volt-amperes (VA).

2.21. *Rated battery voltage* is specified by the manufacturer and typically printed on the label of the battery itself. 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 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.

2.22. *Rated charge capacity* is the capacity the manufacturer declares the battery can store under specified test conditions, usually given in ampere-hours (Ah) or milliampere-hours (mAh) and typically printed on the label of the battery itself. 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.

2.23. *Rated energy capacity* means the product (in watt-hours) of the rated battery voltage and the rated charge capacity.

2.24. *Standby mode* or *no-battery mode* means the condition in which:

(1) The battery charger is connected to the main electricity supply;

(2) The battery is not connected to the charger; and

(3) For battery chargers with manual on-off switches, all such switches are turned on.

2.25. *Total harmonic distortion* (THD), expressed as a percent, is the root mean square (RMS value of an AC signal after the fundamental component is removed and interharmonic components are ignored, divided by the RMS value of the fundamental component.

2.26. *Unit under test* (UUT) in this appendix refers to the combination of the battery charger and battery being tested.

3. Standard Test Conditions

3.1. General

The values that may be measured or calculated during the conduct of this test procedure have been summarized for easy reference in Table 3.1.

TABLE 3.1—LIST OF MEASURED OR CALCULATED VALUES

	Name of measured or calculated value	Reference	Value
1	Time required to reach end-of discharge, ($t_{discharge\_0.5A}$)	Section 4.6.	
2	Charge Capacity Estimate	Section 4.6.	

[1] For clarity on any other terminology used in the test method, please refer to IEEE Standard 1515–2000.

TABLE 3.1—LIST OF MEASURED OR CALCULATED VALUES—Continued

	Name of measured or calculated value	Reference	Value
3	Trial 0.2 C discharge current, ($I_{0.2C\_trial}$)	Section 4.6.	
4	Improved Charge Capacity Estimate (if second discharge lasts for less than 4 or more than 5 hours).	Section 4.6.	
5	Improved 0.2 C discharge current estimate (if second discharge lasts for less than 4 or more than 5 hours), ($I'_{0.2C\_trial}$).	Section 4.6.	
6	Duration of the charge and maintenance mode test	Section 5.2.	
7	Battery Discharge Energy	Section 4.6.	
8	Initial time, power (W), power factor, and crest factor of the input current of connected battery.	Section 5.8.	
9	Power factor and crest factor of the input current during last 10 min of test	Section 5.8.	
10	Active and Maintenance Mode Energy Consumption	Section 5.8.	
11	Maintenance Mode Power	Section 5.9.	
12	24 Hour Energy Consumption	Section 5.10.	
12	Standby Mode Power	Section 5.11.	
13	Off Mode Power	Section 5.12.	

3.2. Verifying Accuracy and Precision of Measuring Equipment

a. Measurements of active power of 0.5 W or greater shall be made with an uncertainty of ≤ 2% at the 95% confidence level. Measurements of active power of less than 0.5 W shall be made with an uncertainty of ≤ 0.01 W at the 95% confidence level. The power measurement instrument shall. As applicable, have a resolution of:

(1) 0.01 W or better for measurements up to 10 W;

(2) 0.1 W or better for measurements of 10 to 100 W; or

(3) 1 W or better for measurements over 100 W.

b. Measurements of energy (Wh) shall be made with an uncertainty of ≤ 2% at the 95% confidence level. Measurements of voltage and current shall be made with an uncertainty of ≤ 1% at the 95% confidence level. Measurements of temperature shall be made with an uncertainty of ≤ 2 °C at the 95% confidence level.

c. All equipment used to conduct the tests must be selected and calibrated to ensure that measurements will meet the above uncertainty requirements. For suggestions on measuring low power levels, *see* IEC 62301, (Reference for guidance only, *see* § 430.4) especially Section 5.3.2 and Annexes B and D.

3.3. Setting Up the Test Room

All tests, battery conditioning, and battery rest periods shall be carried out in a room with an air speed immediately surrounding the UUT of ≤ 0.5 m/s. The ambient temperature shall be maintained at 25 °C ± 5 °C throughout the test. There shall be no intentional cooling of the UUT such as by use of separately powered fans, air conditioners, or heat sinks. The UUT shall be conditioned, rested, and tested on a thermally non-conductive surface. A readily available material such as Styrofoam will be sufficient. When not undergoing active testing, batteries shall be stored at 25 °C ± 5 °C.

3.4. Verifying the UUT's Input Voltage and Input Frequency

a. If the UUT is intended for operation on AC line-voltage input in the United States, it shall be tested at 115 V at 60 Hz. If the UUT is intended for operation on AC line-voltage input but cannot be operated at 115 V at 60 Hz, it shall not be tested.

b. If a charger is powered by a low-voltage DC or AC input, and the manufacturer packages the charger with a wall adapter, sells, or recommends an optional wall adapter capable of providing that low voltage input, then the charger shall be tested using that wall adapter and the input reference source shall be 115 V at 60 Hz. If the wall adapter cannot be operated with AC input voltage at 115 V at 60 Hz, the charger shall not be tested.

c. If the UUT is intended for operation only on DC input voltage and does not include a wall adapter, it shall be tested with one of the following input voltages: 12.0 V DC for products intended for automotive, recreational vehicle, or marine use, 5.0 V DC for products drawing power from a computer USB port, or the midpoint of the rated input voltage range for all other products. The input voltage shall be within ± 1% of the above specified voltage.

d. If the input voltage is AC, the input frequency shall be within ± 1% of the specified frequency. The THD of the input voltage shall be ≤ 2%, up to and including the 13th harmonic. The crest factor of the input voltage shall be between 1.34 and 1.49.

e. If the input voltage is DC, the AC ripple voltage (RMS) shall be:

(1) ≤ 0.2 V for DC voltages up to 10 V; or

(2) ≤ 2% of the DC voltage for DC voltages over 10 V.

4. Unit Under Test Setup Requirements

4.1. General Setup

a. The battery charger system shall be prepared and set up in accordance with the manufacturer's instructions, except where those instructions conflict with the requirements of this test procedure. If no instructions are given, then factory or "default" settings shall be used, or where there are no indications of such settings, the UUT shall be tested as supplied.

b. If the battery charger has user controls to select from two or more charge rates (such as regular or fast charge) or different charge currents, the test shall be conducted at the fastest charge rate that is recommended by the manufacturer for everyday use, or failing any explicit recommendation, the factory-default charge rate. If the charger has user controls for selecting special charge cycles that are recommended only for occasional use to preserve battery health, such as equalization charge, removing memory, or battery conditioning, these modes are not required to be tested. The settings of the controls shall be listed in the report for each test.

4.2. Selection and Treatment of the Battery Charger

The UUT, including the battery charger and its associated battery, shall be new products of the type and condition that would be sold to a customer. If the battery is lead-acid chemistry and the battery is to be stored for more than 24-hours between its initial acquisition and testing, the battery shall be charged before such storage.

4.3. Selection of Batteries To Use for Testing

a. For chargers with integral batteries, the battery packaged with the charger shall be used for testing. For chargers with detachable batteries, the battery or batteries to be used for testing will vary depending on whether there are any batteries packaged with the battery charger.

(1) If batteries are packaged with the charger, batteries for testing shall be selected from the batteries packaged with the battery charger, according to the procedure below.

(2) If no batteries are packaged with the charger, but the instructions specify or recommend batteries for use with the charger, batteries for testing shall be selected from those recommended or specified in the instructions, according to the procedure below.

(3) If no batteries are packaged with the charger and the instructions do not specify or recommend batteries for use with the charger, batteries for testing shall be selected from any that are suitable for use with the charger, according to the procedure below.

b. From the detachable batteries specified above, the technician shall use Table 4.1 to select the batteries to be used for testing depending on the type of charger being tested. Each row in the table represents a mutually exclusive charger type. The technician shall find the single applicable row for the UUT, and test according to those requirements.

c. A charger is considered as:

(1) Single-capacity if all associated batteries have the same rated charge capacity (*see* definition) and, if it is a batch charger, all configurations of the batteries have the same rated charge capacity.

(2) Multi-capacity if there are associated batteries or configurations of batteries that have different rated charge capacities.

d. The selected battery or batteries will be referred to as the test battery and will be used through the remainder of this test procedure.

TABLE 4.1—BATTERY SELECTION FOR TESTING

Type of charger			Tests to perform	
Multi-voltage	Multi-port	Multi-capacity	Number of tests	Battery selection (from all configurations of all associated batteries)
No	No	No	1	Any associated battery.
No	No	Yes	2	Lowest charge capacity battery. Highest charge capacity battery.
No	Yes	Yes or No	2	Use only one port and use the minimum number of batteries with the lowest rated charge capacity that the charger can charge. Use all ports and use the maximum number of identical batteries of the highest rated charge capacity the charger can accommodate.
Yes	No	No	2	Lowest voltage battery. Highest voltage battery.
Yes	Yes to either or both.		3	Of the batteries with the lowest voltage, use the one with the lowest charge capacity. Use only one port. Of the batteries with the highest voltage, use the one with the lowest charge capacity. Use only one port. Use all ports and use the battery or the configuration of batteries with the highest total calculated energy capacity.

4.4. Limiting Other Non-Battery-Charger Functions

a. If the battery charger or product containing the battery charger does not have any additional functions unrelated to battery charging, this subsection may be skipped.

b. Any optional functions controlled by the user and not associated with the battery charging process (*e.g.,* the answering machine in a cordless telephone charging base) shall be switched off. If it is not possible to switch such functions off, they shall be set to their lowest power-consuming mode during the test.

c. If the battery charger takes any physically separate connectors or cables not required for battery charging but associated with its other functionality (such as phone lines, serial or USB connections, Ethernet, cable TV lines, etc.), these connectors or cables shall be left disconnected during the testing.

d. Any manual on-off switches specifically associated with the battery charging process shall be switched on for the duration of the charge, maintenance, and no-battery mode tests, and switched off for the off mode test.

4.5. Accessing the Battery for the Test

a. The technician may need to disassemble the end-use product or battery charger to gain access to the battery terminals for the Battery Discharge Energy Test in section 5.6. If the battery terminals are not clearly labeled, the technician shall use a voltmeter to identify the positive and negative terminals. These terminals will be the ones that give the largest voltage difference and are able to deliver significant current (0.2 C) into a load.

b. All conductors used for contacting the battery must be cleaned and burnished prior to connecting in order to decrease voltage drops and achieve consistent results.

c. Manufacturer's instructions for disassembly shall be followed, except those instructions that:

(1) Lead to any permanent alteration of the battery charger circuitry or function;

(2) Could alter the energy consumption of the battery charger compared to that experienced by a user during typical use, *e.g.,* due to changes in the airflow through the enclosure of the UUT; or

(3) Contradict requirements of this test procedure.

d. Care shall be taken by the technician during disassembly to follow appropriate safety precautions. If the functionality of the device or its safety features is compromised, the product shall be discarded after testing.

e. Some products may include protective circuitry between the battery cells and the remainder of the device. In some cases, it is possible that the test battery cannot be discharged without activating protective control circuitry. If the manufacturer provides a description for accessing connections at the output of the protective circuitry, the energy measurements shall be made at the terminals of the test battery, so as not to include energy used by the protective control circuitry.

f. If the technician, despite diligent effort and use of the manufacturer's instructions:

(1) Is unable to access the battery terminals;

(2) Determines that access to the battery terminals destroys charger functionality; or

(3) Is unable to draw current from the test battery, then the Battery Discharge Energy and the Charging and Maintenance Mode Energy shall be reported as "Not Applicable."

4.6. Determining Charge Capacity for Batteries With No Rating

a. If the test battery has a rated charge capacity, this subsection may be skipped. Otherwise, if there is no rating for the battery charge capacity on the test battery or in the instructions, then the technician shall estimate the battery capacity in accordance with the following iterative procedure involving two or three charge and logged discharge cycles. These cycles can be used in lieu of the battery conditioning specified in section 5.3:

(1) The test battery shall be fully charged according to the procedure in section 5.2.

(2) The test battery shall then be discharged at a rate of 0.5 amperes until its average cell voltage under load reaches the end-of-discharge voltage specified in Table 5.2 for the relevant battery chemistry. The time required to reach end-of-discharge shall be measured, and the capacity estimated by multiplying the 0.5 ampere discharge current by the discharge time.

(3) The test battery shall again be fully charged, as in step a.(1), of this section.

(4) The test battery shall then be discharged at a trial 0.2 C rate based on the above capacity estimate. The trial 0.2 C discharge current can be calculated as follows:

$$I_{0.2C\_TRIAL} = \frac{0.5\ \mathrm{A} \times t_{DISCHARGE\_0.5\ \mathrm{A}}}{5\ \mathrm{h}}$$

Where:

$I_{0.2C\_TRIAL}$ = is the trial discharge current; and

$t_{DISCHARGE\_0.5A}$ is the time required to discharge the battery at 0.5 amperes.

(5) The time required to reach end-of-discharge shall again be measured. If this second discharge time is greater than 4.5 hours and less than 5.5 hours, the capacity determined using the above method shall be used as the rated charge capacity throughout the remainder of this test procedure. Furthermore, the current calculated above shall be used as the 0.2 C rate.

(6) Otherwise, if the second discharge time measured in step a.(4), of this section, is greater than 4.5 hours and less than 5.5 hours, the capacity estimate shall be updated by multiplying by the second discharge time, and an updated trial discharge current shall be calculated as follows:

$$I'_{0.2C\_TRIAL} = \frac{I_{0.2C\_TRIAL} \times t'_{DISCHARGE\_0.5\,A}}{5\,\mathrm{h}}$$

Where:

$I_{0.2C\_TRIAL}$ is the original trial discharge current;

$I'_{0.2C\_TRIAL}$ is the updated trial discharge current;

$t'_{DISCHARGE\_0.5A}$ is the updated discharge time measured at the $I_{0.2C\_TRIAL}$ rate.

b. This updated capacity estimate and updated trial discharge current shall then be used throughout this test procedure as the rated battery capacity and the 0.2 C rate, respectively.

5. Test Measurement

The test sequence to measure the battery charger energy consumption is summarized in Table 5.1, and explained in detail below. Measurements shall be made under test conditions and with the equipment specified in Sections 3 and 4.

TABLE 5.1—TEST SEQUENCE

Step	Description	Data taken?	Equipment needed				
			Test battery	Charger	Battery analyzer or constant-current load	AC power meter	Thermometer (for flooded lead-acid BCs only)
1	Record general data on UUT; Section 5.1	Yes	X	X			
2	Determine test duration; Section 5.2	No					
3	Battery conditioning; Section 5.3	No	X	X	X		
4	Prepare battery for discharge test; Section 5.4	No	X	X			
5	Battery rest period; Section 5.5	No	X				X
6	Battery Discharge Energy Test; Section 5.6	Yes	X		X		
7	Battery Rest Period; Section 5.7	No	X				X
8	Conduct Charge Mode and Battery Maintenance Mode Test; Section 5.8.	Yes	X	X		X	
9	Determining the Maintenance Mode Power; Section 5.9.	Yes	X	X		X	
10	Calculating the 24–Hour Energy Consumption; Section 5.10.	No					
11	Standby Mode Test; Section 5.11	Yes		X		X	
12	Off Mode Test; Section 5.12	Yes		X		X	

5.1. Recording General Data on the UUT

The technician shall record:

(1) The manufacturer and model of the battery charger;

(2) The presence and status of any additional functions unrelated to battery charging;

(3) The manufacturer, model, and number of batteries in the test battery;

(4) The rated battery voltage of the test battery;

(5) The rated charge capacity of the test battery; and

(6) The rated charge energy of the test battery.

(7) The settings of the controls, if battery charger has user controls to select from two or more charge rates.

5.2. Determining the Duration of the Charge and Maintenance Mode Test

a. The charging and maintenance mode test, section 5.8, shall be 24 hours or longer, as determined by the items below, in order of preference:

(1) If the battery charger has an indicator to show that the battery is fully charged, that indicator shall be used as follows: If the indicator shows that the battery is charged after 19 hours of charging, the test shall be terminated at 24 hours. Conversely, if the full-charge indication is not yet present after 19 hours of charging, the test shall continue until 5 hours after the indication is present.

(2) If there is no indicator, but the manufacturer's instructions indicate that charging this battery or this capacity of battery should be complete within 19 hours, the test shall be for 24 hours. If the instructions indicate that charging may take longer than 19 hours, the test shall be run for the longest estimated charge time plus 5 hours.

(3) If there is no indicator and no time estimate in the instructions, but the charging current is stated on the charger or in the instructions, calculate the test duration as the longer of 24 hours or:

$$Duration = 1.4 \cdot \frac{RatedChargeCapacity\ (\mathrm{Ah})}{ChargeCurrent\ (\mathrm{A})} + 5\mathrm{h}$$

b. If none of the above applies, the duration of the test shall be 24 hours.

5.4. Preparing the Battery for Discharge Testing

Following any conditioning prior to beginning the battery discharge test (section 5.6), the test battery shall be fully charged for the duration specified in section 5.2 or no longer using the UUT.

5.5. Resting the Battery

The test battery shall be rested between preparation and the battery discharge test. The rest period shall be at least one hour and not exceed 24 hours. For batteries with flooded cells, the electrolyte temperature shall be less than 33 °C before charging, even if the rest period must be extended longer than 24 hours.

5.6. Battery Discharge Energy Test

a. If multiple batteries were charged simultaneously during the preparation step, the discharge energy is the sum of the discharge energies of all the batteries.

(1) For a multi-port charger: batteries that were charged in separate ports shall be discharged independently.

(2) For a batch charger: batteries that were charged as a group may be discharged individually, as a group, or in sub-groups connected in series and/or parallel. The position of each battery with respect to the other batteries need not be maintained.

b. During discharge, the battery voltage and discharge current shall be sampled and recorded at least once per minute. The values recorded may be average or instantaneous values.

c. For this test, the technician shall follow these steps:

(1) Ensure that the test battery has been charged by the UUT and rested according to the procedures above.

(2) Set the battery analyzer for a constant discharge current of 0.2 C and the end-of-discharge voltage in Table 5.2 for the relevant battery chemistry.

(3) Connect the test battery to the analyzer and begin recording the voltage, current, and wattage, if available from the battery analyzer. When the end-of-discharge voltage is reached or the UUT circuitry terminates the discharge, the test battery shall be returned to an open-circuit condition. If for any reason, current continues to be drawn from the test battery after the end-of-discharge condition is first reached, this additional energy is not to be counted in the battery discharge energy.

d. If not available from the battery analyzer, the battery discharge energy (in watt-hours) is calculated by multiplying the voltage (in volts), current (in amperes), and sample period (in hours) for each sample, and then summing over all sample periods until the end-of-discharge voltage is reached.

5.7. Resting the Battery

The test battery shall be rested between discharging and charging. The rest period shall be at least one hour and not more than 24-hours. For batteries with flooded cells, the electrolyte temperature shall be less than 33 °C before charging, even if the rest period must be extended longer than 4 hours.

5.8. Testing Charge Mode and Battery Maintenance Mode

a. The Charge and Battery Maintenance Mode test measures the energy consumed during charge mode and some time spent in the maintenance mode of the UUT. Functions required for battery conditioning that happen only with some user-selected switch or other control shall not be included in this measurement. (The technician shall manually turn off any battery conditioning cycle or setting.) Regularly occurring battery conditioning or maintenance functions that are not controlled by the user will, by default, be incorporated into this measurement.

b. During the measurement period, input power values to the UUT shall be recorded at least once every minute.

(1) If possible, the technician shall set the data logging system to record the average power during the sample interval. This allows the total energy to be computed as the sum of power samples (in watts) multiplied by the sample interval (in hours).

(2) If this setting is not possible, then the power analyzer shall be set to integrate or accumulate the input power over the measurement period and this result shall be used as the total energy.

c. The technician shall follow these steps:

(1) Ensure that user-controllable device functionality not associated with battery charging and any battery conditioning cycle or setting are turned off, as instructed in section 4.4;

(2) Ensure that the test battery used in this test has been conditioned, prepared, discharged, and rested as described in sections 5.3 through 5.7, above;

(3) Connect the data logging equipment to the battery charger;

(4) Record the start time of the measurement period, and begin logging the input power;

(5) Connect the test battery to the battery charger within 3 minutes of beginning logging. For integral battery products, connect the product to a cradle or wall adapter within 3 minutes of beginning logging;

(6) After the test battery is connected, record the initial time, power (W), power factor, and crest factor of the input current to the UUT. These measurements shall be taken within the first 10 minutes of active charging;

(7) Record the input power for the duration of the "Charging and Maintenance Mode Test" period, as determined by 5.2. The actual time that power is connected to the UUT shall be within ±5 minutes of the specified period;

(8) During the last 10 minutes of the test, record the power factor and crest factor of the input current to the UUT; and

(9) Disconnect power to the UUT, terminate data logging, and record the final time.

5.9. Determining the Maintenance Mode Power

a. After the measurement period is complete, the technician shall determine the average maintenance mode power consumption as follows. Examine the power-versus-time data, and:

(1) If the maintenance mode power is cyclic or shows periodic pulses, compute the average power over a time period that spans an integer number of cycles and includes at least the last 4 hours.

(2) Otherwise, calculate the average power value over the last 4 hours.

5.10. Determining the 24–Hour Energy Consumption

a. If the charge and maintenance test period determined in section 5.2 was 24-hours, either the accumulated energy or the average input power, integrated over the test period, shall be used to calculate 24-hour energy consumption.

b. If the charge and maintenance test period was greater than 24-hours, only the first 24-hours of the accumulated energy or the average input power, integrated over 24-hours, shall be used to calculate the 24-hour energy consumption.

TABLE 5.2—REQUIRED BATTERY DISCHARGE RATES AND END-OF-DISCHARGE BATTERY VOLTAGES

Battery chemistry	Discharge rate C	End-of-discharge voltage Volts per cell
Valve-Regulated Lead Acid (VRLA)	0.2	1.75
Flooded Lead Acid	0.2	1.70
Nickel Cadmium (NiCd)	0.2	1.0
Nickel Metal Hydride (NiMH)	0.2	1.0
Lithium Ion (Li-Ion)	0.2	2.5
Lithium Polymer	0.2	2.5
Rechargeable Alkaline	0.2	0.9
Nanophosphate Lithium Ion	0.2	2.0
Silver Zinc	0.2	1.2

5.11. Standby Mode Energy Consumption Measurement

a. Conduct a measurement of standby power consumption while the battery charger is connected to the power source. Disconnect the battery from the charger, allow the charger to operate for at least 30 minutes, and record the power (*i.e.,* watts) consumed as the time series integral of the power consumed over a 10 minute test period, divided by the period of measurement. If the battery charger has manual on-off switches, all must be turned on for the duration of the standby mode test.

b. Standby mode may also apply to products with integral batteries. If the product uses a cradle and/or adapter for power conversion and charging, then "disconnecting the battery from the charger" will require disconnection of the end-use product, which contains the batteries. The other enclosures of the battery charging system will remain connected to the main electricity supply, and standby mode power consumption will equal that of the cradle and/or adapter alone.

c. If the product also contains integrated power conversion and charging circuitry and is powered through a detachable AC power cord, then only the cord will remain connected to mains, and standby mode power consumption will equal that of the AC power cord (*i.e.,* zero watts).

d. Finally, if the product contains integrated power conversion and charging circuitry but is powered through a non-detachable AC power cord or plug blades, then no part of the system will remain connected to mains, and standby mode measurement is not applicable.

5.12 Off Mode Energy Consumption Measurement

a. If the battery charger has manual on-off switches, record a measurement of off mode energy consumption while the battery charger is connected to the power source. Remove the battery from the charger, allow the charger to operate for at least 30 minutes, and record the power (*i.e.,* watts) consumed as the time series integral of the power consumed over a 10-minute test period, divided by the period of measurement, with all manual on-off switches turned off. If the battery charger does not have manual on-off switches, record that the off mode measurement is not applicable to this product.

b. Off mode may also apply to products with integral batteries. If the product uses a cradle and/or adapter for power conversion and charging, then "disconnecting the battery from the charger" will require disconnection of the end-use product, which contains the batteries. The other enclosures of the battery charging system will remain connected to the main electricity supply, and off mode power consumption will equal that of the cradle and/or adapter alone.

c. If the product also contains integrated power conversion and charging circuitry and is powered through a detachable AC power cord, then only the cord will remain connected to mains, and off mode power consumption will equal that of the AC power cord (*i.e.,* zero watts).

d. Finally, if the product contains integrated power conversion and charging circuitry but is powered through a non-detachable AC power cord or plug blades, then no part of the system will remain connected to mains, and off mode measurement is not applicable.

4. Amend appendix Z to subpart B of part 430 by:

a. Revising paragraph 2(c).

b. Revising paragraphs 3(b) and 4(b).

The revisions read as follows:

Appendix Z to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of External Power Supplies

* * * * *

2. * * *

c. *Active power (P)* (also *real power*) means the average power consumed by a unit. For a two terminal device with current and voltage waveforms i(t) and v(t) which are periodic with period T, the real or active power P is:

$$P = \frac{1}{T}\int_0^T v(t)i(t)dt$$

* * * * *

3. * * *

(b) Multiple-Voltage External Power Supply. Unless otherwise specified, measurements shall be made under test conditions and with equipment specified below.

(i) Verifying Accuracy and Precision of Measuring Equipment

(A) Measurements of power 0.5 W or greater shall be made with an uncertainty of ≤ 2% at the 95% confidence level. Measurements of power less than 0.5 W shall be made with an uncertainty of ≤ 0.01 W at the 95% confidence level. The power measurement instrument shall have a resolution of:

(*1*) 0.01 W or better for measurements up to 10 W;

(*2*) 0.1 W or better for measurements of 10 to 100 W; or

(*3*) 1 W or better for measurements over 100 W.

(B) Measurements of energy (Wh) shall be made with an uncertainty of ≤ 2% at the 95% confidence level. Measurements of voltage and current shall be made with an uncertainty of ≤ 1% at the 95% confidence level. Measurements of temperature shall be made with an uncertainty of ≤ 2 °C at the 95% confidence level.

(C) All equipment used to conduct the tests must be selected and calibrated to ensure that measurements will meet the above uncertainty requirements. For suggestions on measuring low power levels, *see* IEC 62301, (Reference for guidance only, *see* § 430.4) especially Section 5.3.2 and Annexes B and D.

(ii) Setting Up the Test Room

All tests shall be carried out in a room with an air speed immediately surrounding the UUT of ≤ 0.5 m/s. The ambient temperature shall be maintained at 25 °C ± 5 °C throughout the test. There shall be no intentional cooling of the UUT such as by use of separately powered fans, air conditioners, or heat sinks. The UUT shall be conditioned, rested, and tested on a thermally non-conductive surface. A readily available material such as Styrofoam will be sufficient.

(iii) Verifying the UUT's Input Voltage and Input Frequency

(A) If the UUT is intended for operation on AC line-voltage input in the United States, it shall be tested at 115 V at 60 Hz. If the UUT is intended for operation on AC line-voltage input but cannot be operated at 115 V at 60 Hz, it shall not be tested. The input voltage shall be within ± 1% of the above specified voltage.

(B) If the UUT is intended for operation only on DC input voltage, it shall be tested with one of the following input voltages: 12.0 V DC for products intended for automotive, recreational vehicle, or marine use; 5.0 V DC for products drawing power from a computer USB port; or the midpoint of the rated input voltage range for all other products. The input voltage shall be within ± 1% of the above specified voltage.

(C) If the input voltage is AC, the input frequency shall be within ± 1% of the specified frequency. The THD of the input voltage shall be ≤ 2%, up to and including the 13th harmonic. The crest factor of the input voltage shall be between 1.34 and 1.49.

(D) If the input voltage is DC, the AC ripple voltage (RMS) shall be:

(*1*) ≤ 0.2 V for DC voltages up to 10 V

(*2*) ≤ 2% of the DC voltage for DC voltages over 10 V.

4. * * *

(b) Multiple-Voltage External Power Supply—Power supplies must be tested with the output cord packaged with the unit for sale to the consumer, as it is considered part of the unit under test. There are two options for connecting metering equipment to the output of this type of power supply: Cut the cord immediately adjacent to the output connector or attach leads and measure the efficiency from the output connector itself. If the power supply is attached directly to the product that it is powering, cut the cord immediately adjacent to the powered product and connect output measurement probes at that point. The tests should be conducted on the sets of output wires that constitute the output busses. If the product has additional wires, these should be left electrically disconnected unless they are necessary for controlling the product. In this case, the manufacturer shall supply a connection diagram or test fixture that will allow the testing laboratory to put the unit under test into active mode.

(i) Standby-Mode and Active-Mode Measurement—The measurement of the multiple-voltage external power supply standby mode (also no-load-mode) energy consumption and active-mode efficiency shall be as follows:

(A) Loading conditions and testing sequence. (*1*) If the unit under test has on-off switches, all switches shall be placed in the "on" position. Loading criteria for multiple-voltage external power supplies shall be based on nameplate output current and not on nameplate output power because output voltage might not remain constant.

(*2*) The unit under test shall operate at 100 percent of nameplate current output for at least 30 minutes immediately before conducting efficiency measurements.

(*3*) After this warm-up period, the technician shall monitor AC input power for a period of 5 minutes to assess the stability of the unit under test. If the power level does not drift by more than 1 percent from the maximum value observed, the unit under test can be considered stable and measurements can be recorded at the end of the 5-minute period. Measurements at subsequent loading conditions, listed in Table 1, can then be conducted under the same 5-minute stability guidelines. Only one warm-up period of 30 minutes is required for each unit under test at the beginning of the test procedure.

(*4*) If AC input power is not stable over a 5-minute period, the technician shall follow the guidelines established by IEC Standard 62301 for measuring average power or accumulated energy over time for both input and output.

(*5*) The unit under test shall be tested at the loading conditions listed in Table 1, derated per the proportional allocation method presented in the following section.

TABLE 1—LOADING CONDITIONS FOR UNIT UNDER TEST

Loading Condition 1	100% of Derated Nameplate Output Current ± 2%.
Loading Condition 2	75% of Derated Nameplate Output Current ± 2%.
Loading Condition 3	50% of Derated Nameplate Output Current ± 2%.
Loading Condition 4	25% of Derated Nameplate Output Current ± 2%.
Loading Condition 5	0%.

(*6*) Input and output power measurements shall be conducted in sequence from Loading Condition 1 to Loading Condition 4, as indicated in Table 1. For Loading Condition 5, the unit under test shall be placed in no-load mode, any additional signal connections to the unit under test shall be disconnected, and input power shall be measured.

(B) Proportional allocation method for loading multiple-voltage external power supplies. For power supplies with multiple voltage busses, defining consistent loading criteria is difficult because each bus has its own nameplate output current. The sum of the power dissipated by each bus loaded to its nameplate output current may exceed the overall nameplate output power of the power supply. The following proportional allocation method must be used to provide consistent loading conditions for multiple-voltage external power supplies. For additional explanation, please refer to section 6.1.1 of the California Energy Commission's "Proposed Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies Revision 6.2," November 2007.

(*1*) Assume a multiple-voltage power supply with N output busses, and nameplate output voltages V_I, * * *, V_N, corresponding output current ratings I_I, * * *, I_N, and a nameplate output power *P.* Calculate the derating factor *D* by dividing the power supply nameplate output power *P* by the sum of the nameplate output powers of the individual output busses, equal to the product of bus nameplate output voltage and current $I_i V_i$, as follows:

$$D = \frac{P}{\sum_{i=1}^{N} V_i I_i},$$

(*2*) If $D \geq 1$, then loading every bus to its nameplate output current does not exceed the overall nameplate output power for the power supply. In this case, each output bus will simply be loaded to the percentages of its nameplate output current listed in Table 1. However, if $D < 1$, it is an indication that loading each bus to its nameplate output current will exceed the overall nameplate output power for the power supply. In this case, and at each loading condition, each output bus will be loaded to the appropriate percentage of its nameplate output current listed in Table 1, multiplied by the derating factor *D.*

(C) Minimum output current requirements. Depending on their application, some multiple-voltage power supplies may require a minimum output current for each output bus of the power supply for correct operation. In these cases, ensure that the load current for each output at Loading Condition 4 in Table 1 is greater than the minimum output current requirement. Thus, if the test method's calculated load current for a given voltage bus is smaller than the minimum output current requirement, the minimum output current must be used to load the bus. This load current shall be properly recorded in any test report.

(D) Test loads. Active loads such as electronic loads or passive loads such as rheostats used for efficiency testing of the unit under test shall be able to maintain the required current loading set point for each output voltage within an accuracy of ± 0.5 percent. If electronic load banks are used, their settings should be adjusted such that they provide a constant current load to the unit under test.

(E) Efficiency calculation. Efficiency shall be calculated by dividing the measured active output power of the unit under test at a given loading condition by the active AC input power measured at that loading condition. Efficiency shall be calculated at each Loading Condition (1, 2, 3, and 4, in Table 1) and be recorded separately.

(F) Power consumption calculation. Power consumption of the unit under test at Loading Conditions 1, 2, 3, and 4 is the difference between the active output power at that Loading Condition and the active AC input power at that Loading Condition. The power consumption of Loading Condition 5 (no-load) is equal to the AC active input power at that Loading Condition.

(ii) Off Mode Measurement—If the multiple-voltage external power supply unit under test incorporates any on-off switches, the unit under test shall be placed in off mode and its power consumption in off mode measured and recorded. The measurement of the off mode energy consumption shall conform to the requirements specified in paragraph 4.(b)(i) of this appendix. Note that the only loading condition that will be measured for off mode is "Loading Condition 5" in paragraph 4.(b)(i)(A) of this appendix, except that all manual on-off switches shall be placed in the off position for the measurement.

[FR Doc. 2010–6318 Filed 4–1–10; 8:45 am]

BILLING CODE 6450–01–P