DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[EERE–2020–BT–TP–0012]

RIN 1904–AE49

Energy Conservation Program: Test Procedure for Battery Chargers

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

ACTION: Notice of proposed rulemaking and request for comment.

SUMMARY: The U.S. Department of Energy (''DOE'') proposes to amend the test procedures for battery chargers to improve test procedure representativeness. The proposal would: Establish a new appendix Y1 that would expand coverage of inductive wireless battery chargers and establish associated definitions and test provisions; establish a new test procedure approach that relies on separate metrics for active mode, stand-by, and off-mode (consequently removing the battery charger usage profiles and unit energy consumption calculation); and update the wall adapter selection criteria. DOE also proposes changes to appendix Y to reorganize two subsections, to clarify symbology and references, to correct an incorrect cross reference and section title, to update the list of battery chemistries, and to terminate an existing test procedure waiver because the covered subject models have been discontinued. DOE further proposes to mirror these changes in the newly proposed appendix Y1. DOE is seeking comment from interested parties on the proposals.

DATES: DOE will accept comments, data, and information regarding this proposal no later than January 24, 2022. See section V, ''Public Participation,'' for details. DOE will hold a webinar on Wednesday, December 15, 2021, from 12:30 p.m. to 4:00 p.m. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants. If no participants register for the webinar, it will be cancelled.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *www.regulations.gov.* Alternatively, interested persons may submit comments, identified by docket number EERE–2020–BT–TP–0012, by any of the following methods:

(1) *Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.*

(2) *Email: BatteryChargers2020TP0012@ee.doe.gov. Include the docket number EERE–2020–BT–TP–0012 or regulatory information number (''RIN'') 1904–AE49 in the subject line of the message.*

No telefacsimiles (''faxes'') will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section V ''Public Participation,'' of this document.

Although DOE has routinely accepted public comment submissions through a variety of mechanisms, including postal mail or hand delivery/courier, the Department has found it necessary to make temporary modifications to the comment submission process in light of the ongoing COVID–19 pandemic. DOE is currently suspending receipt of public comments via postal mail and hand delivery/courier. If a commenter finds that this change poses an undue hardship, please contact Appliance Standards Program staff at (202) 586–1445 to discuss the need for alternative arrangements. Once the COVID–19 pandemic health emergency is resolved, DOE anticipates resuming all of its regular options for public comment submission, including postal mail and hand delivery/courier.

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts (if a public meeting is held), comments, and other supporting documents/materials, is available for review at *www.regulations.gov.* All documents in the docket are listed in the *www.regulations.gov* index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

The docket web page can be found at *www.regulations.gov/docket?D=EERE-2020-BT-TP-0012.* The docket web page contains instructions on how to access all documents, including public comments, in the docket. See section V, ''Public Participation,'' for information on how to submit comments through *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT:

Mr. Jeremy Dommu, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–9870. Email *ApplianceStandardsQuestions@ee.doe.gov.*

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–8145. Email: *michael.kido@hq.doe.gov.*

For further information on how to submit a comment, review other public comments and the docket, or participate in a public meeting (if one is held), contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

SUPPLEMENTARY INFORMATION: DOE proposes to maintain the previously incorporated by reference standards and to incorporate by reference the following industry standards into part 430:

IEC 62301, (''IEC 62301''), ''Household electrical appliances—Measurement of standby power, (Edition 2.0, 2011–01).''

Copies IEC 62301 can be obtained from the International Electrotechnical Commission at 446 Main Street, Sixteenth Floor, Worcester, MA 01608, or by going to *www.iec.ch.*

See section IV.M. for a discussion of this standard.

Table of Contents

I. Authority and Background

Battery chargers are included among the consumer products for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6295(u)) DOE's energy conservation standards and test procedures for battery chargers are currently prescribed at title 10 CFR 430.32(z), and 10 CFR part 430, subpart B, appendix Y (''Appendix Y''), respectively. The following sections discuss DOE's authority to establish test procedures for battery chargers and relevant background information regarding DOE's consideration of test procedures for this product.

A. Authority

The Energy Policy and Conservation Act, as amended (''EPCA''),[1] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part B [2] of EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles, which sets forth a variety of provisions designed to improve energy efficiency. This NOPR covers battery chargers, which are included under EPCA. (42 U.S.C. 6291(32); 42 U.S.C 6295(u))

The energy conservation program under EPCA consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA specifically include definitions (42 U.S.C. 6291), test procedures (42 U.S.C. 6293), labeling provisions (42 U.S.C. 6294), energy conservation standards (42 U.S.C. 6295), and the authority to require information and reports from manufacturers (42 U.S.C. 6296).

The Federal testing requirements consist of test procedures that manufacturers of covered products must use as the basis for: (1) Certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6295(s)), and (2) making representations about the efficiency of those consumer products (42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to determine whether the products comply with relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

Federal energy efficiency requirements for covered products established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6297(d))

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products. EPCA requires that any test procedures prescribed or amended under this section be reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle or period of use, and not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

In addition, EPCA requires that DOE amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption. (42 U.S.C. 6295(gg)(2)(A); *see also* 42 U.S.C. 6295(u)(1)(B)(i)) Standby mode and off mode energy consumption must be incorporated into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product unless the current test procedures already account for and incorporate standby and off mode energy consumption or unless such integration is technically infeasible. If an integrated test procedure is technically infeasible, DOE must prescribe a separate standby mode and off mode energy use test procedure for the covered product, if such test procedures are technically feasible. (42 U.S.C. 6295(gg)(2)(A)(ii)) Any such amendment must consider the most current versions of the International Electrotechnical Commission (''IEC'') Standard 62301 [3] and IEC Standard 62087 [4] as applicable. (42 U.S.C. 6295(gg)(2)(A))

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 data, views, and arguments with respect to such procedures. (42 U.S.C. 6293(b)(2)) EPCA also requires that DOE evaluate test procedures for each type of covered product at least once every 7 years to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A)) If the Secretary determines, on her own behalf or in response to a petition by any interested person, that a test procedure should be prescribed or amended, the Secretary shall promptly publish in the **Federal Register** proposed test procedures and afford interested persons an opportunity to present oral and written data, views, and arguments with respect to such procedures. (42 U.S.C. 6293(b)(2) The comment period on a proposed rule to amend a test procedure shall be at least 60 days and may not exceed 270 days. *Id.* In prescribing or amending a test procedure, the Secretary shall take into account such information as the Secretary determines relevant to such procedure, including technological developments relating to energy use or energy efficiency of the type (or class) of covered products involved. *Id.* If DOE determines that test procedure revisions are not appropriate, DOE must publish its determination not to amend the test procedures. (42 U.S.C. 6293(b)(1)(A)(ii)) DOE is publishing this NOPR in satisfaction of the 7-year review requirement specified in EPCA. (42 U.S.C. 6293(b)(1)(A))

B. Background

On May 4, 2020, DOE published a request for information (''May 2020 RFI'') seeking stakeholder comments and data on whether, since the last test procedure update, there have been changes in battery charger testing methodology or new products

[1] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Public Law 116–260 (Dec. 27, 2020).

[2] For editorial reasons, upon codification in the U.S. Code, Part B was re-designated Part A.

[3] IEC 62301, *Household electrical appliances—Measurement of standby power* (Edition 2.0, 2011–01).

[4] IEC 62087, *Methods of measurement for the power consumption of audio, video, and related equipment* (Edition 3.0, 2011–04).

introduced to the market that may necessitate amending the test procedure for battery chargers. 85 FR 26369. DOE specifically solicited feedback on possible approaches to testing inductive wireless battery chargers not designed for use in a wet environment, and whether any industry test procedures have been developed or were being developed to specifically address such products. 85 FR 26369, 26371. DOE requested data on how inductive wireless chargers were used in the field, particularly with regard to the placement of the wireless charging receiver found in end use products on the transmitting surface of the charger. *Id.* For battery charger products that require a wall adapter but do not come prepackaged with one, DOE requested comment on the characteristics of the wall adapters typically used by manufacturers for testing and certification purposes and, if different, the characteristics of the wall adapters used by consumers in real-world settings. DOE also requested comment on whether using a reference wall adapter for testing would be appropriate in such a situation. *Id.* DOE similarly requested comment on the appropriateness of testing a battery charger using a reference battery load. 85 FR 26369, 26372. DOE further requested comment on whether other parts of the battery charger test procedure need to be updated such as end-of-discharge voltages, prescribed battery chemistries, consumer usage profiles, battery selection criteria, and the battery charger waiver process. 85 FR 26369, 26372–26373.

DOE received comments in response to the May 2020 RFI from the interested parties listed in Table I.1.

TABLE I.1—WRITTEN COMMENTS RECEIVED IN RESPONSE TO MAY 2020 RFI

Commenter(s)	Reference in this NOPR	Commenter type
Association of Home Appliance Manufacturers	AHAM	Trade Association.
Association of Home Appliance Manufacturers, Power Tool Institute, Inc	Joint Commenters	Trade Association.
California Investor Owned Utilities (Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison).	CA IOUs	Utility Association.
Delta-Q Technologies Corp	Delta-Q	Manufacturer.
Information Technology Industry Council	ITI	Trade Association.
Northwest Energy Efficiency Alliance	NEEA	Efficiency Organization.
Techtronic Cordless GP	TTI	Manufacturer.
Wireless Power Consortium	WPC	Efficiency Organization.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[5]

II. Synopsis of the Notice of Proposed Rulemaking

In this notice of proposed rulemaking (''NOPR''), DOE proposes to update appendix Y to reflect updates in battery chemistry and user profiles, to provide more explicit direction, correct cross-reference errors, and to improve organization of the test procedure, as follows:

(1) Update terms used in the battery chemistry table;

(2) Provide further direction regarding the application for a battery charger test procedure waiver when battery energy cannot be directly measured;

(3) Provide more descriptive terms for battery energy and battery voltage values used for determining product class and calculating unit energy; and

(4) Correct a cross-reference and a table title, further clarify certain references, and reorganize certain subsections for improved readability.

DOE is also proposing to establish an amended test procedure for all covered battery chargers in a new appendix Y1, which would generally require that testing be conducted as provided in the proposed amendments to appendix Y, but with the following additional changes:

(1) Establish definitions associated with inductive wireless power transfer, and differentiate between those that incorporate a physical receiver locating feature (*e.g.,* a peg, cradle, dock, locking mechanism, magnet, etc.) for aligning or orienting the position of the receiver (''fixed-location'' wireless chargers) with respect to the transmitter and those that do not (''open-placement'' wireless chargers);

(2) Include within the scope of the test procedure fixed-location inductive wireless battery chargers, and add a separate no-battery mode test for open-placement wireless chargers;

(3) Remove the unit energy consumption (''UEC'')[6] calculations and usage profiles and instead rely on separate metrics for active mode, standby mode, and off mode using E_a, P_{sb}, and P_{off}, respectively, as measured by the newly established appendix Y1; and

(4) Specify wall adapter selection priority and amend selection requirements for battery chargers that do not ship with a wall adapter and for which one is not recommended by the manufacturer.

If the proposed amendments for appendix Y are finalized, manufacturers testing and reporting battery charger's energy use will have to do so based on the DOE test procedure as amended beginning 180 days following the final rule. Furthermore, as proposed, manufacturers would not be required to test according to proposed appendix Y1 until such time as compliance is required with amended energy conservation standards, should such standards be amended.

Additionally, DOE is not proposing amendments to address an existing test procedure waiver and extension of waiver (Case Nos. BC–001 and 2018–012), having initially determined that the basic models subject to the waiver are no longer available on the market.

DOE's proposed actions are summarized in Table II.1 compared to the current test procedure as well as the reason for the proposed change.

[5] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop energy conservation standards for pool heaters. (Docket No. EERE–2020–BT–TP–0012, which is maintained at *www.regulations.gov/#!docketDetail;D=EERE-2020-BT-TP-0012*). The references are arranged as follows: (Commenter name, comment docket ID number, page of that document).

[6] The UEC represents the annualized amount of the non-useful energy consumed by a battery charger among all tested modes of operation. Non-useful energy is the energy consumed by a battery charger that is not transferred and stored in a battery as a result of charging, *i.e.,* the losses.

TABLE II.1—SUMMARY OF CHANGES TO THE CURRENT TEST PROCEDURE AND THE NEW PROPOSED TEST PROCEDURE RELATIVE TO CURRENT TEST PROCEDURE

Current DOE test procedure	Proposed test procedure	Applicable test procedure	Attribution
Only those wireless chargers that operate in "wet environments" and have a battery energy of less than or equal to 5 watt-hours (Wh) are in scope of the battery charger test procedure.	Proposes to increase the 5 Wh limit to 100Wh and to replace the "wet environment" designation with "fixed-location wireless chargers", such that wireless chargers meant for dry as well as wet environments would be in scope.	Appendix Y1	To reflect changes in the market.
Does not differentiate between types of wireless chargers.	Addresses open-placement wireless chargers and fixed-location wireless chargers, and proposes definitions for both.	Appendix Y1	To reflect changes in the market.
Does not provide a test method for open-placement wireless chargers.	Adds a no-battery mode test method for open-placement wireless chargers in a newly created section of the appendix.	Appendix Y1	To reflect changes in the market and to improve representativeness.
Does not provide wall adapter selection priority for chargers that do have associated wall adapters. For those that do not, current test procedure requires DC battery chargers be tested with 5.0 V DC for USB port powered devices, or the midpoint of the rated input voltage range for others.	Adds wall adapter selection order priority and removes the 5.0V DC input criteria. For battery chargers that do not ship with a wall adapter and do not have a recommended adapter, proposes that the charger be tested using a wall adapter that is minimally compliant with the applicable energy conservation standard and supplies the rated input voltage and current.	Appendix Y1	To reflect changes in technology and to improve representativeness and comparability of results.
Battery chemistries specified in Table 3.3.2 do not reflect the latest industry naming convention.	Updates "Lithium Polymer" to "Lithium-ion Polymer," and changes "Nanophosphate Lithium-ion" to "Lithium Iron Phosphate".	Appendix Y and Appendix Y1.	To reflect changes in the market.
UEC calculation relies on usage profiles to determine the length of time spent in each mode of operation.	Removes battery charger usage profiles and the UEC calculation; adopts separate metrics, E_a, P_{sb} and P_{off}, for the energy performance of a battery charger in each of the following three modes of operation respectively: Active mode, standby mode and off mode.	Appendix Y1	To improve representativeness.
Total test duration might not capture the true maintenance mode power of certain battery chargers.	Prolongs the test duration until maintenance mode power has been captured representatively, if needed.	Appendix Y1	To improve representativeness.
Manufacturer can report the battery discharge energy and the charging and maintenance mode energy as "Not Applicable" if the measurements cannot be made.	Provides specific direction to apply for a test procedure waiver if the battery energies cannot be directly measured.	Appendix Y and Appendix Y1.	To improve representativeness.
Uses the designation "E_{batt}" for both experimentally measured battery energy and representative battery energy.	Changes the denotations to "Measured E_{batt}" for experimentally measured battery energy, and "Representative E_{batt}" for representative battery energy, with further clarification in the footnotes.	Appendix Y	To improve readability.
Section 3.3.4 incorrectly references section 3.3.2 for instructions on how to discharge batteries.	Corrects the cross-section reference to Table 3.3.2.	Appendix Y and Appendix Y1.	To improve readability.
Table 3.3.2 is located after Section 3.3.10 (Determining the 24-hour Energy Consumption) but is required for use in section 3.3.8 (Battery Discharge Energy Test).	Moves Table 3.3.2 to Section 3.3.8	Appendix Y and Appendix Y1.	To improve readability.
Certain sections use terms such as "above" or "below" for references.	Further clarifies the referenced sections	Appendix Y and Appendix Y1.	To improve readability.
Battery charger standby mode and off mode can be inappropriately tested if manufacturer does not follow the test procedure in order.	Reorganizes sections 3.3.11 and 3.3.12 so battery charger standby and off modes can be tested correctly even if the test procedure order is not followed.	Appendix Y and Appendix Y1.	To improve readability.
Column title in Table 3.3.3 states "Special characteristic or rated battery voltage".	Corrects the title to read "Special characteristic or highest rated battery voltage" to clarify that for multi-voltage chargers, the highest battery voltage must be used to determine product class.	Appendix Y and Appendix Y1.	To improve readability.

DOE has tentatively determined that, of the proposed amendments described in section III of this NOPR, the proposals in appendix Y1 to require testing with a minimally compliant wall adapter, increase the scope of wireless chargers, and to remove the usage profiles and UEC calculation would result in a value for measured energy use that is different from that measured using the current test procedure. However, as proposed, testing in accordance with these specific proposed changes would not be required until such time as compliance is required with new and amended energy conservation standards. DOE further clarifies that if the proposed amendments for appendix Y were made final manufacturers testing and reporting a battery charger's energy use will have to do so based on the DOE test procedure at appendix Y as amended beginning 180 days following the final rule. DOE has also determined that the test procedure will not be unduly burdensome to conduct. Discussion of DOE's proposed actions are addressed in detail in section III of this NOPR.

III. Discussion

As stated, EPCA requires DOE to periodically review the test procedure for battery chargers and determine whether amendments to the test procedure would more accurately or fully comply with the requirements regarding representativeness and test burden. (42 U.S.C. 6293(b)(1)(A)) In the following sections, DOE discusses in detail relevant test procedure issues, proposes changes to the current DOE test procedure for battery chargers, and responds to relevant comments received in response to the May 2020 RFI. The Joint Commenters and AHAM stated in response to the May 2020 RFI that there are no product or testing changes that would warrant a significant update to DOE's current battery charger test procedure, recommended only minor revisions, and urged DOE to prioritize other issues. (Joint Commenters, No. 6 at pp. 1–2, AHAM, No. 5 at p. 2) DOE is undertaking this rulemaking pursuant to the periodic review as required by EPCA. As discussed in the following sections, DOE has initially determined that amending the current test procedure (and adding a new appendix) as proposed would more fully comply with the requirements in EPCA regarding representativeness and test burden. (42 U.S.C. 6293(b)(3))

A. Scope of Applicability

1. Battery Chargers

This rulemaking applies to battery chargers, which are devices that charge batteries for consumer products, including battery chargers embedded in other consumer products. 10 CFR 430.2. (*See also* 42 U.S.C. 6291(32)) Functionally, a battery charger is a power conversion device used to transform input voltage to a suitable voltage for charging batteries used to power consumer products. (*See* 42 U.S.C. 6291(32)) A battery charger may be wholly embedded in another consumer product, partially embedded in another consumer product, or wholly separate from another consumer product. *Id.*

DOE's current battery charger test procedure applies to battery chargers that operate at either direct current (''DC'') or United States alternating current (''AC'') line voltage (115 Volts at 60 Hertz), as well as to uninterruptible power supplies that have an AC output and utilize the standardized National Electrical Manufacturer Association (''NEMA'') plug, 1–15P or 5–15P, as specified in American National Standards Institute ''ANSI''/NEMA WD 6–2016.

Appendix Y differentiates among different types of battery chargers, including batch chargers, multi-port chargers, and multi-voltage chargers, as well as various battery chemistries. For each type of battery charger, appendix Y specifies test setup requirements and test battery selection, such as battery preparation steps, battery end-of-discharge voltages, and battery charger usage profiles [7] based on the respective product classes. These different specifications ensure that each battery charger is tested to produce results that measure energy use during a representative average use cycle or period of use.

2. Inductive Wireless Battery Chargers

DOE's current energy conversation standards for battery chargers were published on June 13, 2016 (''June 2016 Final Rule''). The standards cover inductive wireless battery charger products (also referred to as ''wireless power devices'') only to the extent that such products are designed and manufactured to operate in a wet environment (*i.e.,* Product Class 1). 81 FR 38266, 38282; 10 CFR 430.32(z)(1). DOE established standards for these wet-environment inductive wireless battery chargers (*e.g.,* battery chargers found in wireless toothbrushes and electric shavers) after finding that the technology used in those products was mature. *Id.* DOE did not establish standards for other types of inductive wireless battery chargers to avoid restricting the development of newer, less mature inductively charged products. *Id.* Similarly, DOE did not generate usage profiles for other types of inductive wireless chargers at the time because of their nascent state of development and their lack of widespread availability in the marketplace. *Id.* Without usage profiles, a corresponding unit energy consumption value cannot be calculated. *Id.*

In the May 2020 RFI, DOE requested comment on whether DOE should further clarify the term ''wet environment,'' whether any industry test procedures have been developed (or are being developed) to specifically address inductive wireless chargers other than those used in a wet environment, and data on how inductive wireless chargers are used in the field. 85 FR 26369, 26371.

In response, CA IOUs and NEEA recommended that DOE create and define categories of wireless chargers based on whether they are dedicated wireless chargers, interoperable single device wireless chargers, and interoperable multiple device wireless chargers, and that DOE expand the scope to include all dedicated wireless chargers rather than just those that are under 5Wh or designed to work in wet environments. (CA IOUs, No. 9 at pp. 2–4, NEEA, No. 8 at p. 11) NEEA stated that wireless charging is expected to continue to be integrated into new consumer products and cited research suggesting that wireless charging could nearly double national energy use of battery chargers by 2030. (NEEA, No. 8 at p. 1) NEEA noted that DOE's current test procedure already covers wired chargers associated with the same end uses as dedicated wireless charging systems. (NEEA, No. 8 at pp. 1–2). CA IOUs recommended that DOE eliminate the wet environment distinction, but that if DOE maintains the wet environment distinction that an ingress protection (''IP'') rating of IPX7 or IPX8 [8] would be suitable to identify wet rated products. (CA IOUs, No. 9 at p. 5) Similarly, the Joint Commenters suggested that DOE re-define Product Class 1 as pertaining to inductive chargers that use a locating feature rather than ''inductive chargers for wet environments'' to avoid confusion. (Joint Commenters, No. 6 at p. 2) ITI stated that the term ''wet environments'' would benefit from further clarification, and requested that DOE provide more examples of products within this category. (ITI, No. 7 at p. 3) Delta-Q commented that the distinction of use in a wet environment does not sufficiently define the scope of covered wireless charger products. (Delta-Q, No. 10 at p. 1) Delta-Q claimed that, although Product Class 1 is intended for low-power personal hygiene products, other chargers such as those for outdoor lawn mowers and drones may also be covered

[7] In section III.B.4, DOE discusses a proposal to remove the UEC metric and the associated usage profile in favor of a multi-metric approach that would measure the energy performance of battery chargers in each mode of operation (active, standby and off modes) independently. If such a proposal were to be finalized, usage profiles would no longer be unnecessary.

[8] IPX7 and IPX8 are both ingress protection levels as defined by IEC 60529, ''Degrees of Protection Provide by Enclosures (IP Code)''.

by the wet environment characterization. *Id.* Delta-Q recommended that DOE continue to exclude non-hygiene products, asserting that they represent a rapidly-changing emerging market and that regulating their efficiency at this time could stifle innovation. (Delta-Q, No. 10 at p. 1)

As stated previously, inductive wireless battery chargers are subject to the DOE test procedures and energy conservation standards only to the extent that such battery chargers have an inductive connection and are designed for use in a wet environment. (*See* Table 3.3.3 of appendix Y, footnote to Product Class 1) This scope of coverage includes those wireless charging products for which DOE determined in the June 2016 Final Rule had sufficiently mature designs such that regulation would not impede innovation, *e.g.,* electric toothbrushes and shavers. 81 FR 38266, 38283. While DOE refers to these as ''wet environment'' products, this term refers to products found in wet environment applications, not the level of waterproofing. But, as discussed further in this section, DOE is proposing to remove the ''wet environment'' distinction altogether.

The wet environment products covered in scope require sealing to prevent moisture ingress, and typically use a locating feature, such as a peg, cradle or a dock, to confine the physical engagement of the receiver (*i.e.*, consumer product) and the transmitter (*i.e.*, charger). 85 FR 26369, 26371. This feature provides relatively consistent placement of the receiver during testing. *Id.* The consistent physical alignment of the receiver to the transmitter enables the battery charger's energy performance to be measured repeatably using DOE test procedure. But DOE tentatively finds that approaches providing consistent receiver-transmitter alignment are now being used in non-wet environments.

Therefore, by adding a new appendix Y1 and eliminating the ''wet-environment'' limitation on inductive wireless battery chargers currently contained in appendix Y, DOE would be subjecting inductive wireless battery chargers as a whole to testing in appendix Y1testingY1. DOE further proposes to define the term ''fixed-location'' wireless charger in appendix Y1 to refer to inductive wireless battery chargers that incorporate a physical receiver locating feature (*e.g.,* a peg, cradle, dock, locking mechanism, magnet, etc.) to repeatably align or orient the position of the receiver with respect to the transmitter, and to require that battery chargers meeting such a definition be subject to the DOE test procedure regardless of whether it is for a wet-environment. This proposed amendment to include fixed-location inductive wireless chargers would cover products such as inductive chargers for electronic watches, fitness bands, smartphones, wireless earbuds, and wireless speakers, if the basic model prioritizes wireless charging of a battery and has a physical receiver locating feature.

DOE also proposes to increase the rated battery energy limit of fixed-location wireless chargers in appendix Y1 from ≤5 Wh to <100 Wh in order to address the broader scope of battery chargers that currently employ inductive wireless connections and to accommodate potential future product designs that may have larger battery energies. For battery chargers, the UEC metric represents an annualized amount of non-useful energy consumed by a battery charger in all modes of operation by combining the energy or power consumption in each mode with specified usage profiles (*i.e.* the time spent in that mode) and subtracting from it the discharged energy of a fully charged battery. Table 3.3.3 of appendix Y established such usage profiles for different classes of battery chargers, including inductive wireless chargers, defined by ranges of battery energy and voltage. At the time of the June 2016 Final Rule, inductive wireless chargers designed for use in wet environments were all found to have a battery energy under 5Wh. 81 FR 38266, 38283. As such, Table 3.3.3 of appendix Y specifies a rated battery energy of ≤5 Wh for Product Class 1. But, since the June 2016 Finale Rule, products on the market that rely on such inductive wireless charger designs have grown to include electronic wearable devices such as watches, fitness trackers, wireless earbuds, and even some smartphones. DOE has conducted initial research and found that although most of the fixed-location inductive wireless chargers were designed for batteries with lower energy ratings, typically within 20Wh, there are some fixed-location inductive wireless chargers that can charge products with higher battery energy levels of around 80Wh, namely inductively charged power tool products. DOE is not able to find fixed-location inductive chargers designed for products with battery energy of more than 100Wh. Therefore, DOE tentatively concludes that a rated battery energy limit of <100 Wh would appropriately cover the range of products that would be newly included in scope as a result of DOE's proposal to remove the wet environment designation.

As noted, in section III.B.4, DOE discusses the proposal to remove the UEC metric and the associated usage profile in favor of a multi-metric approach that provides the energy performance of battery chargers in each mode of operation (active, standby, and off modes) independently. If such a proposal were finalized, usage profiles based on battery energy limits would be unnecessary altogether.

DOE seeks comment on its proposal to define fixed-location wireless chargers in appendix Y1 and whether this definition accurately captures all the types of wireless chargers with locating features that are on the market; its proposal to remove the ''wet environment'' designation for wireless chargers; its proposal to revise the scope of Product Class 1 to include all fixed-location wireless chargers in appendix Y1; and its proposal to increase the rated battery energy limit for fixed-location wireless chargers from ≤5 Wh to <100 Wh in appendix Y1 to accommodate the range of inductive wireless battery chargers on the market and potential future product designs that may have larger battery energies. DOE also requests information on which types of inductive wireless battery chargers would be subject to DOE regulations due to the proposed change in scope, including any corresponding usage data, if available.

DOE also proposes to define the term ''open-placement'' wireless chargers in appendix Y1 to address wireless charging products that do not have a physical locating feature (*e.g.,* charging mats). CA IOUs, NEEA, and ITI stated in response to the May 2020 RFI that there are difficulties in testing open-placement wireless chargers, but encouraged DOE to continue working with stakeholders to establish either its own uniform wireless charger test method or adopt one being developed by the industry, such as ANSI/ Consumer Technology Association (''CTA'') 2042.3 [9] (''ANSI/CTA 2042.3''), the WPC protocol,[10] or the IEC 63288 test procedure.[11] (CA IOUs, No. 9 at pp.

[9] American National Standards Institute/ Consumer Technology Association Standard 2042.3, ''Methods of Measurement for Power Transfer Efficiency and Standby Power of Wireless Power Systems''.

[10] Wireless Power Consortium, ENERGY STAR Test Method for Wireless Power Transmitters, test procedure development in progress.

[11] International Electrotechnical Commission IEC 63288, ''Wireless Power Transfer—Measuring method for wireless power transfer efficiency and standby power—mobile phone''. For more information on the development of IEC 63288,

Continued

1–2, ITI, No. 7 at pp. 1, 3–4, NEEA, No. 8 at p. 6) CA IOUs suggested that wireless chargers are no longer a nascent technology; however, NEEA claimed that wireless chargers are still relatively nascent when compared to other charging technologies. (CA IOUs, No. 9 at p. 2, NEEA, No. 8 at p. 5) CA IOUs and NEEA commented that wireless chargers are rapidly growing in popularity, and that because of the wide variation in efficiency, wireless chargers present significant opportunities for energy savings. (CA IOUs, No. 9 at pp. 1–2, NEEA, No. 8 at pp. 1–3, ITI, No. 7 at pp. 3–4) WPC further commented that wireless chargers still need to be tested uniquely to account for the wide charging area, unique standby, and end of charge behavior, irrespective of whether the system is treated as a battery charger or as an external power supply (''EPS''). (WPC, No. 4 at p. 2) NEEA suggested that interoperable (*i.e.,* open-placement) wireless chargers are similar to EPSs, in which standby power and active mode efficiency are regulated separately. (NEEA, No. 8 at pp. 4–5 and 7–9) WPC also asserted that the term ''wireless battery chargers'' may be misleading and cause overly burdensome testing for wireless power sources, and that wireless chargers are better classified as EPSs because of their lack of battery charging circuitry and their AC-to-DC power conversion nature. (WPC, No. 4 at p. 2) Similarly, for open-placement wireless power transfer devices, CA IOUs and NEEA suggested that DOE implement a standby power measurement in the interim while an active mode test method continues to be developed. (CA IOUs, No. 9 at p. 2, NEEA, No. 8 at pp. 9–10).

DOE recognizes the increasing usage of open-placement inductive wireless chargers designed to work with a range of products by supporting multiple wireless charging protocols and having physical form factors that do not restrict engagement or alignment to one specific end use device. DOE also recognizes that, as indicated by commenters, a number of challenges remain with establishing a representative test procedure for these interoperable open-placement inductive wireless products. First, efficiency of wireless power transfer varies greatly depending on the alignment of the receiver with respect to the transmitter. A test procedure designed to capture the representative energy performance of such a device would need to repeatably measure the average power transfer efficiency across the full range of possible placement positions on the transmitter. Second, representative test load(s) would need to account for all charging scenarios because these open-placement wireless chargers are designed to work with various third-party products. Third, these devices also typically incorporate other non-battery-charging related features inherent to implementing an open-placement design, such as foreign object detection circuits, that may affect charging efficiency.

DOE acknowledges the industry's progress in developing test methods for open-placement wireless chargers, such as ANSI/CTA 2042.3, the WPC protocol, and the IEC 63288 test procedure. These test methods specify the use of either one reference receiver at multiple charging positions on the transmitter or require using multiple receivers at an optimal receiver placement point. DOE has reviewed these industry test standards, and tentatively finds that they do not sufficiently address the challenges with respect to repeatability of placement and ensuring use of a representative third-party receiver. DOE, working in conjunction with industry organizations such as the WPC, has found that mitigating these challenges is difficult. To-date, that work has yielded test methods that either lack repeatability or result in significant test burden. In addition, evaluating whether a particular test procedure measures the energy performance of open-placement wireless chargers during a representative average use cycle, specifically during active mode operation, requires data on consumer usage at the various modes of operation. DOE lacks, and is unaware of, such data.

Because data are lacking to develop a test procedure that would provide representative measurements of such a technology during active mode operation, DOE is not proposing a test procedure for measuring the active mode energy performance of open-placement wireless chargers in this NOPR. DOE will continue its efforts, working with industry bodies, such as WPC, IEC, and ANSI/CTA, to develop an active mode test procedure for open-placement wireless chargers that appropriately addresses the impact of receiver placement on charging efficiency, and will continue to gather relevant consumer usage data.

DOE finds, however, that measuring the no-battery mode energy performance of an open-placement wireless charger would not be affected by the same issues discussed above for active-mode testing, and is more straightforward than measuring active-mode energy. Therefore, DOE proposes to create a new section 5 of appendix Y1 titled, ''Testing requirements for all open-placement wireless chargers,'' which would include instructions for testing open-placement wireless chargers in no-battery mode according to IEC 62301 Ed. 2.0. DOE proposes that, after observing a period of stability, the AC input power of the open-placement wireless charger would be measured without any foreign objects (*i.e.,* without any load) placed on the charging surface. DOE also proposes that if the open-placement wireless charger has power supplied by an EPS but does not come pre-packaged with such an EPS, then testing must be conducted with any compatible and commercially-available EPS that is minimally compliant with DOE's energy conservation standards for EPSs as prescribed in 10 CFR 430.32(w). DOE notes that open-placement wireless chargers are not currently subject to energy conservation standards and are not subject to requirements regarding standby energy use. Were the proposed standby test procedure provisions to be adopted, open-placement wireless chargers would not be required to be tested according to such provisions until such time as compliance is required with any energy conservation standards that DOE may establish for these chargers. If the proposed amendments were made final, manufacturers voluntarily testing and reporting the energy usage of any open-placement wireless chargers would have to be based on the DOE test procedure as amended beginning 180 days following the final rule.

DOE seeks comment on its proposal to define open-placement wireless chargers in appendix Y1 and whether this definition accurately captures all the types of wireless chargers without physical locating features that are on the market. DOE also requests comment on its proposal to require testing of the no-battery mode power consumption of these open-placement wireless chargers.

B. Test Procedure

1. External Power Supply Selection

Most battery chargers require the use of a power adapter to convert 120 volt (''V'') AC line voltage into a low-voltage DC or AC output suitable for powering the battery charger. DOE's battery charger test procedure specifies that the battery charger be tested with the power adapter packaged with the charger, or the power adapter that is sold or recommended by the manufacturer. If a power adapter is not packaged with the charger, or if the manufacturer does not

including access to drafts of the test procedure, visit *www.iec.ch/dyn/www/f?p=103:7:516407272337837::::SP_ORG_ID,FSP_LANG_ID:10039,25.*

sell or recommend a power adapter, then the battery charger is tested using a 5.0V DC input for products that draw power from a computer USB port, or using the midpoint of the rated input voltage range for all other products. Appendix Y, sections 3.1.4.(b) and 3.1.4.(c). However, the 5.0 V DC specification for products drawing power from a computer USB port may not be representative for battery chargers designed for operation only on DC input voltage and for which the manufacturer does not package the charger with a wall adapter or sell or recommend a wall adapter. The current generation USB specification can support up to 20 V, per the voltage and current provisions of the most recent version of the International Electrotechnical Commission's (''IEC'') ''Universal serial bus interfaces for data and power—Part 1–2: Common components—USB Power Delivery'' (''IEC 62680–1–2'') specification.

In the May 2020 RFI, DOE requested information on the characteristics and technical specifications of the wall adapters typically used when testing battery chargers shipped without a wall adapter and for which a wall adapter is not recommended by the manufacturer. 85 FR 26369, 26371. DOE also sought detailed technical information and data on the characteristics of the wall adapters typically used in the real world with such battery chargers including, but not limited to, input and output voltages, output wattage, power supply topologies, output connector type, and the impact of these on average efficiencies. *Id.* Additionally, DOE sought comment on whether testing such battery chargers using a reference wall adapter would be appropriate, and if so, how a reference wall adapter should be defined.

Both CA IOUs and ITI supported providing additional direction on the AC adapter used to test chargers that do not come with one. (CA IOUs, No. 9 at p. 4; ITI, No. 7 at p. 5) CA IOUs and ITI recommended that DOE provide minimum technical characteristics that must be met when testing battery chargers with external power supplies without an AC adapter pre-packaged, sold, or recommended by the manufacturer. *Id.* ITI further commented that the cable used can also affect power consumption, and that a reference wall adapter would work only if DOE designs one for universal connection types. (ITI, No. 7 at p. 5) The Joint Commenters stated that the test procedure already addresses USB chargers and therefore amendments are not necessary regarding the wall adapter provisions. (Joint Commenters, No. 6 at p. 2)

Considering the current market and these comments, DOE proposes to require in appendix Y1 that when wall adapter is not pre-packaged with a battery charger (and the charger manufacturer does not sell or recommend a compatible charger), testing would be performed using any commercially-available EPS that is both minimally compliant with DOE's energy conservation standards for external power supplies (''EPS'') found in 10 CFR 430.32(w) and satisfies the EPS output criteria specified by the battery charger manufacturer. DOE recognizes that these battery chargers are always operated with an EPS by the consumer, and that testing them without one is unrepresentative of their actual use. Because the battery charger energy consumption is measured at the input, under the proposed appendix Y1 requirement to test these battery chargers with a minimally compliant EPS, the energy consumption of the minimally compliant EPS will be included when calculating the battery charger product's unit energy consumption, similar to the testing condition in which an EPS is supplied with the charger. DOE has tentatively concluded that this proposal would not result in additional test burden; the current battery charger test procedure already requires input power to be captured, and this proposal does not lead to additional test steps. Furthermore, this proposed EPS selection criterion would not be required until DOE amends the energy conservation standards to account for the updated EPS selection criteria, if adopted. However, manufacturers are still required to continue testing their battery charger products following the amended appendix Y, if made final, during the meantime. If the proposed appendix Y1 amendments were made final, manufacturers can voluntarily test and report any such representations based on the appendix Y1 test procedure as amended beginning 180 days following the test procedure final rule.

When performing compliance or enforcement testing on such a battery charger basic model, DOE proposes that if the certified EPS is no longer available in the market, DOE would test the battery charger with any compatible minimally compliant EPS that meets the performance criteria. The intent of the proposal to test with a minimally compliant power supply is to allow manufacturers a wider selection of EPSs that are readily available, while ensuring that the battery charger is tested in a configuration representative of actual use. This proposal would also only apply to appendix Y1.

Additionally, DOE is proposing to specify in section 3.1.4(b) of appendix Y the order of preference for the test configuration when a wall adapter is provided or recommended. DOE is proposing that a battery charger would be tested using the pre-packaged wall adapter; if the battery charger does not include a pre-packaged wall adapter, then the battery charger would be tested with a wall adapter sold and recommended by the manufacturer; if the manufacturer does not recommend a wall adapter that it sells, then the battery charger is to be tested with a wall adapter recommended by the manufacturer.

ITI commented that input or output cables can affect a battery charger's power consumption but stopped short of quantifying their impact. (ITI, No. 7 at p. 5) DOE's analysis suggests that only output cables have the potential to notably impact power consumption, but that battery chargers are rarely shipped without an output cable. DOE, therefore, continues to require that battery chargers be tested with the output cable that is supplied with the device.

DOE requests comment on the proposal to specify the priority of wall adapter selection in appendix Y1. DOE also requests comment on the proposal in appendix Y1 to replace the 5 V DC input requirement for those chargers that do not ship with an adapter, and one is not recommended, with the requirement that these chargers be tested with any compatible and commercially-available EPS that is minimally compliant with DOE's energy conservation standards for EPSs. DOE also requests comments on whether these proposals would result in increased test burden.

2. Battery Chemistry and End-of-Discharge Voltages

The battery charger test procedure requires that, as part of the battery discharge energy test, the battery must be discharged at a specified discharge rate until it reaches the specified end-of-discharge voltage stipulated in Table 3.3.2 of appendix Y. Appendix Y, section 3.3.8(c)(2). Table 3.3.3 defines different end-of-discharge voltages for different battery chemistries. A footnote to Table 3.3.2 provides that if the presence of protective circuitry prevents the battery cells from being discharged to the end-of-discharge voltage specified, then the battery cells must be discharged to the lowest possible voltage permitted by the protective circuitry. *Id.*

In the May 2020 RFI, DOE requested information on whether there have been any new battery chemistries that are not covered by the categories listed in Table 3.3.2 of appendix Y. 85 FR 26369, 26372. DOE also requested information on whether any of the end-of-discharge voltages listed for the battery chemistries under Table 3.3.2 of appendix Y need to be updated. *Id.*

ITI and the Joint Commenters stated that they were not aware of any new battery technologies or changes to existing chemistries that would warrant an update to Table 3.3.2 of appendix Y. (ITI, No. 7 at p. 6; Joint Commenters, No. 6 at pp. 1–2) The Joint Commenters stated that the footnote to Table 3.3.2 addresses the end-of-discharge voltage of battery chemistries not explicitly included in Table 3.3.2. (Joint Commenters, No. 6 at p. 2)

Delta-Q commented that, normally, the battery management system would terminate discharge before reaching the appendix Y specified end-of-discharge voltage, which is consistent with the Table 3.3.2 footnote. (Delta-Q, No. 10 at p. 1) Delta-Q stated that because of this, DOE should keep the protective circuitry guidelines in the test procedure, as it is representative of the charger's energy use. *Id.* Delta-Q also commented that the term ''Lithium Polymer'' listed in Table 3.3.2 is not clear because the term can refer to either an existing, but commercially unsuccessful, battery technology with cells that rely on a polymer electrolyte instead of a liquid electrolyte; or the term may refer to non-rigid laminated pouch packing, as is found in small consumer products. *Id.* Delta-Q also asserted that the term is altogether unnecessary in Table 3.3.2 since ''Lithium-Ion'' captures all lithium battery sub-types. *Id.* Delta-Q suggested that DOE remove the term ''Lithium Polymer'' from the table. *Id.* Delta-Q also commented that ''Nanophosphate Lithium-ion,'' which is included in Table 3.3.2, is a registered trademark and should be re-designated as ''Lithium Iron Phosphate,'' a common battery chemistry, to avoid unintentional referral to a proprietary product. *Id.*

CA IOUs encouraged DOE to incorporate emerging battery chemistries but did not suggest any specific new battery chemistries. (CA IOUs, No. 9 at p. 5)

DOE is proposing to replace the term ''Lithium Polymer'' in Table 3.3.2 of appendix Y with ''Lithium-ion Polymer.'' Lithium-ion polymer batteries are structurally different from lithium-ion batteries in that lithium-ion polymer batteries incorporate a polymer separator to reduce safety hazards. Although having the same end-of-discharge voltage as lithium-ion batteries, DOE proposes a separate listing for lithium-ion polymer batteries to reflect the structural differences of these batteries. DOE also proposes to update the term ''nanophosphate lithium-ion'' to refer to the non-proprietary version of this battery chemistry, *i.e.,* ''lithium iron phosphate.'' DOE is proposing to incorporate these changes in the proposed appendix Y1, as well.

Although the presence of protective circuitries allows some batteries to discharge to end-of-discharge voltages that are different from the voltages prescribed in Table 3.3.2 of appendix Y, such circuits are not universal, and accurate values for end-of-discharge voltages are required to ensure batteries are safely and representatively discharged when such circuits are not present. Therefore, no changes are proposed for the footnote regarding protective circuitries.

DOE requests comment on the proposal to update the term ''Lithium Polymer'' to ''Lithium-ion Polymer''. DOE also requests comment on the proposal to rename the term ''Nanophosphate Lithium'' to the non-proprietary term ''Lithium Iron Phosphate''.

3. Battery Selection

Table 3.2.1 of appendix Y specifies battery selection criteria based on the type of charger being tested; specifically, whether the charger is multi-voltage, multi-port, and/or multi-capacity. For multi-capacity chargers, Table 3.2.1 specifies using a battery with the highest charge capacity. Similarly, for multi-voltage chargers, Table 3.2.1 specifies using the highest voltage battery. Section 3.2.3(b)(2) of appendix Y specifies that if the battery selection criteria specified in Table 3.2.1 results in two or more batteries or configurations of batteries with same voltage and capacity ratings, but made of different chemistries, the battery or configuration of batteries that results in the highest maintenance mode power must be used for testing.

As indicated, some battery chargers (*e.g.,* lead-acid battery chargers) can charge numerous combinations of batteries from third-party vendors, and these battery chargers generally do not have a maximum battery capacity limit because, theoretically, multiple batteries can be connected in parallel to a single charger. For these devices, finding the most consumptive combination of charger and battery could require a number of trials.

In the May 2020 RFI, DOE requested comment on how manufacturers are certifying battery chargers that can charge third-party batteries from different manufacturers but do not ship with batteries themselves. 85 FR 26369, 26372. To address this scenario, DOE also requested feedback on possible alternate approaches to testing battery chargers, such as by replacing the batteries with a reference load during testing. *Id.*

CA IOUs supported both the current battery selection criteria, and the concept of replacing the test batteries with a representative resistive load. (CA IOUs, No. 9 at p. 5) CA IOUs stated that this latter approach would require comprehensive study of multiple batteries with different chemistries from multiple manufacturers at various states to be accurate. *Id.* CA IOUs suggested that DOE analyze any developed dataset and validate it against actual battery values. *Id.* CA IOUs recommended that while a representative resistive load is being developed, DOE collect a set of reference measurements for a test laboratory to use in choosing batteries that meet the specified attributes and tolerances—and if multiple batteries meet the same criteria, the batteries shall be selected according to Table 3.2.1 of appendix Y. (CA IOUs, No. 9 at pp. 5–6)

Delta-Q commented that for its multi-capacity chargers sold without a dedicated battery pack, it would choose commercially-available batteries with a maximum charge capacity based on the individual charger, following Table 3.2.1 of appendix Y. (Delta-Q, No. 10 at p. 2) Delta-Q further stated that it would choose a flooded lead acid battery to test with chargers that support multiple battery chemistries, asserting that flooded lead acid batteries have the lowest efficiency. *Id.* Delta-Q discouraged an approach that would test battery chargers with a reference load that simulates the characteristics of a battery. *Id.* Delta-Q stated that although using a reference load could improve test repeatability, it would be almost impossible to simulate the non-linear response of many common battery chemistries in a way that would be representative of real-world energy consumption. *Id.* Delta-Q further stated that if DOE were to take this approach, it would propose testing a charger's power conversion efficiency at several steady-state operating points and calculating a weighted average. *Id.*

As suggested by commenters, deriving a representative reference load that accurately models the performance of a battery would require a considerable amount of testing and development; in addition, the rapid pace of evolution in battery design would require frequent updates that would likely outpace DOE's regulatory processes. Therefore, DOE is not proposing the use of reference test loads.

Furthermore, none of the comments received indicated any particular difficulty testing battery chargers that can charge numerous combinations of batteries from third-party vendors. Therefore, DOE is not proposing any changes to the current battery selection criteria in Table 3.2.1 of appendix Y, or the proposed new appendix Y1.

4. Battery Charger Usage Profile and Unit Energy Consumption

The UEC equation in section 3.3.13 of appendix Y combines various performance parameters, including 24-hour energy, measured battery energy, maintenance mode power, standby mode power, off mode power, charge test duration, and usage profiles. Table 3.3.3 specifies values for time spent (in hours per day) in active and maintenance mode, standby mode, off mode; number of charges per day; and threshold charge time (in hours). The usage profiles are based on data for a variety of applications and that primarily consisted of user surveys, metering studies, and stakeholder input that DOE considered during the rulemaking culminating in the June 2016 Final Rule. 81 FR 38266, 38287.

In the May 2020 RFI, DOE requested feedback on whether the usage profiles listed in Table 3.3.3 of appendix Y required updating, with a particular interest in data specific to end-use device type and battery voltage. 85 FR 26369, 26372.

Delta-Q and NEEA stated that they were not aware of any usage profile changes for both wired and wireless battery chargers. (Delta-Q, No. 10 at p. 2; NEEA, No. 8 at p. 10) NEEA recommended that DOE study and update the usage profiles to help develop a test procedure for dedicated and interoperable wireless chargers. (NEEA, No. 8 at p. 10) The Joint Commenters stated that the current usage profiles are sufficient and that there is no need to change them since manufacturers have already familiarized themselves with the current profile. (Joint Commenters, No. 6 at p. 3) CA IOUs commented that wireless chargers can have different user profiles that result in a longer maintenance charging period, but that most overnight charging profiles remain the same as wired chargers. (CA IOUs, No. 9 at pp. 5–6) CA IOUs recommended that DOE conduct additional research to develop a comprehensive set of usage profiles. (CA IOUs, No. 9 at p. 6)

Currently, the energy use of a battery charger is captured by a single metric, UEC. UEC integrates active mode, standby mode, and off mode energy use in order to estimate the amount of non-useful energy (*i.e.* energy not transferred to the battery) consumed by the battery charger over the course of a year. UEC requires the use of usage profiles to appropriately reflect the period of time a product spends in each mode. DOE's product class-specific usage profiles were initially developed using the shipment weighted average usage hours of all the applications of battery chargers whose battery voltage and energy met the criteria for each product class. The intended result is for each usage profile to be appropriately representative of the usage of the product class as a whole. As the battery charger market continues to evolve, DOE has observed that the relative share of shipments among different types of products within a product class has changed; the types of products within a given product class as well as the usage patterns of the products within a product class have become more varied. For example, the current Product Class 2 includes both smartphones and home power tools—two products with widely different usage patterns and annual shipments. A more recent market review shows that the shipments for certain applications, such as smartphones, cordless phones, wireless headsets etc. have changed significantly since the usage profiles in appendix Y were originally established. Additionally, the market and shipments of battery chargers has shown to change over short periods of time as new products that rely on battery chargers emerge and are adopted by the market, and as consumer use of products that rely on battery chargers changes. As an example, note that the shipments for Digital Audio Players and Digital Cameras have declined significantly with the advent of smart phones that have similar built-in capabilities.

As discussed, EPCA requires DOE to amend its test procedures for all covered products to include standby mode and off mode energy consumption, with such energy consumption integrated into the overall energy efficiency, energy consumption, or other energy descriptor for each covered product, unless the Secretary determines that (i) the current test procedures for a covered product already fully account for and incorporate the standby mode and off mode energy consumption of the covered product; or (ii) such an integrated test procedure is technically infeasible for a particular covered product, in which case the Secretary shall prescribe a separate standby mode and off mode energy use test procedure for the covered product, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) DOE is also required to establish test procedures that are reasonably designed to produce test results which measure energy efficiency and/or energy use of a covered product during a representative average use cycle or period of use, as determined by the Secretary, and such test procedures must not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) Therefore, when considering the feasibility of a test procedure that provides for a metric that integrates active mode, standby mode, and off mode energy use DOE must also consider the representativeness and burden of the test procedure.

The current test procedure approach specifies an integrated metric relying on usage profiles, but changes in consumer use of a limited number of products within a product class and the emergence of new products can both impact the representativeness of that usage profile. As the market and usage of battery chargers continues to evolve, the current test procedure approach risks becoming less representative, absent additional and continuously-revised usage profiles. Because the test procedure metric requires integrating active mode, standby mode, and off mode energy use, the need for new or amended usage profiles would potentially result in the need to repeatedly amend test procedures, which in turn potentially would require manufacturers to update representations, increasing manufacturer burden.

In an effort to maintain the representativeness of the test procedure for battery chargers while minimizing the potential need for future amendments, DOE is proposing an approach that does not rely on the UEC equation or usage profiles. Specifically, DOE is proposing in appendix Y1 to establish an approach that relies on a separate metric for each of the following modes of operation: Active mode, standby mode and off mode. This proposal is discussed in further detail in section III.B.5 of this NOPR.

DOE notes that if it were to adopt the proposed multi-metric approach, compliance with the test procedure in appendix Y1 would not be required until such time as DOE were to amend the energy conservation standards for battery chargers based on the revised test procedure in compliance with EPCA. (42 U.S.C. 6295(o) and 42 U.S.C. 6295(gg)(3)(A)–(B))

DOE requests feedback on the proposal to remove the specification of usage profiles and the associated UEC calculation in appendix Y1, to be replaced with an approach that relies on separate metrics for active mode, standby mode, and off mode. For further consideration of the existing approach, DOE requests, for all applications in each product class, data such as the percentage of time spent in each mode of operation along with data sources for consideration in updating the usage profiles for battery chargers.

5. Battery Charger Modes of Operation

a. Active Mode

Battery charger active mode is the state in which the battery charger system is connected to the main electricity supply and is actively delivering power to bring the battery to a fully charged state, as defined in section 2.1 of appendix Y. Appendix Y currently tests the active mode power consumption along with battery maintenance mode power [12] to produce a consolidated 24-hour energy consumption value, or E_{24}, which is then used in the UEC calculation. As previously discussed, DOE is proposing to replace the UEC metric system with a discrete multi-metric approach that determines the energy efficiency and energy use of the active mode, standby mode, and off mode power consumption separately.

In the newly proposed appendix Y1, DOE proposes to use a charge test in which the test period would begin upon insertion of a depleted battery and would end when the battery is fully charged. The active mode energy, E_a would represent the accumulated input energy, meaning the average input power integrated over this test period.

Similar to the procedure currently in section 3.3.2 of appendix Y (*Determining the Duration of the Charge and Maintenance Mode Test*), if a battery charger has an indicator to show that the battery is fully charged, that indicator would be used to terminate the active mode test. If no indicator besides the manufacturer's instructions indicates how long it should take to charge the test battery, the active mode test would be conducted for the longest estimated charge time as provided in the manufacturer's materials. If the battery charger does not have such an indicator and a manufacturer does not provide such a time estimate, the length of the active mode test would be 1.4 multiplied by the rated charge capacity of the battery divided by the maximum charge current. DOE also proposes to arrange sections of appendix Y1 such that the battery discharge test is performed immediately after this active mode test is completed and prior to continuing to the 24-hour charge and maintenance mode test that would then be used to determine maintenance mode power.

In DOE's experience, it may be possible to analyze the resulting data from the 24-hour charge and maintenance mode energy consumption test and divide it into its constituents; *i.e.,* the active mode energy and maintenance mode power. Under this alternative approach, active mode energy consumption, E_a, would be the time series integral of the power consumed from the point when the battery was first inserted (or plugged in for chargers with integrated batteries) until the measured data indicate a drop in power associated with the transition from active charging to maintenance mode. Under this approach, a single test period would provide the necessary measurements for the active mode energy, E_a, from the 24-hour charge and maintenance mode test data.

DOE is proposing a separate test for active mode to allow the battery discharge test to be conducted immediately afterwards and prior to the maintenance mode test. This would ensure that the energy put into the battery can be directly compared to the energy extracted from it without any contribution from other modes of operation such as maintenance mode. However, DOE may also consider the discussed alternate approach in the development of the final rule.

DOE requests comment on the proposed approach to determining active mode energy, as well as the suggested alternate method. In particular, under the alternate method, DOE requests comment on how to define the drop in power associated with the transition from active charging to maintenance mode, such that this method would provide repeatable and reproducible results.

b. Standby Mode and Battery Maintenance Mode

Standby mode is the condition in which an energy-using product is:

(1) Connected to a mains power source; and

(2) Offers 1 or more of the following user-oriented or protective functions:

(aa) To facilitate the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer.

(bb) Continuous functions, including information or status displays (including clocks) or sensor-based functions.

(42 U.S.C. 6295(gg)(1)(A)(iii))

Appendix Y defines standby mode for battery chargers as the condition in which a battery charger is connected to mains electricity supply, the battery is not connected to the charger—and for battery chargers with manual on-off switches, all switches are turned on. Appendix Y also includes a definition for maintenance mode in section 2.8 to mean the mode of operation in which the battery charger is connected to the main electricity supply and the battery is fully charged but still connected to the charger. In maintenance mode, a battery charger continuously monitors the voltage of the fully charged battery and periodically supplies charge current to maintain the battery at the fully-charged state.

As mentioned previously, because the current test procedure relies on a metric that integrates active mode, standby mode, and off mode, it is less critical as to whether maintenance mode is characterized as standby mode as compared to the proposed multi-metric approach. The current ''standby mode'' definition in appendix Y only captures what can be referred to as ''no-battery mode,'' *i.e.,* the condition where a battery charger is connected to a mains power source but a battery itself has not yet been inserted. In the context of the proposed multi-metric approach, DOE has tentatively determined that maintenance mode is also appropriately characterized as a standby power mode. In maintenance mode, a battery charger provides continuous monitoring of the battery charge. While a battery charger provides some limited charging in maintenance mode in order to maintain the battery at full charge, it is not charging a depleted battery. Unlike active mode, maintenance mode can persist indefinitely. As an example, power tool chargers in residential environments routinely spend an indefinite amount of time maintaining batteries that are not regularly used but are required to be fully charged. In addition to balancing and mitigating self-discharge of the cells, these chargers also typically provide a status display indicating that the battery is in the fully charged state and ready for use. As previously mentioned, DOE has tentatively determined that these continuous functions in maintenance

[12] Maintenance mode is the operation of a battery charger to maintain a battery at full charge while a battery remains in the charger after fully charged. Under the current test procedure the characterization of maintenance mode as active mode or standby mode is less critical because the current test procedure metric integrates the modes. As discussed in the following section, DOE has tentatively characterized maintenance mode as part of standby mode.

mode satisfies both EPCA's and IEC 62301's definition of standby.

To better account for these conditions, DOE proposes to rename what is currently defined in appendix Y as standby mode to ''no-battery mode'' in appendix Y1 (and reference this term, as appropriate, throughout appendix Y1). DOE also proposes to define in appendix Y1 the term ''standby mode'' to capture both no-battery mode and maintenance mode. Specifically, DOE proposes that in appendix Y1, standby mode power of a battery charger (P_{sb}), would be calculated as the sum of the no-battery mode power (P_{nb}), and maintenance mode power (P_m).

DOE requests feedback on its proposed definition of standby mode in newly proposed appendix Y1 to capture both no-battery mode as well as maintenance mode. DOE also requests feedback on its proposal to define standby power, or P_{sb}, to mean the summation of the no-battery mode (P_{nb}) and maintenance mode (P_m).

In proposing to replace the UEC metric with mode-specific metrics, DOE considered utilizing the existing E_{24} metric instead of the proposed active mode energy E_a. E_{24} captures the energy performance of a battery charger in active mode as well as some time spent in maintenance mode. However, in doing so maintenance mode would have been captured twice—once as part of E_{24} and again as part of the proposed definition of standby mode. DOE believes that regulating maintenance mode and no-battery mode in terms of their power consumption (*i.e.,* in watts), rather than as an energy consumption metric over a certain period of time (*i.e.,* in watt-hours), is more appropriate and representative because of the indefinite amount of time a battery charger may spend in either of these modes, as described above. As such, DOE is proposing that maintenance mode be accounted for as part of standby mode instead of within the E_{24} metric in conjunction with active mode.

Per section 3.3.9 of appendix Y, maintenance mode power is currently measured by examining the power-versus-time data from the charge and maintenance test, and computing the average power that spans a whole number of cycles, and includes, at least, the last 4 hours of the test data. DOE considered an alternative test method in which maintenance mode power would be calculated as the highest rolling average over at least a 4-hour continuous time period during the charge and maintenance mode test, starting from when active mode charging ends. DOE, however, did not propose this alternate test method in this NOPR due to lack of sufficient data needed to determine if such a method would be appropriate for all battery chargers.

DOE requests feedback on its proposed approach to rely on E_a, P_{sb} and P_{off} instead of E_{24}, P_{nb} and P_{off} to determine the energy performance of a battery charger, and whether a different approach exists that may provide test results that are more representative of the energy performance and energy use of battery chargers. DOE also requests comment on the described alternate approach to capturing maintenance mode power and whether such an approach would be representative of actual use for all battery chargers.

6. Test Procedure Waivers Regarding Non-Battery-Charging Related Functions

DOE granted Dyson, Inc. (''Dyson'') a waiver from the current battery charger test procedure for a specified battery charger model (used in a robotic vacuum cleaner) and provided an alternate means for disabling non-battery-charging functions during testing.[13] 82 FR 16580 (Apr. 5, 2017). As described in the petition for waiver, the battery charger basic models subject to the waiver have a number of settings and remote management features not associated with the battery charging function, but are instead associated with the vacuum cleaner end product that must remain on at all times. 82 FR 16580, 16581. Dyson explained that it would be inappropriate to make these functions user controllable, as they are integral to the function of the robot. *Id.* The DOE test procedure for battery chargers requires that any function controlled by the user and not associated with the battery charging process must be switched off; or, for functions not possible to switch off, be set to the lowest power consuming mode. Section 3.2.4.b of appendix Y. DOE determined that the current test procedure at appendix Y would evaluate the battery charger basic models specified in the Orders granting the waiver and (related waiver extension) in a manner so unrepresentative of its true energy consumption characteristics as to provide materially inaccurate comparatively data. 82 FR 16580, 16581 and 84 FR 12240, 12241. Pursuant to the approved test procedure waiver, the specified basic models must be tested and rated such that power to functions not associated with the battery charging process are disabled by isolating a terminal of the battery pack using isolating tape. *Id.* In the May 2020 RFI, DOE requested comment on whether the waiver approach is generally appropriate for testing basic models with similar features. 85 FR 26369, 26372–26373.

Delta-Q supported incorporating the waiver language into the test procedure to make available the same testing method available for other chargers with integrated non-charging features, such as DC–DC converters, communication, diagnostics, and datalogging, that increase user value and reduce cost and complexity. (Delta-Q, No. 10 at p. 2) The Joint Commenters and ITI also supported physically disabling non-charging-related features, stating that the inclusion of these features during the charge and maintenance mode test would produce results that are not representative of a battery charger's actual use. (Joint Commenters, No. 6 at p. 3, ITI, No. 7 at p. 1, 8) The Joint Commenters suggested that DOE add a column to the certification report for manufacturers to indicate when special modifications were made to an end-use product for testing and certification purposes. (Joint Commenters, No. 6 at p. 3) The Joint Commenters recommended that DOE add additional anti-circumvention language that makes the intent of the approach to disable non-battery-charging functions clear. *Id.* ITI further commented that smart devices must be connected to a network and that DOE should update the test method to recognize the constant connectivity needs of these devices, including during charging. (ITI, No. 7 at p. 9) As an alternative, ITI suggested that DOE could also prescribe ''adders'' for different functions instead of allowing them to be disabled. (ITI, No. 7 at pp. 8–9)

CA IOUs recommended that DOE continue to rely on the use of waivers and review them on a case-by-case basis, granting them only when publicly available solutions to make the product compliant with DOE's standards are unavailable. (CA IOUs, No. 9 at pp. 4–5) Furthermore, CA IOUs recommended that DOE only prescribe waivers to those products with core components that cannot be disabled without risk of damaging the product. *Id.*

NEEA suggested that the robotic vacuum cleaner waivers should be discontinued, asserting that other manufacturers of similar products have been able to redesign their products to be successfully tested without a waiver in response to enforcement action taken

[13] Decision and Order Granting a Waiver to Dyson, Inc. From the Department of Energy Battery Charger Test Procedure (Case No. BC–001). Subsequently, DOE issued an Extension of Waiver to Dyson, Inc. to cover an additional basic model (Case No. 2018– 012). 84 FR 12240 (Apr. 1, 2019).

by the California Energy Commission (''CEC''). (NEEA, No. 8 at p. 10)

Based on DOE's review of the market indicating that products subject to the waivers granted to Dyson are no longer available, DOE is not proposing to amend the test procedure to include instructions regarding disabling power to functions not associated with the battery charging process that are not consumer controllable. If made final, this proposal would terminate the existing Dyson waivers consistent with 10 CFR 430.27(h)(3) and 10 CFR 430.27(l).

DOE is also not proposing to include different power consumption adders for non-battery-charging related functions. As stated, the DOE test procedure applies to battery chargers as that term is defined by EPCA and in the DOE regulations. Inclusion of power consumption adders for non-battery charging-related functions would result in a UEC or active energy consumption value unrepresentative of the energy use by the battery charger.

C. Corrections and Non-Substantive Changes

Since the publication of DOE's current battery charger test procedure and energy conservation standards, DOE has received numerous stakeholder inquiries regarding various topics involving battery charger testing and certification. Based on these inquiries, DOE identified the need for certain minor corrections. These corrections are addressed in the following sections. Additionally, in the interest of improving overall clarity, DOE will include a flowchart in the docket outlining the required testing and certification process upon publication of a final rule.

1. Certification Flow Charts

Upon publication of a final rule, DOE will include flowcharts in the docket, shown in Figure III.C.1 and Figure III.C.2,[14] to help manufacturers better understand the battery charger testing and certification process. In particular, the flow charts would provide an overview of the testing and certification process including an overview of the basic model definition; the scope of DOE's battery charger test procedure; the required sample size; difference between a rated value, a represented value, and a certified rating; and the statistical criteria for determining compliance with energy conservation standards. The flow charts are not intended to address all aspects of the testing and certification requirements, but instead provide a general-level guide to the process. As such, manufacturers should not rely solely on the flow charts for testing and compliance. Manufacturers of battery chargers are required to comply with the applicable provisions under 10 CFR parts 429 and 430.

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[14] Figures III.C.1 and III.C.2 are included to clarify the process in this rulemaking only. Manufacturers should not rely solely on the flow charts as substantive guides for testing and compliance, should changes proposed in this NOPR be finalized.

Figure III.C.1 Appendix Y Battery Charger Certification Testing and Certification Flow Chart

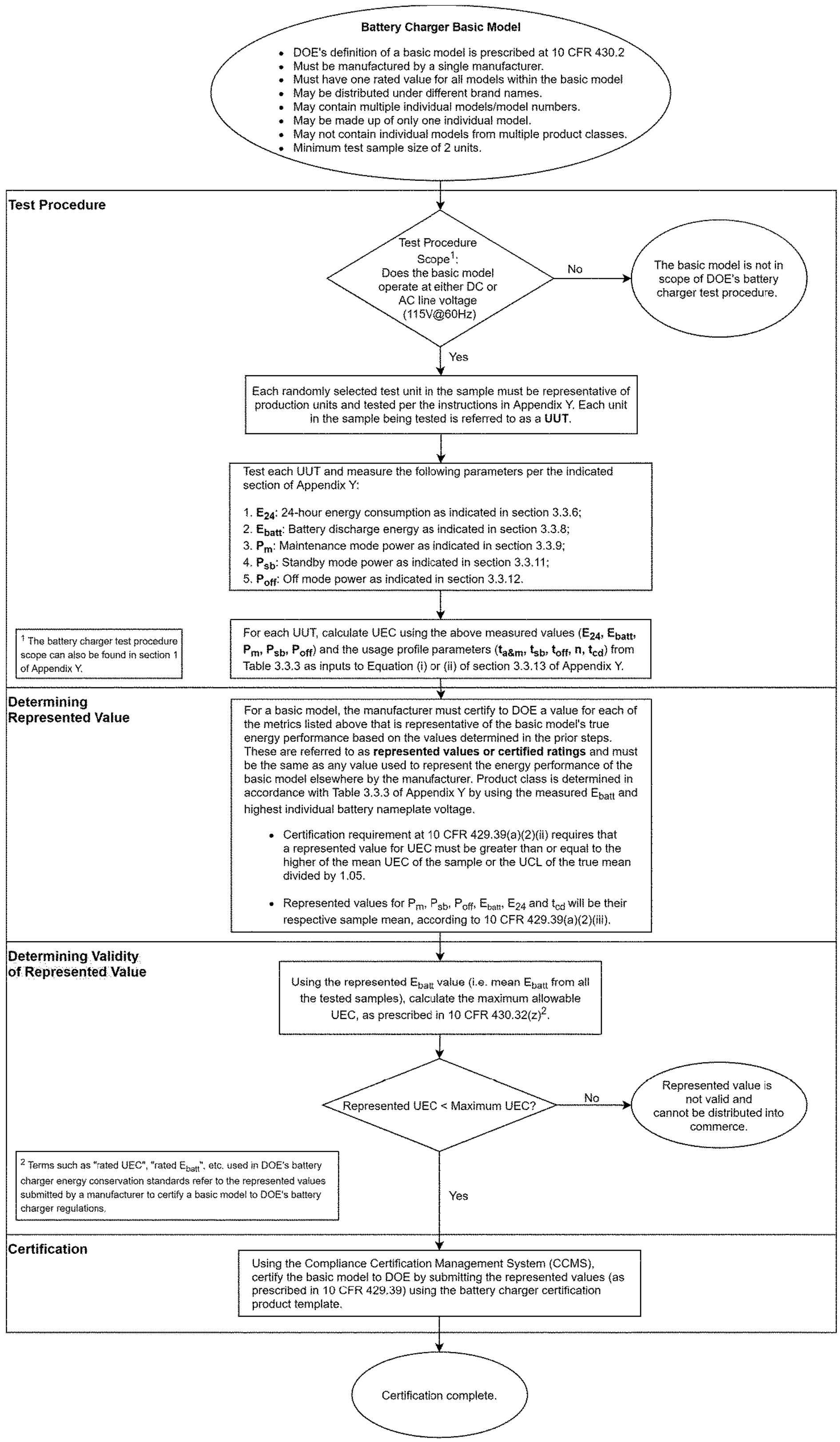
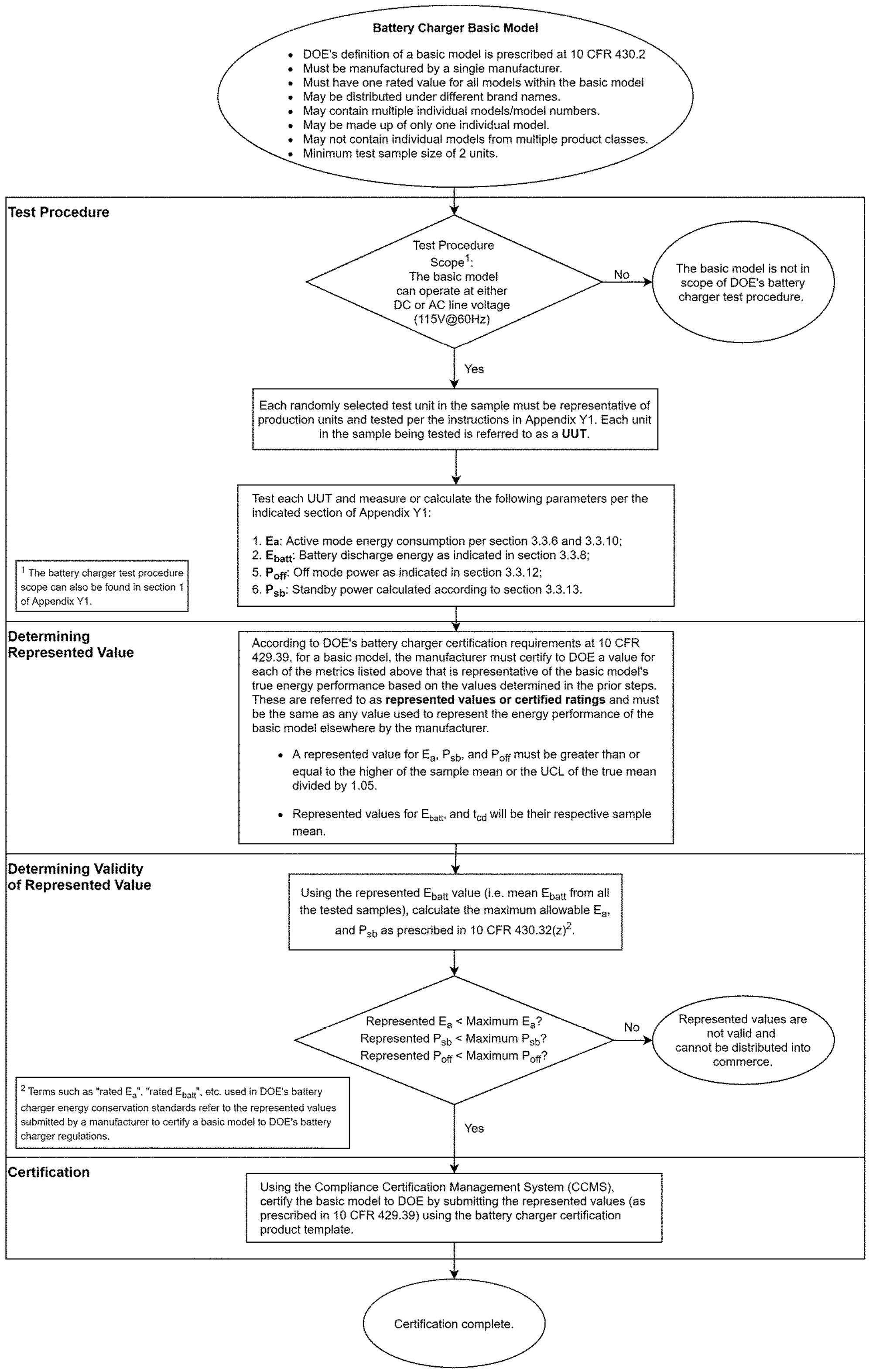


Figure III.C.2 Appendix Y1 Battery Charger Testing and Certification Flow Chart



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DOE requests stakeholder feedback on whether such flow charts will assist manufacturers through the certification testing and certification process. DOE also requests comment on whether the flow charts would benefit from the inclusion of any additional information.

2. Testing and Certification Clarifications

DOE's current battery charger UEC calculation is prescribed in section 3.3.13 of appendix Y, with product specific certification requirements prescribed in 10 CFR 429.39. In response to the May 2020 RFI, stakeholders submitted comments suggesting areas regarding the testing and certification requirements that may benefit from additional detail or re-organization.

a. Multiple Battery Combinations

ITI suggested that DOE add the term ''representative testing'' to make it clear that testing is not required for every combination of battery pack and EPS if the battery packs and EPSs are identical in electrical ratings. (ITI, No. 7 at pp. 1–2) ITI commented that testing every combination would be time-consuming, costly, and requires excessive test samples, which produces nearly identical test results between combinations. (ITI, No. 7 at p. 2) ITI also suggested that the sample size should be reduced for products that pass DOE's energy conservation standards by more than a certain margin. (ITI, No. 7 at pp. 1–2)

Manufacturers are required to test and certify basic models of battery chargers, as defined in 10 CFR 430.2. For battery chargers, the term ''basic model'' means all units of a given battery charger class manufactured by one manufacturer; having the same primary energy source; and, which have essentially identical electrical, physical, and functional characteristics that affect energy consumption and energy efficiency. 10 CFR 430.2. Individual units within a basic model may be distributed under different brand names but must be made by the same manufacturer. If the battery selection criteria specified in Table 3.2.1 of appendix Y results in two or more batteries or configurations of batteries of different chemistries, but with equal voltage and capacity ratings, the battery or configuration of batteries with the highest maintenance mode power, as determined in section 3.3.9 of appendix Y, should be selected for testing. This would result in a single battery or a single configuration of batteries for conducting the test.

In cases where the battery charger basic model's UEC passes DOE's energy conservation standards and shows consistent energy consumption, manufacturers have the potential to certify the product with only 2 units tested so long as they follow the test procedure and the certification requirement. Otherwise, more samples would need to be tested until the sampling requirements of 10 CFR 429.39 are met.

b. Measured vs. Rated Battery Energy

The product class distinctions provided in Table 3.3.3 of appendix Y are based in part on rated battery energy as determined in 10 CFR 429.39(a), which in turn references the represented value of battery discharge energy. 10 CFR 429.29(a)(1). The calculation of UEC in section 3.3.13 of appendix Y is based in part on the tested (*i.e.,* measured) battery energy.

TTI commented that there is inconsistency when determining the battery charger product class between appendix Y and DOE's battery charger standard at 10 CFR 430.32(z). Under appendix Y, the term ''E_{batt}'' refers to the measured battery energy while under the standard (10 CFR 430.32(z), the term ''E_{batt}'' refers to the rated battery energy determined in 10 CFR 429.39(a). (TTI, No. 3 at p. 1) TTI commented that because of this, different labs are using different battery energy values to determine battery charger product class and energy conservation standards, resulting in possibly inaccurate certifications. *Id.*

As described, UEC calculation in section 3.3.13 of appendix Y incorporates the measured battery energy as determined in section 3.3.8 of appendix Y. In contrast, determining the appropriate product class determination for purposes of standards compliance is based on the ''rated'' battery energy (*i.e.,* the represented value of the battery energy). To better distinguish between measured battery energy and rated (*i.e.,* represented) battery energy, DOE proposes updating the nomenclature in appendix Y by modifying the ''E_{batt}'' term used in the UEC calculation and usage profile selection in Table 3.3.3 to ''Measured E_{batt}''. DOE notes, however, that if the proposal to remove the UEC equation and usage profiles, as described in III.B.4 are finalized, all remaining instructions within appendix Y1 will rely on measured E_{batt}, such that distinguishing between measured and rated E_{batt} would not be required.

DOE requests comments on whether manufacturers and test laboratories are currently using ''measured'' battery energy or ''rated''/''represented'' battery energy values to determine battery charger product class. DOE requests comment on its proposal to update the nomenclature in appendix Y to refer to ''Measured E_{batt}'' and ''Represented E_{batt}'' to better distinguish between the two values.

c. Alternate Test Method for Small Electronic Devices

ITI recommended that DOE simplify the test procedure for small electronic devices by relying on the battery capacity as marked on the battery pack/cell instead of direct measurements. (ITI, No. 7 at p. 2) ITI claimed that this approach would simplify sample preparation for certain samples, avoid the need for obtaining special samples from the factory with unsealed enclosures, and avoid the difficulty of soldering test leads to a very small battery terminals in mobile products. *Id.*

DOE has observed several occasions where the measured battery energy was lower than the capacity as marked on the battery pack/cell (*i.e.,* nameplate) battery energy. In such cases, a test procedure reliant on the nameplate battery energy, rather than measured battery energy, could result in an unrepresentative value of UEC or active energy consumption. Accordingly, DOE is not proposing to amend the requirement to rely on the measured battery energy value for the purpose of the testing and certification.

d. Inability To Directly Measure Battery Energy

Section 3.2.5.(f) of appendix Y states that when the battery discharge energy and the charging and maintenance mode energy cannot be measured directly due to any of the following conditions: (1) Inability to access the battery terminals; (2) access to the battery terminals destroys charger functionality; or (3) inability to draw current from the test battery, the battery discharge energy and the charging and maintenance mode energy shall be reported as ''Not Applicable.'' In such cases, the test procedure does not provide instruction on how to proceed with the remainder of the test, and an alternate test method must be used to measure battery discharge energy and the charging and maintenance mode energy. DOE therefore proposes to update section 3.2.5(f) of appendix Y to explicitly state that if any of the aforementioned conditions are applicable, preventing the measurement of the battery discharge energy and the charging and maintenance mode energy, a manufacturer must submit a petition for a test procedure waiver in accordance with 10 CFR 430.27. The same provision would also be included as part of the new appendix Y1.

e. Determining Battery Voltage

The product class distinctions provided in Table 3.3.3 of appendix Y are based in part on ''battery voltage'' in addition to rated battery energy or special charging characteristics, as described previously. Section 3.3.1 of appendix Y specifies recording the nameplate battery voltage of the test battery. Section 2.21 of appendix Y defines ''nameplate battery voltage'' as specified by the battery manufacturer and typically printed on the label of the battery itself. If there are multiple batteries that are connected in a series, the nameplate battery voltage of the batteries is the total voltage of the series configuration—that is, the nameplate voltage of each battery multiplied by the number of batteries connected in series. Connecting multiple batteries in parallel does not affect the nameplate battery voltage. Section 2.21 of appendix Y.

Additionally, for a multi-voltage charger, the battery with the highest battery voltage must be selected for testing, as prescribed by Table 3.2.1 of appendix Y. Consequently, the highest supported battery voltage should also be used to determine product class, which is not reflected by the current term ''battery voltage'' in Table 3.3.3. Updating the language in Table 3.3.3 would avoid the potential for future confusion with regard to multi-voltage products.

TTI asked DOE to provide a method to determine battery voltage for certification purposes. (TTI, No. 3 at p. 1)

DOE proposes to amend Table 3.3.3 of appendix Y by replacing the term ''battery voltage'' with ''highest nameplate battery voltage'' to provide clearer direction that the battery voltage used to determine product class is based on its nameplate battery voltage, and that for multi-voltage products, the highest voltage is used. This proposed change would also be reflected in the proposed appendix Y1.

DOE is not aware of any multi-voltage battery chargers that are currently incorrectly certified. Updating the language in appendix Y would further avoid the potential for future confusion with regard to multi-voltage products. DOE requests comments on its proposal to amend Table 3.3.3 of appendix Y, and the corresponding language in the proposed appendix Y1, with the term ''highest nameplate battery voltage.''

3. Cross-Reference Corrections

Section 3.3.4 of appendix Y, ''Preparing the Battery for Charge Testing,'' specifies that the test battery shall be fully discharged for the duration specified in section 3.3.2 of appendix Y, or longer using a battery analyzer. However, DOE's intention was to instruct the user to discharge a test battery not for a set duration but until it reaches the end of discharge voltages listed in Table 3.3.2 of appendix Y. While a battery would be fully discharged with either set of instructions, current instructions would lead to a battery preparation step that is significantly longer. Additionally, there are several instances in appendix Y of which DOE used generic terms such as ''specified above'' or ''noted below''. While these generic reference terms are referring to the test procedure sections immediately preceding or following, identifying the specific referenced sections would improve the test procedure clarity. Therefore, DOE proposes to further clarify these cross-references in appendix Y, and incorporate this same change into proposed appendix Y1, to reduce test burden and avoid potential confusion. To further streamline the readability of appendix Y, DOE also proposes to move the end-of-discharge Table 3.3.2 so that it immediately follows the battery discharge energy test at section 3.3.8.

4. Sub-Section Corrections

Sections 3.3.11(b) and 3.3.12(b) of appendix Y provide instructions for testing the standby and off mode power consumption, respectively, of a battery charger with integral batteries. Section 2.6 of appendix Y describes an integral battery as a battery that is contained within the consumer product and is not removed from the consumer product for charging purposes. Sections 3.3.11(c), 3.3.11(d), 3.3.12(c), and 3.3.12(d) provide instructions applicable to products containing ''integrated power conversion and charging circuitry,'' which is intended to refer to products with integral batteries for which the circuitry is integrated within the battery charger, in contrast to being integrated within a cradle or an external adapter (as referred to in sections 3.3.11(b) and 3.3.12(b)). To improve the readability of the test procedure and avoid potential confusion as to the applicability of sections 3.3.11(c), 3.3.11(d), 3.3.12(c), and 3.3.12(d) in relation to sections 3.3.11(b) and 3.3.12(b), DOE proposes to reorder these sections of appendix Y such that section 3.3.11(b) would include only the statement that standby mode may also apply to products with integral batteries. The remainder of current section 3.3.11(b), as well as 3.3.11(c) and 3.3.11(d) would be reorganized as subsections (1) through (3) subordinate to section 3.3.11(b), to provide clearer indication that these three subsections refer to three different types of products with integral batteries. The same structure would be applied in section 3.3.12(b) for off mode. This proposed change would also be mirrored in the proposed appendix Y1.

D. Test Procedure Costs and Harmonization

1. Test Procedure Costs and Impact

In this NOPR, DOE proposes to incorporate some editorial changes in the existing test procedure for battery chargers at appendix Y to: (1) Update battery chemistry table to improve representativeness; (2) explicitly refer manufacturers to the test procedure waiver provisions when battery energy cannot be measured; and (3) provide more descriptive designation of the different battery energy and battery voltage values used for determining product class and calculating unit energy consumption. The proposed changes to appendix Y also include minor cross reference corrections and test procedure organization improvements. DOE is also proposing to terminate the existing Dyson test procedure waiver.

Newly proposed appendix Y1 would include all the changes previously listed, as well as: (1) Remove the ''wet environment'' designation and expand the 5 Wh battery energy limit to 100 Wh for fixed-location wireless chargers; (2) add definitions for ''fixed-location'' and ''open-placement'' wireless chargers; (3) introduce a new no-battery mode only test for open-placement wireless chargers; (4) amend the wall adapter selection for chargers that do not come with one; and (5) establish an approach that relies on separate metrics for active mode, standby mode, and off mode, in place of the UEC calculation in appendix Y. DOE has tentatively determined that these proposed amendments would not be unduly burdensome for manufacturers to conduct.

Appendix Y Test Procedure Amendments

The proposals specific to appendix Y would not alter the scope of applicability or the measured energy use of basic models currently certified to DOE. DOE does not anticipate that the proposals specific to appendix Y would cause any manufacturer to re-test any currently covered battery chargers or incur any additional testing costs.

Appendix Y1 Test Procedure Proposal

All the proposals specific to appendix Y1 would not be required to be used until DOE amends energy conservation standards for battery chargers in a future rulemaking and requires battery charger manufacturers to rate their products using appendix Y1. DOE is aware that certain manufacturers may be voluntarily reporting under state programs the energy efficiency as determined under appendix Y of a limited number of fixed-location wireless chargers that are not currently subject to the DOE test procedure. DOE is not aware of such representations being included in manufacturer literature. Given that such reporting appears limited to state programs and manufacturers are not otherwise making representations of the energy efficiency or energy use of such products, DOE is unable to estimate the extent of such reporting. If the proposed amendments were made final, beginning 180 days following the final rule, were manufacturers to continue such voluntary reporting, any such representations would have to be based on the DOE test procedure as amended. To the extent there is a limited number of models for which manufacturers are making voluntary representations, such models may require re-testing were the proposed amendments finalized. Further details regarding the cost impact of the proposed amendments for when battery charger manufacturers are required to test their products using appendix Y1 are presented in the following paragraphs.

Appendix Y1—Wireless Chargers

The proposal to remove the ''wet environment'' designation and increase the battery energy limit will increase the scope of the existing battery charger test procedure to include wireless battery chargers other than those with inductive connection and designed for use in a wet environment. DOE has estimated the testing cost associated to test these fixed-location and open-placement wireless chargers in accordance with the proposed test procedures, if finalized. DOE estimates that it would take approximately 48 hours to conduct the test for one fixed-location wireless charger unit and 2.2 hours to conduct the no-battery mode only test for one open-placement wireless charger unit. These tests do not require the wireless charger unit being tested to be constantly monitored by a lab technician. DOE estimates that a lab technician would spend approximately 4.2 hours to test a fixed-location wireless charger unit and one hour to test an open-placement wireless charger unit.

Based on data from the Bureau of Labor Statistics' (''BLS's'') Occupational Employment and Wage Statistics, the mean hourly wage for electrical and electronic engineering technologist and technician is $32.84.[15] DOE also used data from BLS's Employer Costs for Employee Compensation to estimate the percent that wages comprise the total compensation for an employee. DOE estimates that wages make up 70.4 percent of the total compensation for private industry employees.[16] Therefore, DOE estimates that the total hourly compensation (including all fringe benefits) of a technician performing these tests is approximately $46.65.[17] Using these labor rates and time estimates, DOE estimates that it would cost wireless charger manufacturers approximately $196 to conduct a single test on a fixed-location wireless charger unit and approximately $47 to conduct a single test on an open-placement wireless charger unit.[18]

DOE requires that at least two units to be tested for each basic model prior to certifying a rating with DOE. Therefore, DOE estimates that manufacturers would incur testing costs of approximately $392 per fixed-location wireless charger basic model and approximately $94 per open-placement wireless charger basic model, when testing these wireless chargers. However, this proposal to remove the ''wet environment'' designation and increase the battery energy limit for wireless battery chargers, if finalized, would only be applicable for appendix Y1, and manufacturers would not be required to use appendix Y1 for wireless battery chargers that are not currently covered by appendix Y until DOE amends the energy conservation standards for battery chargers as part of a future rulemaking. DOE will further address the expected costs to industry if and when DOE establishes energy conservation standards for wireless chargers.

Appendix Y1—Wall Adapter Selection

The proposed update to require the use of a minimally compliant power supply selection criteria for battery chargers that are not sold with one ensures that these products are tested in a manner that is representative of actual use in accordance with EPCA. This proposal would not create additional cost or require additional time as compared to the current test procedure, as these battery chargers currently require a low voltage input; this proposal would only specify how the low voltage input must be provided and would not result in additional costs. DOE also anticipates this proposal to impact the measured energy consumption of battery chargers, but only for scenarios where the manufacturer previously certified the product using an EPS that is either not minimally compliant or used a bench power supply and failed to include its energy consumption as part of the battery charger system.

However, the proposed test procedure would only apply to the proposed new appendix Y1, meaning it would not be required for testing until DOE amends energy conservation standards and requires manufacturers to use appendix Y1. Based on DOE's market research, DOE estimates that most battery charger models do not remain on the market for more than four years because of frequent battery charger new model updates and retirement of old models. Therefore, DOE anticipates that most battery chargers required to use appendix Y1 will likely be introduced into the market after this test procedure amendment is finalized.[19] Because of this, DOE does not anticipate that battery charger manufacturers would have to re-test battery charger models that were introduced into the market prior to DOE finalizing this proposed test procedure. Should use of appendix Y1 be required due to amended energy conservation standards, battery chargers introduced prior to this test procedure's finalization would likely no longer be on the market. Battery charger manufacturers using the proposed selection criteria of a power supply would not incur any additional testing costs compared to the current battery charger testing costs. Therefore, battery chargers introduced into the market after DOE finalizes this proposed test procedure, is finalized, have the option to test those models using the proposed selection criteria of a power supply. Any manufacturer seeking to avoid any risk of retesting costs can choose to comply with the propose selection criteria of a power supply earlier. If a manufacturer chooses this option, they would incur the same testing costs when using the proposed selection criteria as they currently incur

[15] DOE used the mean hourly wage of the ''17–3023 Electrical and Electronic Engineering Technologists and Technicians'' from the most recent BLS Occupational Employment and Wage Statistics (May 2020) to estimate the hourly wage rate of a technician assumed to perform this testing. *See www.bls.gov/oes/current/oes173023.htm*. Last accessed on July 22, 2021.

[16] DOE used the March 2021 ''Employer Costs for Employee Compensation'' to estimate that for ''Private Industry Workers,'' ''Wages and Salaries'' are 70.4 percent of the total employee compensation. *See www.bls.gov/news.release/archives/ecec_06172021.pdf*. Last accessed on July 22, 2021.

[17] $32.84 ÷ 0.704 = $46.65.

[18] Fixed-location wireless charger: $46.65 × 4.2 hours = $195.93 (rounded to $196)

Open-placement wireless charger: $46.65 × 1 hour = $46.65 (rounded to $47).

[19] For this cost analysis DOE estimates that the battery charger test procedures will be finalized in 2022. Similarly, amended energy conservation standards, if justified, would be finalized in 2024 with an estimated 2026 compliance date.

and would not have to retest those battery chargers after appendix Y1 is required to comply with future energy conservation standards. DOE will examine the potential retesting costs of manufacturers continuing to test battery charger models that do not use the proposed selection criteria of a power supply in the future energy conservation standard.

Appendix Y1—Modes of Operation

DOE has also estimated the testing costs associated with battery charger testing under the proposed appendix Y1. Removing usage profiles and switching the UEC metric to an active, standby, and off modes separate multi-metric system in appendix Y1 will cause battery charger manufacturers to re-test their products when DOE amends energy conservation standards requiring manufacturers to test their products using appendix Y1. Under appendix Y1, if the manufacturer has (i) already tested and certified the battery charger basic model under the current appendix Y and (ii) still has the original testing data from the appendix Y testing available for standby power calculation, those battery charger basic models would only need to be retested with the active charge energy and discharge tests with additional standby power data analysis. For these battery charger basic models, DOE estimates an extra labor time of 1.5 hours would be needed to set up and analyze the test results.[20] Using the previously calculated fully-burdened labor rate of $46.65 per hour for an employee conducting these tests, DOE estimates manufacturers would incur approximately $70 to analyze the test results for these battery chargers. DOE requires at least two units be tested per basic model. Therefore, DOE estimates manufacturers would incur approximately $140 per battery charger basic model for these battery chargers.

Basic models that will either be newly covered under the expanded scope or that are missing the original test data from their appendix Y testing would need to be fully tested under appendix Y1. DOE estimates a total testing time ranging from 43 to 62 hours would be needed, with 4.2 hours of technician intervention required to test each additional battery charger unit. Using the previously calculated fully-burdened labor rate of $46.65 for an electrical technician to conduct these tests, manufacturers would incur approximately $196 per unit. DOE requires at least two units be tested per basic model. Therefore, DOE estimates manufacturers would incur approximately $392 per battery charger basic model to conduct the complete testing under appendix Y1.

All Other Test Procedure Amendments

The remainder of the proposal would add additional detail and instruction to improve the readability of the test procedure. The cross-reference corrections, sub-section corrections and reorganizations also help improve the test procedure readability and clarity without modifying or adding any steps to the test method. As such, these proposals, if finalized, will not result in increased test burden.

DOE requests comment on its understanding of the impact of the proposals presented in this document in relation to test burden, costs, and impact on the measured unit energy consumption of battery charger products. Specifically, DOE requests comment on the per basic model test costs associated with testing battery chargers and wireless chargers to the proposed appendix Y1. DOE also requests comment on DOE's initial assumption that manufacturers would not incur any additional testing burden associated with the proposed changes to appendix Y and the proposed changes regarding the power supply selection criteria in appendix Y1.

2. Harmonization With Industry Standards

DOE's established practice is to adopt relevant industry standards as DOE test procedures unless such methodology would be unduly burdensome to conduct or would not produce test results that reflect the energy efficiency, energy use, water use (as specified in EPCA) or estimated operating costs of that product during a representative average use cycle or period of use. Section 8(c) of appendix A, 10 CFR part 430 subpart C. But where the industry standard does not meet EPCA statutory criteria for test procedures, DOE will make modifications to the DOE test procedure via these standards through the rulemaking process.

The test procedures for battery chargers at 10 CFR part 430, subpart B, appendix Y currently incorporates by reference certain provisions of IEC 62301 (testing equipment and measuring device specifications), IEC 62040 (specifies testing conditions and measurement specifications for uninterruptible power supplies), and ANSI/NEMA WD 6–2016 for uninterruptible power supply plug standards. DOE is proposing to maintain the incorporation of these standards and incorporate these standards in the new appendix Y1.

Different organizations either have developed or are in the process of developing their own test procedures for measuring the wireless charging efficiency of interoperable chargers, including the ANSI/CTA 2042.3, WPC protocol, and the IEC TC 100 TA 15 test method. The WPC protocol provides a ranking of various wireless battery chargers by comparing their relative power transfer efficiencies when a reference receiver is placed on the most optimum charging location. The WPC protocol, however, does not provide an absolute value for a wireless charger's efficiency, and because it currently relies on a small number of reference receivers to represent the entire breadth of real-world loading conditions it may not be representative of actual use. Similarly, ANSI/CTA 2042.3 and IEC TC 100 TA 15 requires receivers to be placed at precise optimal charging locations.

DOE tentatively finds that these approaches are likely to lead to significant repeatability issues. Even a slight variation in alignment between the wireless transmitter and receiver can result in significantly different efficiency measurements. These approaches also require that the receiver be placed at the highest signal strength area, which may not be representative of real-world usage. Furthermore, IEC's test method utilizes 5 reference receivers with 4 different load ratings, requiring a total of 20 tests for a single wireless charger; this creates a total testing time considerably longer than the current DOE test procedure. Due to the potential issues with repeatability, non-representativeness of actual use, and test burden, DOE is not proposing to incorporate the aforementioned industry standards in its test procedure for battery chargers.

DOE recognizes that adopting industry standards with modifications may increase overall testing costs if the modifications needed to meet the conditions under EPCA require different testing equipment or facilities. DOE seeks comment on the degree to which the DOE test procedure should consider and be harmonized further with the most recent relevant industry standards for battery chargers, and whether there are any changes to the Federal test method that would provide additional benefits to the public. DOE also requests comment on the benefits and burdens of, or any other comments regarding adopting any industry/voluntary consensus-based or other appropriate test procedure, without modification.

[20] The total additional testing time for conducting the extra active charge energy charge and discharge test can range from 8 hours to 21 hours. However, only 1.5 hours of the total extra testing time would require technician intervention.

E. Compliance Date and Waivers

EPCA prescribes that, if DOE amends a test procedure, all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with that amended test procedure, beginning 180 days after publication of such a test procedure final rule in the **Federal Register**. (42 U.S.C. 6293(c)(2)) To the extent the modified test procedure proposed in this document is required only for the evaluation and issuance of updated efficiency standards, use of the modified test procedure, if finalized, would not be required until the implementation date of updated standards. *See* 10 CFR part 430, subpart C, appendix A, section 8(d). Manufacturers are still required to continue testing their battery charger products following the amended appendix Y, if made final, during the meantime. If the proposed appendix Y1 amendments are made final, manufacturers can voluntarily test and report any such representations based on the appendix Y1 test procedure beginning 180 days following the test procedure final rule.

If DOE were to amend the test procedure, EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer may experience undue hardship in meeting the deadline. (42 U.S.C. 6293(c)(3)) To receive such an extension, petitions must be filed with DOE no later than 60 days before the end of the 180-day period and must detail how the manufacturer will experience undue hardship. *Id.*

Upon the compliance date of test procedure provisions of an amended test procedure that DOE issues, any waivers that had been previously issued and are in effect that pertain to issues addressed by such provisions are terminated. 10 CFR 430.27(h)(2). Recipients of any such waivers would be required to test the products subject to the waiver according to the amended test procedure as of the compliance date of the amended test procedure.

As discussed previously, DOE is not proposing to amend the test procedure to address the waiver and waiver extension granted to Dyson (Case No. BC–001 and Case No. 2018–012), as the products for which the waiver and waiver extension were required are no longer available, making the waiver and waiver extension no longer necessary. If this proposed rulemaking were made final, the final rule would terminate the waiver and waiver extension consistent with 10 CFR 430.27(h)(3) and 10 CFR 430.27(l).

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget (''OMB'') has determined that this test procedure rulemaking does not constitute ''significant regulatory actions'' under section 3(f) of Executive Order (''E.O.'') 12866, Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive order by the Office of Information and Regulatory Affairs (''OIRA'') in OMB.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (''IRFA'') 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 website: *www.energy.gov/gc/office-general-counsel*. DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003.

The following sections detail DOE's IRFA for this test procedure rulemaking.

1. Description of Reasons Why Action Is Being Considered

DOE is proposing to amend the existing DOE test procedures for battery chargers. DOE shall amend test procedures with respect to any covered product, if the Secretary determines that amended test procedures would more accurately produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A))

2. Objective of, and Legal Basis for, Rule

DOE is required to review existing DOE test procedures for all covered products every 7 years. (42 U.S.C. 6293(b)(1)(A))

3. Description and Estimate of Small Entities Regulated

For manufacturers of battery chargers, the Small Business Administration (''SBA'') has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. The size standards are listed by North American Industry Classification System (''NAICS'') code and industry description and are available at: *www.sba.gov/document/support—table-size-standards*. Battery charger manufacturing is classified under NAICS 335999, ''All Other Miscellaneous Electrical Equipment and Component Manufacturing.'' The SBA sets a threshold of 500 employees or fewer for an entity to be considered as a small business in this category.

DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the proposed rule. 13 CFR part 121. DOE reviewed the test procedures proposed in this NOPR under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

Wired Battery Chargers

DOE used data from DOE's publicly available Compliance Certification Database (''CCD'')[21] and California Energy Commission's Modernized Appliance Efficiency Database System (''MAEDbS'').[22] DOE identified over 2,000 companies that submitted entries for Federally regulated battery chargers.[23] DOE screened out companies that do not meet the SBA definition of a ''small entity'' or are foreign-owned and operated. DOE identified approximately 294 potential small businesses that currently certify battery chargers or applications using battery chargers to DOE's CCD. These 294 potential small businesses manufacture approximately 3,456 unique basic models of battery chargers or applications using battery chargers. The number of battery charger models made by each potential small business ranges from 1 model to 263 models,

[21] *See www.regulations.doe.gov/certification-data*. Last accessed on August 11, 2021.

[22] *See cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx*. Last accessed on August 11, 2021.

[23] These entities consist of both battery charger manufacturers and manufacturers of devices that use a battery charger (*e.g.,* toys or small electronic devices that have a battery charger embedded in the product).

with an average of approximately 12 unique basic models.

Wireless Battery Chargers

DOE used publicly available data from the Wireless Power Consortium to estimate the number of wireless battery charger manufacturers and number of wireless battery charger models.[24] The majority of these companies are foreign owned and operated, as most wireless battery charger manufacturing is done abroad. DOE identified 13 potential domestic small businesses that manufacture approximately 327 wireless battery charger models. The number of wireless battery charger models made by each potential small business ranges from 1 model to 183 models, with an average of approximately 25 models.

4. Description and Estimate of Compliance Requirements

Wired Battery Chargers

DOE assumes that each small business's regulatory costs would depend on the number of unique basic battery charger models and applications using a battery charger that small business manufactures. It is likely that some unique applications using a battery charger may use the same battery charging component as another unique application listed in DOE's CCD, meaning the cost of testing would be double counted in this analysis. However, DOE has conservatively estimated the cost associated with re-testing each unique application using a battery charger. Additionally, while some battery charger manufacturers could partially rely on previous testing conducted under appendix Y for their battery chargers (as described in section III.D.1), DOE conservatively estimates each small business would need to conduct the entire test under appendix Y1 for each unique basic model they manufacture.

As discussed in section III.D.1, battery chargers would only need to be tested under appendix Y1 when DOE sets future energy conservation standards for battery chargers that require appendix Y1. DOE estimates that the total time for conducting testing under appendix Y1 would range from 43 to 62 hours, and that it would require approximately 4.2 hours of technician intervention to test each additional battery charger unit. Using the previously calculated fully-burdened labor rate of $46.65 for an electrical technician to conduct these tests,[25] manufacturers would incur approximately $196 of testing costs per unit. DOE requires at least two units be tested per basic model. Therefore, DOE estimates manufacturers would incur approximately $392 of testing costs per battery charger basic model to conduct the complete testing under appendix Y1.

DOE estimates that all small businesses combined would incur approximately $1.35 million[26] if these small businesses re-tested all their unique basic models of battery chargers or applications using battery chargers under appendix Y1. An The potential range of testing costs for an individual small business would be between $392 (to re-test one basic model to) and approximately $103,000 (to re-test 263 basic models,), with an average cost of approximately $4,704 to re-test 12 basic models (the average number of models) under appendix Y1.

DOE was able to find annual revenue estimates for 289 of the 294 small businesses DOE identified. DOE was not able to identify any reliable annual revenue estimates for the remaining five small businesses. Based on the number of unique basic models of battery chargers or applications using battery chargers each small business manufactures, DOE estimates that the $392 per model potential re-testing cost would represent less than 2 percent of annual revenue for 286 of the 289 small businesses. DOE estimates that three small businesses could incur re-testing costs that would exceed 2.0 percent of their annual revenue.[27]

Wireless Battery Chargers

DOE assumed that each small business's regulatory costs would depend on the number of wireless battery charger models that small business manufactures. As discussed in section III.D.1, wireless battery chargers would only need to be tested under appendix Y1 when DOE sets future energy conservation standards for battery chargers. DOE estimates that a total testing time for conducting testing under appendix Y1 for wireless battery chargers would take approximately 48 hours to conduct the test for one fixed-location wireless charger unit, and 2.2 hours to conduct the no-battery mode only test for one open-placement wireless charger unit. These tests do not require the wireless charger unit being tested to be constantly monitored by a lab technician. DOE estimates that a lab technician would spend approximately 4.2 hours to test a fixed-location wireless charger unit and one hour to test an open-placement wireless charger unit.

The Wireless Power Consortium database does not identify if the wireless charger is a fixed-location or an open-placement wireless charger. Based on DOE's market research, the vast majority of wireless chargers are open-placement wireless chargers. Therefore, DOE is estimating the costs to small businesses using the estimated per unit open-placement wireless charger testing costs.

Using the previously calculated fully-burdened labor rate of $46.65 for an electrical technician to conduct these tests, manufacturers would incur approximately $47 per unit. DOE requires at least two units be tested per basic model. Therefore, DOE estimates manufacturers would incur approximately $94 to conduct the no-battery mode test for one open-placement wireless charger unit under appendix Y1.

DOE estimates that all small businesses combined would incur approximately $31,000 to test all their wireless chargers under appendix Y1.[28] The potential range of testing costs for an individual small business would be between $94 (to test one wireless charger model) to approximately $17,200 (to test 183 wireless charger models,), with an average cost of approximately $2,350 to test 25 wireless charger models (the average number of models) under appendix Y1.

DOE was able to find annual revenue estimates for 12 of the 13 wireless

[24] *See www.wirelesspowerconsortium.com/products*. Last accessed on September 8, 2021.

[25] Based on data from the BLS's Occupational Employment and Wage Statistics, the mean hourly wage for an electrical and electronic engineering technologist and technician is $32.84 (*www.bls.gov/oes/current/oes173023.htm*). Additionally, DOE used data from BLS's Employer Costs for Employee Compensation to estimate the percent that wages comprise the total compensation for an employee. DOE estimates that wages make up 70.4 percent of the total compensation for private industry employees (*www.bls.gov/news.release/archives/ecec_06172021.pdf*). $32.84 ÷ 0.704 = $46.65.

[26] $392 (testing cost per basic model) × 3,456 (number of unique basic models manufactured by all small businesses) = $1,354,752.

[27] One small business manufactures eight unique basic models, which if all basic models were re-tested could cost up to $3,136. This small business has an estimated annual revenue of $52,000, meaning testing costs could comprise up to 6.0 percent of their annual revenue. Another small business manufactures six basic models, which if all basic models were re-tested could cost up to $2,352. This small business has an estimated annual revenue of $94,000, meaning testing costs could comprise up to 2.5 percent of their annual revenue. The remaining small business manufactures five basic models, which if all basic models were re-tested could cost up to $1,960. This small business has an estimated annual revenue of $68,400, meaning testing costs could comprise up to 2.9 percent of their annual revenue.

[28] $94 (testing cost per model) × 327 (number of wireless charger models manufactured by all small businesses) = $30,738.

charger small businesses DOE identified. DOE was not able to identify any reliable annual revenue estimates for the remaining wireless charger small businesses DOE identified. Based on the number of wireless charger models each small business manufactures, DOE estimates that the $94 per model testing cost would represent less than 2 percent of annual revenue for all 12 of the wireless charger small businesses that DOE found annual revenue estimates for.

DOE requests comment on the number of small businesses DOE identified; the number of battery charger models assumed these small business manufacture; and the per model re-testing or testing costs and total re-testing or testing costs DOE estimated small businesses may incur to re-test wired battery chargers or to test wireless chargers to appendix Y1. DOE also requests comment on any other potential costs small businesses may incur due to the proposed amended test procedures, if finalized.

5. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being considered today.

6. Significant Alternatives to the Rule

As previously stated in this section, DOE is required to review existing DOE test procedures for all covered products every 7 years. Additionally, DOE shall amend test procedures with respect to any covered product, if the Secretary determines that amended test procedures would more accurately produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A)) DOE has initially determined that appendix Y1 would more accurately produce test results to measure the energy efficiency of battery chargers.

While DOE recognizes that requiring that battery charger manufacturers use appendix Y1 to comply with future energy conservation standards would cause manufacturers to re-test some battery charger models or test some wireless chargers, for most battery charger manufacturers it will be inexpensive to re-test or test these models. Additionally, some manufacturers might be able to partially rely on previous test data used manufacturers tested their wired battery chargers under appendix Y.

DOE has tentatively determined that there are no better alternatives than the proposed amended test procedures in terms of meeting the agency's objectives to more accurately measure energy efficiency and reducing burden on manufacturers. Therefore, DOE is proposing in this NOPR to amend the existing DOE test procedure for battery chargers.

Additional compliance flexibilities may be available through other means. EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. (42 U.S.C. 6295(t)) Additionally, section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of battery chargers must certify to DOE that their products comply with any applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their products according to the DOE test procedures, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including battery chargers. (*See generally* 10 CFR part 429.) The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (''PRA''). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 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.

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.

D. Review Under the National Environmental Policy Act of 1969

In this proposed rule, DOE proposes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for battery chargers. 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.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, DOE has determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10 CFR part 1021, appendix A to subpart D, A5 and A6. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (Aug. 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 this 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(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 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.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (''UMRA'') requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure 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 a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *https://www.energy.gov/gc/office-general-counsel*. DOE examined this proposed rule according to UMRA and its statement of policy and determined that the 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.

H. Review Under the 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 rule that may affect family well-being. This 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 not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights'' 53 FR 8859 (March 18, 1988), that this proposed regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (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 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). Pursuant to OMB Memorandum M–19–15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf*. DOE has reviewed this proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under 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 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.

The proposed regulatory action to amend the test procedure for measuring the energy efficiency of battery chargers 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, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under 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 relevant 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. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether they were developed in a manner that fully provides for public participation, comment, and review). DOE will consult with both the Attorney General and the Chairman of the FTC concerning the impact of this test procedure on competition, prior to prescribing a final rule.

M. Description of Materials Incorporated by Reference

DOE proposes to maintain previously approved incorporation by reference standards in appendix Y. Additionally, DOE proposes to incorporate by reference the following industry standards into the new appendix Y1:

1. IEC 62301, ''Household electrical appliances—Measurement of standby power, (Edition 2.0, 2011–01)'' into the new appendix Y1. Appendix Y1 references various sections from IEC 62301 for test conditions, standby power measurement, and measurement uncertainty determination.

2. EC 62040–3, ''Uninterruptible power systems (UPS)—Part 3: Methods of specifying the performance and test requirements,'' Edition 2.0, 2011–03. Appendix Y1 references various sections from IEC 62040 for test requirements of uninterruptible power supplies.

3. ANSI/NEMA WD 6–2016, ''Wiring Devices—Dimensional Specifications,'' ANSI approved February 11, 2016. Appendix Y1 references the input plug requirements in Figure 1–15 and Figure 5–15 of ANSI/NEMA WD 6–2016.

Copies of IEC 62301 and IEC 62040–3 can be obtained from the International Electrotechnical Commission at 446 Main Street, Sixteenth Floor, Worcester, MA 01608, or by going to *www.iec.ch*.

Copies of ANSI/NEMA WD 6–2016 can be obtained from American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, 212–642–4900, or by going to *www.ansi.org*.

V. Public Participation

A. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this document.[29]

Submitting comments via www.regulations.gov. The *www.regulations.gov* web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *www.regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (''CBI'')). Comments submitted through *www.regulations.gov* cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through *www.regulations.gov* before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that *www.regulations.gov* provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or postal mail. Comments and documents submitted via email, hand delivery/courier, or postal mail also will be posted to *www.regulations.gov.* If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information on a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via postal mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No faxes will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English and free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant 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 via email, postal mail, or hand delivery/courier two well-marked copies: One copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential

[29] DOE has historically provided a 75-day comment period for test procedure NOPRs pursuant to the North American Free Trade Agreement, U.S.-Canada-Mexico (''NAFTA''), Dec. 17, 1992, 32 I.L.M. 289 (1993); the North American Free Trade Agreement Implementation Act, Public Law 103–182, 107 Stat. 2057 (1993) (codified as amended at 10 U.S.C.A. 2576) (1993) (''NAFTA Implementation Act''); and Executive Order 12889, ''Implementation of the North American Free Trade Agreement,'' 58 FR 69681 (Dec. 30, 1993). However, on July 1, 2020, the Agreement between the United States of America, the United Mexican States, and the United Canadian States (''USMCA''), Nov. 30, 2018, 134 Stat. 11 (*i.e.,* the successor to NAFTA), went into effect, and Congress's action in replacing NAFTA through the USMCA Implementation Act, 19 U.S.C. 4501 *et seq.* (2020), implies the repeal of E.O. 12889 and its 75-day comment period requirement for technical regulations. Thus, the controlling laws are EPCA and the USMCA Implementation Act. Consistent with EPCA's public comment period requirements for consumer products, the USMCA only requires a minimum comment period of 60 days. Consequently, DOE now provides a 60-day public comment period for test procedure NOPRs.

status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

B. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

(1) DOE seeks comment on its proposal to define fixed-location wireless chargers in appendix Y1 and whether this definition accurately captures all the types of wireless chargers with locating features that are on the market; its proposal to remove the ''wet environment'' designation for wireless chargers; its proposal to revise the scope of Product Class 1 to include all fixed-location wireless chargers in appendix Y1; and its proposal to increase the rated battery energy limit for fixed-location wireless chargers from ≤ 5 Wh to < 100 Wh in appendix Y1 to accommodate the range of inductive wireless battery chargers on the market and potential future product designs that may have larger battery energies. DOE also requests information on which types of inductive wireless battery chargers would be subject to DOE regulations due to the proposed change in scope, including any corresponding usage data, if available.

(2) DOE seeks comment on its proposal to define open-placement wireless chargers in appendix Y1 and whether this definition accurately captures all the types of wireless chargers without physical locating features that are on the market. DOE also requests comment on its proposal to require testing of the no-battery mode power consumption of these open-placement wireless chargers.

(3) DOE requests comment on the proposal to specify the priority of wall adapter selection in appendix Y1. DOE also requests comment on the proposal in appendix Y1 to replace the 5 V DC input requirement for those chargers that do not ship with an adapter, and one is not recommended, with the requirement that these chargers be tested with any compatible and commercially-available EPS that is minimally compliant with DOE's energy conservation standards for EPSs. DOE also requests comments on whether these proposals would result in increased test burden.

(4) DOE requests comment on the proposal to update the term ''Lithium Polymer'' to ''Lithium-ion Polymer''. DOE also requests comment on the proposal to rename the term ''Nanophosphate Lithium'' to the non-proprietary term ''Lithium Iron Phosphate''.

(5) DOE requests feedback on the proposal to remove the specification of usage profiles and the associated UEC calculation in appendix Y1, to be replaced with an approach that relies on separate metrics for active mode, standby mode, and off mode. For further consideration of the existing approach, DOE requests, for all applications in each product class, data such as the percentage of time spent in each mode of operation along with data sources for consideration in updating the usage profiles for battery chargers.

(6) DOE requests comment on the proposed approach to determining active mode energy, as well as the suggested alternate method. In particular, under the alternate method, DOE requests comment on how to define the drop in power associated with the transition from active charging to maintenance mode, such that this method would provide repeatable and reproducible results.

(7) DOE requests feedback on its proposed definition of standby mode in newly proposed appendix Y1 to capture both no-battery mode as well as maintenance mode. DOE also requests feedback on its proposal to define standby power, or Psb, to mean the summation of the no-battery mode (Pnb) and maintenance mode (Pm).

(8) DOE requests feedback on its proposed approach to rely on Ea, Psb and Poff instead of E24, Pnb and Poff to determine the energy performance of a battery charger, and whether a different approach exists that may provide test results that are more representative of the energy performance and energy use of battery chargers. DOE also requests comment on the described alternate approach to capturing maintenance mode power and whether such an approach would be representative of actual use for all battery chargers.

(9) DOE requests stakeholder feedback on whether such flow charts will assist manufacturers through the testing and certification process. DOE also requests comment on whether the flow charts would benefit from the inclusion of additional information.

(10) DOE requests comments on whether manufacturers and test laboratories are currently using ''measured'' battery energy or ''rated''/''represented'' battery energy values to determine battery charger product class. DOE requests comment on its proposal to update the nomenclature in appendix Y to refer to ''Measured Ebatt'' and ''Represented Ebatt'' to better distinguish between the two values.

(11) DOE is not aware of any multi-voltage battery chargers that are currently incorrectly certified. Updating the language in appendix Y would further avoid the potential for future confusion with regard to multi-voltage products. DOE requests comments on its proposal to amend Table 3.3.3 of appendix Y, and the corresponding language in the proposed appendix Y1, with the term ''highest nameplate battery voltage.''

(12) DOE requests comment on its understanding of the impact of the proposals presented in this document in relation to test burden, costs, and impact on the measured unit energy consumption of battery charger products. Specifically, DOE requests comment on the per basic model test costs associated with testing battery chargers and wireless chargers to the proposed appendix Y1. DOE also requests comment on DOE's initial assumption that manufacturers would not incur any additional testing burden associated with the proposed changes to appendix Y and the proposed changes regarding the power supply selection criteria in appendix Y1.

(13) DOE requests comment on the number of small businesses DOE identified; the number of battery charger models assumed these small business manufacture; and the per model re-testing or testing costs and total re-testing or testing costs DOE estimated small businesses may incur to re-test wired battery chargers or to test wireless chargers to appendix Y1. DOE also requests comment on any other potential costs small businesses may incur due to the proposed amended test procedures, if finalized.

VI. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Signing Authority

This document of the Department of Energy was signed on November 3, 2021, by Kelly Speakes-Backman, Principal Deputy Assistant Secretary and Acting Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on November 3, 2021.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

For the reasons stated in the preamble, DOE is proposing to amend parts 429 and 430 of Chapter II of Title 10, Code of Federal Regulations as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291—6317; 28 U.S.C. 2461 note.

■ 2. Section 429.39 is amended by revising the introductory text of paragraphs (a) and paragraphs (a)(1) through (2)(iii) to read as follows:

§ 429.39 Battery chargers.

(a) *Determination of represented value.* Manufacturers must determine represented values, which include certified ratings, for each basic model of battery charger in accordance with the following sampling provisions.

(1) *Represented values include.* The unit energy consumption (UEC) in kilowatt-hours per year (kWh/yr) (if applicable), battery discharge energy (E_{batt}) in watt hours (Wh), 24-hour energy consumption (E_{24}) in watt hours (Wh) (if applicable), active mode energy consumption (E_a) in watt hours (Wh) (if applicable), maintenance mode power (P_m) in watts (W), no-battery mode power (P_{nb}) in watts (W) (if applicable), standby mode power (P_{sb}) in watts (W), off mode power (P_{off}) in watts (W), and duration of the charge and maintenance mode test (t_{cd}) in hours (hrs) (if applicable) for all battery chargers other than uninterruptible power supplies (UPSs); and average load adjusted efficiency (Eff_{avg}) for UPSs.

(2) *Units to be tested.* (i) The general requirements of § 429.11 are applicable to all battery chargers; and

(ii) For each basic model of battery chargers other than UPSs, a sample of sufficient size must be randomly selected and tested to ensure that the represented value of UEC or E_a is greater than or equal to the higher of:

(A) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the UEC or E_a of the *i*th sample; or,

(B) The upper 97.5-percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{0.975}\left(\frac{s}{\sqrt{n}}\right)$$

And, $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.975}$ is the t-statistic for a 97.5-percent one-tailed confidence interval with n − 1 degrees of freedom (from appendix A of this subpart).

(iii) For each basic model of battery chargers other than UPSs, using the sample from paragraph (a)(2)(ii) of this section, calculate the represented values of each metric (*i.e.,* maintenance mode power (P_m), no-battery mode power (P_{nb}), standby power (P_{sb}), off mode power (P_{off}), battery discharge energy (E_{batt}), 24-hour energy consumption (E_{24}), and duration of the charge and maintenance mode test (t_{cd})), where the represented value of the metric is:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean, n is the number of samples, and x_i is the measured value of the *i*th sample for the metric.

* * * * *

■ 3. Section 429.134 is amended by adding paragraph (s) to read as follows:

§ 429.134 Product specific enforcement provisions.

* * * * *

(s) *Battery chargers—verification of reported represented value obtained from testing in accordance with appendix Y1 of 10 CFR part 430 subpart B when using an external power supply.* If the battery charger basic model requires the use of an external power supply (''EPS''), and the manufacturer reported EPS is no longer available on the market, then DOE will test the battery charger with any compatible EPS that is minimally compliant with DOE's energy conservation standards for EPSs as prescribed in § 430.32(w) of this subchapter and that meets the battery charger input power criteria.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

§ 430.3 [Amended]

■ 5. Section 430.3 is amended by:

■ a. Removing the words ''IBR approved for Appendix Y'', in paragraph (e)(22), and adding in its place the words ''IBR approved for appendices Y and Y1'';

■ b. Removing the words ''appendix Y to subpart B'', in paragraph (o)(3), and adding in its place the words ''appendices Y and Y1 to subpart B''; and

■ c. Removing the words ''Y, Z,'', in paragraph (o)(6), and adding in its place the words ''Y, Y1, Z,''.

■ 6. Section 430.23 is amended by revising paragraph (aa) to read as follows:

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

* * * * *

(aa) *Battery Chargers.* (1) For battery chargers subject to compliance with the relevant standard at § 430.32 as that standard appeared in the January 1, 2021 edition of 10 CFR parts 200–499:

(i) Measure the maintenance mode power, standby power, off mode power, battery discharge energy, 24-hour energy consumption and measured duration of the charge and maintenance mode test for a battery charger other than uninterruptible power supplies in accordance with appendix Y to this subpart,

(ii) Calculate the unit energy consumption of a battery charger other than uninterruptible power supplies in accordance with appendix Y to this subpart,

(iii) Calculate the average load adjusted efficiency of an uninterruptible power supply in accordance with appendix Y to this subpart.

(2) For a battery charger subject to compliance with any amended relevant standard provided in § 430.32 that is published after January 1, 2021:

(i) Measure active mode energy, maintenance mode power, no-battery mode power, off mode power and battery discharge energy for a battery charger other than uninterruptible power supplies in accordance with appendix Y1 to this subpart.

(ii) Calculate the standby power of a battery charger other than uninterruptible power supplies in accordance with appendix Y1, to this subpart.

(iii) Calculate the average load adjusted efficiency of an uninterruptible power supply in accordance with appendix Y1 to this subpart.

* * * * *

■ 7. Appendix Y to subpart B of part 430 is amended by:

■ a. Revising the introductory paragraph;

■ b. Revising sections 3.2.5.(f), 3.3.4., and 3.3.8.;

■ c. Revising Table 3.3.2 through 3.3.10.; and

■ d. Revising sections 3.3.11. through 3.3.13.

The revisions read as follows:

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

Note: Manufacturers must use the results of testing under appendix Y to determine compliance with the relevant standard from § 430.32(z) as that standard appeared in the January 1, 2021 edition of 10 CFR parts 200–499. Specifically, before [Date 180 days following publication of the final rule] representations must be based upon results generated either under this appendix or under appendix Y as it appeared in the 10 CFR parts 200–499 edition revised as of January 1, 2021.

For any amended standards for battery chargers published after January 1, 2021, manufacturers must use the results of testing under appendix Y1 to determine compliance. Representations related to energy consumption must be made in accordance with the appropriate appendix that applies (*i.e.,* appendix Y or appendix Y1) when determining compliance with the relevant standard. Manufacturers may also use appendix Y1 to certify compliance with amended standards, published after January 1, 2021, prior to the applicable compliance date for those standards.

* * * * *

3.2.5. Accessing the Battery for the Test

* * * * *

(f) If any of the following conditions noted immediately below in sections 3.2.5.(f)(1) to 3.2.5.(f)(3) are applicable, preventing the measurement of the Battery Discharge Energy and the Charging and Maintenance Mode Energy, a manufacturer must submit a petition for a test procedure waiver in accordance with § 430.27:

(1) Inability to access the battery terminals;

(2) Access to the battery terminals destroys charger functionality; or

(3) Inability to draw current from the test battery.

* * * * *

3.3.4. Preparing the Battery for Charge Testing

Following any conditioning prior to beginning the battery charge test (section 3.3.6 of this appendix), the test battery shall be fully discharged to the end of discharge voltage prescribed in Table 3.3.2 of this appendix, or until the UUT circuitry terminates the discharge.

* * * * *

3.3.8. Battery Discharge Energy Test

(a) If multiple batteries were charged simultaneously, 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 sections 3.3.6. and 3.3.7.

(2) Set the battery analyzer for a constant discharge rate and the end-of-discharge voltage in Table 3.3.2 of this appendix 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 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.

* * * * *

TABLE 3.3.2—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-ion Polymer	0.2	2.5
Lithium Iron Phosphate	0.2	2.0
Rechargeable Alkaline	0.2	0.9
Silver Zinc	0.2	1.2

* If the presence of protective circuitry prevents the battery cells from being discharged to the end-of-discharge voltage specified, then discharge battery cells to the lowest possible voltage permitted by the protective circuitry.

3.3.11. Standby Mode Energy Consumption Measurement

The standby mode measurement depends on the configuration of the battery charger, as follows:

(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, as follows:

(1) 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.

(2) If the product is powered through a detachable AC power cord and contains integrated power conversion and charging circuitry, 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).

(3) 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.

3.3.12. Off Mode Energy Consumption Measurement

The off mode measurement depends on the configuration of the battery charger, as follows:

(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, as follows:

(1) 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.

(2) If the product is powered through a detachable AC power cord and contains integrated power conversion and charging circuitry, 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).

(3) 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.

3.3.13. Unit Energy Consumption Calculation

Unit energy consumption (UEC) shall be calculated for a battery charger using one of the two equations (equation (i) or equation (ii)) listed in this section. If a battery charger is tested and its charge duration as determined in section 3.3.2 of this appendix minus 5 hours is greater than the threshold charge time listed in Table 3.3.3 of this appendix (*i.e.,* $(t_{cd} - 5) * n > t_{a\&m}$), equation (ii) shall be used to calculate UEC; otherwise a battery charger's UEC shall be calculated using equation (i).

$$\text{(i) } UEC = 365\left(n\left(E_{24} - 5P_m - Measured\ E_{batt}\right)\frac{24}{t_{cd}} + \left(P_m\left(t_{a\&m} - (t_{cd} - 5)n\right)\right) + \left(P_{sb}t_{sb}\right) + \left(P_{off}t_{off}\right)\right) \text{ or,}$$

$$\text{(ii) } UEC = 365\left(n\left(E_{24} - 5P_m - Measured\ E_{batt}\right)\frac{24}{(t_{cd} - 5)} + \left(P_{sb}t_{sb}\right) + \left(P_{off}t_{off}\right)\right)$$

Where:

E_{24} = 24-hour energy as determined in section 3.3.10 of this appendix,

Measured E_{batt} = Measured battery energy as determined in section 3.3.8. of this appendix,

P_m = Maintenance mode power as determined in section 3.3.9. of this appendix,

P_{sb} = Standby mode power as determined in section 3.3.11. of this appendix,

P_{off} = Off mode power as determined in section 3.3.12. of this appendix,

t_{cd} = Charge test duration as determined in section 3.3.2. of this appendix, and

$t_{a\&m}$, n, t_{sb}, and t_{off}, are constants used depending upon a device's product class and found in the Table 3.3.3:

TABLE 3.3.3—BATTERY CHARGER USAGE PROFILES

Product class				Hours per day ***			Charges (n)	Threshold charge time *
Number	Description	Measured battery energy (measured E_{batt}) **	Special characteristic or highest nameplate battery voltage	Active + maintenance ($t_{a\&m}$)	Standby (t_{sb})	Off (t_{off})	Number per day	Hours
1	Low-Energy	≤20 Wh	Inductive Connection ****.	20.66	0.10	0.00	0.15	137.73
2	Low-Energy, Low-Voltage.	<100 Wh	<4 V	7.82	5.29	0.00	0.54	14.48
3	Low-Energy, Medium-Voltage.		4–10 V	6.42	0.30	0.00	0.10	64.20

TABLE 3.3.3—BATTERY CHARGER USAGE PROFILES—Continued

Product class				Hours per day ***			Charges (n)	Threshold charge time *
Number	Description	Measured battery energy (measured E_{batt}) **	Special characteristic or highest nameplate battery voltage	Active + maintenance ($t_{a\&m}$)	Standby (t_{sb})	Off (t_{off})	Number per day	Hours
4	Low-Energy, High-Voltage.		>10 V	16.84	0.91	0.00	0.50	33.68
5	Medium-Energy, Low-Voltage.	100–3000 Wh.	<20 V	6.52	1.16	0.00	0.11	59.27
6	Medium-Energy, High-Voltage.		≥20 V	17.15	6.85	0.00	0.34	50.44
7	High-Energy	>3000 Wh		8.14	7.30	0.00	0.32	25.44

* If the duration of the charge test (minus 5 hours) as determined in section 3.3.2. of appendix Y to subpart B of this part exceeds the threshold charge time, use equation (ii) to calculate UEC otherwise use equation (i).
** Measured E_{batt} = Measured battery energy as determined in section 3.3.8.
*** If the total time does not sum to 24 hours per day, the remaining time is allocated to unplugged time, which means there is 0 power consumption and no changes to the UEC calculation needed.
**** Fixed-location inductive wireless charger only.

* * * * *

■ 8. Appendix Y1 to subpart B of part 430 is added to read as follows:

Appendix Y1 to Subpart B of Part 430–Uniform Test Method for Measuring the Energy Consumption of Battery Chargers

Note: Manufacturers must use the results of testing under this appendix Y1 to determine compliance with any amended standards for battery chargers provided in § 430.32 that are published after January 1, 2021. Representations related to energy or water consumption must be made in accordance with the appropriate appendix that applies (*i.e.,* appendix Y or appendix Y1) when determining compliance with the relevant standard. Manufacturers may also use appendix Y1 to certify compliance with amended standards, published after January 1, 2021, prior to the applicable compliance date for those standards.

1. Scope

This appendix provides the test requirements used to measure the energy consumption of battery chargers, including fixed-location wireless chargers designed for charging batteries with less than 100 watt-hour battery energy and open-placement wireless chargers, operating at either DC or United States AC line voltage (115V at 60Hz). This appendix also provides the test requirements used to measure the energy efficiency of uninterruptible power supplies as defined in section 2 of this appendix that utilize the standardized National Electrical Manufacturer Association (NEMA) plug, 1–15P or 5–15P, as specified in ANSI/NEMA WD 6–2016 (incorporated by reference, see § 430.3) and have an AC output. This appendix does not provide a method for testing back-up battery chargers or open-placement wireless chargers.

2. Definitions

The following definitions are for the purposes of explaining the 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

[1] For clarity on any other terminology used in the test method, please refer to IEEE Standard 1515–2000, (Sources for information and guidance, see § 430.4).

for charging purposes). The word ''intended'' in this context refers to the whether a battery has been designed in such a way as to permit its removal or disconnection from its associated consumer product.

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 a subset of standby mode in which the battery charger is connected to the main electricity supply and the battery is fully charged, but is still connected to the charger

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* (C) is the rate of charge or discharge, calculated by dividing the charge or discharge current by the nameplate battery 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. *Energy storage system* is a system consisting of single or multiple devices designed to provide power to the UPS inverter circuitry.

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 website maintained by the manufacturer and accessible by the general public at the time of the test. It also includes any information on the packaging or on the product itself. ''Instructions'' also includes any service manuals or data sheets that the manufacturer offers to independent service technicians, whether printed or in electronic form.

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 mains 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 that charges two or more batteries (which may be identical or different) simultaneously. The batteries are not connected in series or in parallel but with each port having 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 nameplate battery voltages. A multi-voltage charger can also be a multi-port charger if it can charge two or more batteries simultaneously with independent voltages and/or current regulation.

2.19. *Normal mode* is a mode of operation for a UPS in which:

(a) The AC input supply is within required tolerances and supplies the UPS,

(b) The energy storage system is being maintained at full charge or is under recharge, and

(c) The load connected to the UPS is within the UPS's specified power rating.

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

(a) Is connected to the main electricity supply;

(b) Is not connected to the battery; and

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

2.21. *Nameplate battery voltage* is specified by the battery manufacturer and typically printed on the label of the battery itself. If there are multiple batteries that are connected in series, the nameplate battery voltage of the batteries is the total voltage of the series configuration—that is, the nameplate voltage of each battery multiplied by the number of batteries connected in series. Connecting multiple batteries in parallel does not affect the nameplate battery voltage.

2.22. *Nameplate battery charge capacity* is the capacity, claimed by the battery manufacturer on a label or in instructions, that the battery can store, 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 nameplate battery charge capacity of the batteries is the total charge capacity of the parallel configuration, that is, the nameplate charge capacity of each battery multiplied by the number of batteries connected in parallel. Connecting multiple batteries in series does not affect the nameplate charge capacity.

2.23. *Nameplate battery energy capacity* means the product (in watts-hours (Wh)) of the nameplate battery voltage and the nameplate battery charge capacity.

2.24. *No-battery mode* is a subset of standby mode and means the condition in which:

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

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

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

2.25. *Reference test load* is a load or a condition with a power factor of greater than 0.99 in which the AC output socket of the UPS delivers the active power (W) for which the UPS is rated.

2.26. *Standby mode* means the condition in which the battery charge is either in maintenance mode or no battery mode as defined in this appendix.

2.27. *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.

2.28. *Uninterruptible power supply* or *UPS* means a battery charger consisting of a combination of convertors, switches and energy storage devices (such as batteries), constituting a power system for maintaining continuity of load power in case of input power failure.

2.28.1. *Voltage and frequency dependent UPS* or *VFD UPS* means a UPS that produces an AC output where the output voltage and frequency are dependent on the input voltage and frequency. This UPS architecture does not provide corrective functions like those in voltage independent and voltage and frequency independent systems.

Note to 2.28.1: VFD input dependency may be verified by performing the AC input failure test in section 6.2.2.7 of IEC 62040–3 Ed. 2.0 (incorporated by reference, see § 430.3) and observing that, at a minimum, the UPS switches from normal mode of operation to battery power while the input is interrupted.

2.28.2. *Voltage and frequency independent UPS,* or *VFI UPS,* means a UPS where the device remains in normal mode producing an AC output voltage and frequency that is independent of input voltage and frequency variations and protects the load against adverse effects from such variations without depleting the stored energy source.

Note to 2.28.2: VFI input dependency may be verified by performing the steady state input voltage tolerance test and the input frequency tolerance test in sections 6.4.1.1 and 6.4.1.2 of IEC 62040–3 Ed. 2.0 respectively and observing that, at a minimum, the UPS produces an output voltage and frequency within the specified output range when the input voltage is varied by ±10% of the rated input voltage and the input frequency is varied by ±2% of the rated input frequency.

2.28.3. *Voltage independent UPS* or *VI UPS* means a UPS that produces an AC output within a specific tolerance band that is independent of under-voltage or over-voltage variations in the input voltage without depleting the stored energy source. The output frequency of a VI UPS is dependent on the input frequency, similar to a voltage and frequency dependent system.

Note to 2.28.3: VI input dependency may be verified by performing the steady state input voltage tolerance test in section 6.4.1.1 of IEC 62040–3 Ed. 2.0 and ensuring that the UPS remains in normal mode with the output voltage within the specified output range when the input voltage is varied by ±10% of the rated input voltage.

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

2.30. *Wireless charger* is a battery charger that can charge batteries inductively.

2.30.1. *Fixed-location wireless charger* is an inductive wireless battery charger that incorporates a physical receiver locating feature (*e.g.,* by physical peg, cradle, locking mechanism, magnet, etc.) to repeatably align or orient the position of the receiver with respect to the transmitter.

2.30.2. *Open-placement wireless charger* is an inductive wireless charger that does not incorporate a physical receiver locating feature (*e.g.,* by a physical peg, cradle, locking mechanism, magnet etc.) to repeatably align or orient the position of the receiver with respect to the transmitter.

3. Testing Requirements for all Battery Chargers Other Than Uninterruptible Power Supplies and Open-Placement Wireless Chargers

3.1. Standard Test Conditions

3.1.1. General

The values that may be measured or calculated during the conduct of this test procedure have been summarized for easy reference in Table 3.1.1 of this appendix.

TABLE 3.1.1—LIST OF MEASURED OR CALCULATED VALUES

Name of measured or calculated value	Reference
1. Duration of the maintenance mode test	Section 3.3.2.
2. Battery Discharge Energy (E_{batt})	Section 3.3.8.
3. Initial time and power (W) of the input current of connected battery	Section 3.3.6.
4. Maintenance Mode Energy Consumption	Section 3.3.6.
5. Maintenance Mode Power (P_m)	Section 3.3.9.
6. Active mode Energy Consumption (E_a)	Section 3.3.10.
7. No-Battery Mode Power (P_{nb})	Section 3.3.11.
8. Off Mode Power (P_{off})	Section 3.3.12.
9. Standby Mode Power (P_{sb})	Section 3.3.13.

3.1.2. Verifying Accuracy and Precision of Measuring Equipment

Any power measurement equipment utilized for testing must conform to the uncertainty and resolution requirements outlined in section 4, ''General conditions for measurement'', as well as annexes B, ''Notes on the measurement of low-power modes'', and D, ''Determination of uncertainty of measurement'', of IEC 62301 (incorporated by reference, see § 430.3).

3.1.3. 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 20 °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. When not undergoing active testing, batteries shall be stored at 20 °C ± 5 °C.

3.1.4. 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 battery charger is powered by a low-voltage DC or AC input and the manufacturer packages the battery charger with a wall adapter, test the battery charger using the packaged wall adapter; if the battery charger does not include a pre-packaged wall adapter, then test the battery charger with a wall adapter sold and recommended by the manufacturer; if the manufacturer does not recommend a wall adapter that it sells, test the battery charger with a wall adapter that the manufacturer recommends for use in the manufacturer materials. 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 a battery charger is designed for operation only on DC input voltage and if the provisions of section 3.1.4.(b) of this appendix do not apply, test the battery charger with an external power supply that minimally complies with the applicable energy conservation standard and meets the external power supply parameters specified by the battery charger manufacturer. The input voltage shall be within ±1 percent of the battery charger manufacturer specified voltage.

(d) If the input voltage is AC, the input frequency shall be within ±1 percent of the specified frequency. The THD of the input voltage shall be ≤2 percent, 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 percent of the DC voltage for DC voltages over 10 V.

3.2. Unit Under Test Setup Requirements

3.2.1. 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 in the condition as it would be supplied to an end user.

(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.

3.2.2. 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.

3.2.3. 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 in section 3.2.3(b) of this appendix.

(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 in section 3.2.3(b) of this appendix.

(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 in section 3.2.3(b) of this appendix.

(b)(1) From the detachable batteries specified in section 3.2.3.(a) above, use Table 3.2.1 of this appendix to select the batteries to be used for testing, depending on the type of battery charger being tested. The battery charger types represented by the rows in the table are mutually exclusive. Find the single applicable row for the UUT, and test according to those requirements. Select only the single battery configuration specified for the battery charger type in Table 3.2.1 of this appendix.

(2) If the battery selection criteria specified in Table 3.2.1 of this appendix results in two or more batteries or configurations of batteries of different chemistries, but with equal voltage and capacity ratings, determine the maintenance mode power, as specified in section 3.3.9 of this appendix, for each of the batteries or configurations of batteries, and select for testing the battery or configuration of batteries with the highest maintenance mode power.

(c) A charger is considered as:

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

(2) Multi-capacity if there are associated batteries or configurations of batteries that have different nameplate battery 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 3.2.1—BATTERY SELECTION FOR TESTING

Type of charger			Tests to perform
Multi-voltage	Multi-port	Multi-capacity	Battery selection (from all configurations of all associated batteries)
No	No	No	Any associated battery.
No	No	Yes	Highest charge capacity battery.
No	Yes	Yes or No	Use all ports. Use the maximum number of identical batteries with the highest nameplate battery charge capacity that the charger can accommodate.
Yes	No	No	Highest voltage battery.
Yes	Yes to either or both		Use all ports. Use the battery or configuration of batteries with the highest individual voltage. If multiple batteries meet this criteria, then use the battery or configuration of batteries with the highest total nameplate battery charge capacity at the highest individual voltage.

3.2.4. 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.

3.2.5. 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 3.3.8 of this appendix. 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 or 1/hr) 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) Conflict 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. If the manufacturer provides a description for accessing the connections at the output of the protective circuitry, these connections shall be used to discharge the battery and measure the discharge energy. The energy consumed by the protective circuitry during discharge shall not be measured or credited as battery energy.

(f) If any of the following conditions specified immediately below in sections 3.2.5.(f)(1) to 3.2.5.(f)(3) are applicable, preventing the measurement of the Battery Discharge Energy and the Charging and Maintenance Mode Energy, a manufacturer must submit a petition for a test procedure waiver in accordance with § 430.27:

(1) Inability to access the battery terminals;

(2) Access to the battery terminals destroys charger functionality; or

(3) Inability to draw current from the test battery.

3.2.6. Determining Charge Capacity for Batteries With No Rating

(a) If there is no rating for the battery charge capacity on the battery or in the instructions, then the technician shall determine a discharge current that meets the following requirements. The battery shall be fully charged and then discharged at this constant-current rate until it reaches the end-of-discharge voltage specified in Table 3.3.2 of this appendix. The discharge time must be not less than 4.5 hours nor more than 5 hours. In addition, the discharge test (section 3.3.8 of this appendix) (which may not be starting with a fully-charged battery) shall reach the end-of-discharge voltage within 5 hours. The same discharge current shall be used for both the preparations step (section 3.3.4 of this appendix) and the discharge test (section 3.3.8 of this appendix). The test report shall include the discharge current used and the resulting discharge times for both a fully-charged battery and for the discharge test.

(b) For this section, the battery is considered as ''fully charged'' when either: it has been charged by the UUT until an indicator on the UUT shows that the charge is complete; or it has been charged by a battery analyzer at a current not greater than the discharge current until the battery analyzer indicates that the battery is fully charged.

(c) When there is no capacity rating, a suitable discharge current must generally be determined by trial and error. Since the conditioning step does not require constant-current discharges, the trials themselves may also be counted as part of battery conditioning.

3.3. Test Measurement

The test sequence to measure the battery charger energy consumption is summarized in Table 3.3.1 of this appendix, and explained in detail in this appendix. Measurements shall be made under test conditions and with the equipment specified in sections 3.1 and 3.2 of this appendix.

TABLE 3.3.1—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 battery chargers only)
1. Record general data on UUT; Section 3.3.1.	Yes	X	X			
2. Determine Maintenance Mode Test duration; Section 3.3.2.	No					
3. Battery conditioning; Section 3.3.3	No	X	X	X		
4. Prepare battery for Active Mode test; Section 3.3.4.	No	X	X			
5. Battery rest period; Section 3.3.5	No	X				X
6. Conduct Active mode Test; Section 3.3.6.	Yes	X	X		X	
7. Battery Rest Period; Section 3.3.7	No	X				X
8. Battery Discharge Energy Test; Section 3.3.8.	Yes	X		X		
9. Conduct Battery Maintenance Mode Test; Section 3.3.9.	Yes	X	X		X	
10. Determine the Maintenance Mode Power; Section 3.3.10.	Yes	X	X		X	
11. Conduct No-Battery Mode Test; Section 3.3.11.	Yes		X		X	
12. Conduct Off Mode Test; Section 3.3.12.	Yes		X		X	
13. Calculating Standby Mode Power; Section 3.3.13.	Yes					

3.3.1. Recording General Data on the UUT

The technician shall record:

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

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

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

(d) The nameplate battery voltage of the test battery;

(e) The nameplate battery charge capacity of the test battery; and

(f) The nameplate battery charge energy of the test battery.

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

3.3.2. Determining the Duration of the Maintenance Mode Test

(a) The maintenance mode test, described in detail in section 3.3.9 of this appendix, shall be 24 hours in length or longer, as determined by the items in sections 3.3.2.(a)(1) to 3.3.2.(a)(3) below. Proceed in order until a test duration is determined. In case when the battery charger does not enter its true battery maintenance mode, the test shall continue until 5 hours after the true battery maintenance mode has been captured.

(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:

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

(b) If none of section 3.3.2.(a) applies, the duration of the test shall be 24 hours.

3.3.3. Battery Conditioning

(a) No conditioning is to be done on lithium-ion batteries. The test technician shall proceed directly to battery preparation, section 3.3.4 of this appendix, when testing chargers for these batteries.

(b) Products with integral batteries will have to be disassembled per the instructions in section 3.2.5 of this appendix, and the battery disconnected from the charger for discharging.

(c) Batteries of other chemistries that have not been previously cycled are to be conditioned by performing two charges and two discharges, followed by a charge, as sections 3.3.3.(c)(1) to 3.3.3.(c)(5) below. No data need be recorded during battery conditioning.

(1) The test battery shall be fully charged for the duration specified in section 3.3.2 of this appendix or longer using the UUT.

(2) The test battery shall then be fully discharged using either:

(i) A battery analyzer at a rate not to exceed 1 C, until its average cell voltage under load reaches the end-of-discharge voltage specified in Table 3.3.2 of this appendix for the relevant battery chemistry; or

(ii) The UUT, until the UUT ceases operation due to low battery voltage.

(3) The test battery shall again be fully charged per step in section 3.3.3(c)(1) of this appendix.

(4) The test battery shall again be fully discharged per step in section 3.3.3(c)(2) of this appendix.

(5) The test battery shall be again fully charged per step in section 3.3.3(c)(1) of this appendix.

(d) Batteries of chemistries, other than lithium-ion, that are known to have been through at least two previous full charge/discharge cycles shall only be charged once per step in section 3.3.3(c)(5) of this appendix.

3.3.4. Preparing the Battery for Charge Testing

Following any conditioning prior to beginning the battery charge test (section 3.3.6 of this appendix), the test battery shall be fully discharged to the end of discharge voltage prescribed in Table 3.3.2 of this appendix, or until the UUT circuitry terminates the discharge.

3.3.5. Resting the Battery

The test battery shall be rested between preparation and the battery charge 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 30 °C before charging, even if the rest period must be extended longer than 24 hours.

3.3.6. Testing Active Mode

(a) The Active Mode test measures the energy consumed by the battery charger as it delivers current, equalizes the cells, and performing other one-time or limited-time functions in order to bring the battery to a fully charged state. 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 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. The total energy is 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 the user-controllable device functionality not associated with battery charging and any battery conditioning cycle or setting are turned off, as instructed in section 3.2.4 of this appendix;

(2) Ensure that the test battery used in this test has been conditioned, prepared, discharged, and rested as described in sections 3.3.3 through 3.3.5 of this appendix;

(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 minute 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 and power (W) of the input current to the UUT;

(7) Record the input power until the battery is fully charged. If the battery charger has an indicator to show that the battery is fully charged, that indicator will be used to terminate the active mode test. If there is no indicator but the manufacturer's instructions indicate how long it should take to charge the test battery, the test active mode test shall be run for the longest estimated charge time. If the battery charger does not have such an indicator and manufacturer's instructions do not provide such a time estimate, the length of the active mode test will be 1.4 times the rated charge capacity of the battery divided by the maximum charge current; and

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

(9) The accumulated energy or the average input power, integrated over the active mode test period (*i.e.* when the depleted test battery is initially connected to the charger up until the battery is fully charged) shall be the active mode energy consumption of the battery charger, E_a.

3.3.7. Resting the Battery

The test battery shall be rested between charging and discharging. The rest period shall be at least 1 hour and not more than 4 hours, with an exception for flooded cells. For batteries with flooded cells, the electrolyte temperature shall be less than 30 °C before charging, even if the rest period must be extended beyond 4 hours.

3.3.8. Battery Discharge Energy Test

(a) If multiple batteries were charged simultaneously, the discharge energy (E_{batt}) 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 prescribed in sections 3.3.6 and 3.3.7 of this appendix.

(2) Set the battery analyzer for a constant discharge rate and the end-of-discharge voltage in Table 3.3.2 of this appendix 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 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.

TABLE 3.3.2—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-ion Polymer	0.2	2.5
Lithium Iron Phosphate	0.2	2.0
Rechargeable Alkaline	0.2	0.9
Silver Zinc	0.2	1.2

* If the presence of protective circuitry prevents the battery cells from being discharged to the end-of-discharge voltage specified, then discharge battery cells to the lowest possible voltage permitted by the protective circuitry.

3.3.9. Maintenance Mode Energy Consumption Measurement

(a) The Charge and Battery Maintenance Mode test measures the average power consumed 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. The total energy is 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 the user-controllable device functionality not associated with battery charging and any battery conditioning cycle or setting are turned off, as instructed in section 3.2.4 of this appendix;

(2) Ensure that the test battery used in this test has been conditioned, prepared, discharged, and rested as described in sections 3.3.3. through 3.3.5. of this appendix;

(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 and power (W) 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 ''Maintenance Mode Test'' period, as determined by section 3.3.2. of this appendix. The actual time that power is connected to the UUT shall be within ±5 minutes of the specified period; and

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

3.3.10. Determining the Maintenance Mode Power

After the measurement period is complete, the technician shall determine the average maintenance mode power consumption (P_m) by examining the power-versus-time data from the charge and maintenance mode test and:

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

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

3.3.11. No-Battery Mode Energy Consumption Measurement

The no-battery mode measurement depends on the configuration of the battery charger, as follows:

(a) Conduct a measurement of no-battery 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 no-battery mode test.

(b) No-battery mode may also apply to products with integral batteries, as follows:

(1) 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 no-battery mode power consumption will equal that of the cradle and/or adapter alone.

(2) If the product is powered through a detachable AC power cord and contains integrated power conversion and charging circuitry, then only the cord will remain connected to mains, and no-battery mode power consumption will equal that of the AC power cord (*i.e.,* zero watts).

(3) 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 no-battery mode measurement is not applicable.

3.3.12. Off Mode Energy Consumption Measurement

The off mode measurement depends on the configuration of the battery charger, as follows:

(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, as follows:

(1) 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.

(2) If the product is powered through a detachable AC power cord and contains integrated power conversion and charging circuitry, 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).

(3) 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.

3.3.13. Standby Mode Power

The standby mode power (P_{sb}) is the summation power of battery maintenance mode power (P_m) and no-battery mode power (P_{nb}).

4. Testing Requirements for Uninterruptible Power Supplies

4.1. Standard Test Conditions

4.1.1. Measuring Equipment

(a) The power or energy meter must provide true root mean square (r.m.s) measurements of the active input and output measurements, with an uncertainty at full rated load of less than or equal to 0.5% at the 95% confidence level notwithstanding that voltage and current waveforms can include harmonic components. The meter must measure input and output values simultaneously.

(b) All measurement equipment used to conduct the tests must be calibrated within the measurement equipment manufacturer specified calibration period by a standard traceable to International System of Units such that measurements meet the uncertainty requirements specified in section 4.1.1(a) of this appendix.

4.1.2. Test Room Requirements

All portions of the test must be carried out in a room with an air speed immediately surrounding the UUT of ≤0.5 m/s in all directions. Maintain the ambient temperature in the range of 20.0 °C to 30.0 °C, including all inaccuracies and uncertainties introduced by the temperature measurement equipment, throughout the test. No intentional cooling of the UUT, such as by use of separately powered fans, air conditioners, or heat sinks, is permitted. Test the UUT on a thermally non-conductive surface.

4.1.3. Input Voltage and Input Frequency

The AC input voltage and frequency to the UPS during testing must be within 3 percent of the highest rated voltage and within 1 percent of the highest rated frequency of the device.

4.2. Unit Under Test Setup Requirements

4.2.1. General Setup

Configure the UPS according to Annex J.2 of IEC 62040–3 Ed. 2.0 with the following additional requirements:

(a) UPS Operating Mode Conditions. If the UPS can operate in two or more distinct normal modes as more than one UPS architecture, conduct the test in its lowest input dependency as well as in its highest input dependency mode where VFD represents the lowest possible input dependency, followed by VI and then VFI.

(b) Energy Storage System. The UPS must not be modified or adjusted to disable energy storage charging features. Minimize the transfer of energy to and from the energy storage system by ensuring the energy storage system is fully charged (at the start of testing) as follows:

(1) If the UUT has a battery charge indicator, charge the battery for 5 hours after the UUT has indicated that it is fully charged.

(2) If the UUT does not have a battery charge indicator but the user manual shipped with the UUT specifies a time to reach full charge, charge the battery for 5 hours longer than the time specified.

(3) If the UUT does not have a battery charge indicator or user manual instructions, charge the battery for 24 hours.

(c) DC output port(s). All DC output port(s) of the UUT must remain unloaded during testing.

4.2.2. Additional Features

(a) Any feature unrelated to maintaining the energy storage system at full charge or delivery of load power (*e.g.,* LCD display) shall be switched off. If it is not possible to switch such features off, they shall be set to their lowest power-consuming mode during the test.

(b) If the UPS takes any physically separate connectors or cables not required for maintaining the energy storage system at full charge or delivery of load power but associated with other features (such as serial or USB connections, Ethernet, etc.), these connectors or cables shall be left disconnected during the test.

(c) Any manual on-off switches specifically associated with maintaining the energy storage system at full charge or delivery of load power shall be switched on for the duration of the test.

4.3. Test Measurement and Calculation

Efficiency can be calculated from either average power or accumulated energy.

4.3.1. Average Power Calculations

If efficiency calculation are to be made using average power, calculate the average power consumption (Pavg) by sampling the power at a rate of at least 1 sample per second and computing the arithmetic mean of all samples over the time period specified for each test as follows:

$$P_{avg} = \frac{1}{n}\sum_{i=1}^{n} P_i$$

Where:

P_{avg} = average power

P_i = power measured during individual measurement (i)

n = total number of measurements

4.3.2. Steady State

Operate the UUT and the load for a sufficient length of time to reach steady state conditions. To determine if steady state conditions have been attained, perform the following steady state check, in which the difference between the two efficiency calculations must be less than 1 percent:

(a)(1) Simultaneously measure the UUT's input and output power for at least 5 minutes, as specified in section 4.3.1 of this appendix, and record the average of each over the duration as P_{avg_in} and P_{avg_out}, respectively; or,

(2) Simultaneously measure the UUT's input and output energy for at least 5 minutes and record the accumulation of each over the duration as E_{in} and E_{out}, respectively.

(b) Calculate the UUT's efficiency, Eff_1, using one of the following two equations:

(1)

$$Eff = \frac{P_{avg\_out}}{P_{avg\_in}}$$

Where:

Eff is the UUT efficiency

P_{avg_out} is the average output power in watts

P_{avg_in} is the average input power in watts

(2)

$$Eff = \frac{E_{out}}{E_{in}}$$

Where:

Eff is the UUT efficiency

E_{out} is the accumulated output energy in watt-hours

E_{in} in the accumulated input energy in watt-hours

(c) Wait a minimum of 10 minutes.

(d) Repeat the steps listed in paragraphs (a) and (b) of section 4.3.2 of this appendix to calculate another efficiency value, Eff_2.

(e) Determine if the product is at steady state using the following equation:

$$Percentage\ difference = \frac{|Eff_1 - Eff_2|}{Average(Eff_1, Eff_2)}$$

If the percentage difference of Eff_1 and Eff_2 as described in the equation, is less than 1 percent, the product is at steady state.

(f) If the percentage difference is greater than or equal to 1 percent, the product is not at steady state. Repeat the steps listed in paragraphs (c) to (e) of section 4.3.2 of this appendix until the product is at steady state.

4.3.3. Power Measurements and Efficiency Calculations

Measure input and output power of the UUT according to Section J.3 of Annex J of IEC 62040–3 Ed. 2.0, or measure the input and output energy of the UUT for efficiency calculations with the following exceptions:

(a) Test the UUT at the following reference test load conditions, in the following order: 100 percent, 75 percent, 50 percent, and 25 percent of the rated output power.

(b) Perform the test at each of the reference test loads by simultaneously measuring the UUT's input and output power in Watts (W), or input and output energy in Watt-Hours (Wh) over a 15 minute test period at a rate of at least 1 Hz. Calculate the efficiency for that reference load using one of the following two equations:

(1)

$$Eff_{n\%} = \frac{P_{avg\_out\ n\%}}{P_{avg\_in\ n\%}}$$

Where:

$Eff_{n\neq}$ = the efficiency at reference test load n%

$P_{avg\_out\ n\neq}$ = the average output power at reference load n%

$P_{avg\_in\ n\neq}$ = the average input power at reference load n%

(2)

$$Eff_{n\%} = \frac{E_{out\ n\%}}{E_{in\ n\%}}$$

Where:

$Eff_{n\neq}$ = the efficiency at reference test load n%

$E_{out\ n\neq}$ = the accumulated output energy at reference load n%

$E_{in\ n\neq}$ = the accumulated input energy at reference load n%

4.3.4. UUT Classification

Optional Test for determination of UPS architecture. Determine the UPS architecture by performing the tests specified in the definitions of VI, VFD, and VFI (sections 2.28.1 through 2.28.3 of this appendix).

4.3.5. Output Efficiency Calculation

(a) Use the load weightings from Table 4.3.1 to determine the average load adjusted efficiency as follows:

$Eff_{avg} = (t_{25\%}) \times Eff|_{25\%}) + (t_{50\%} \times Eff|_{50\%}) + t_{75\%} \times Eff|_{75\%}) + (t_{100\%} \times Eff|_{100\%})$

Where:

Eff_{avg} = the average load adjusted efficiency

$t_{n\neq}$ = the portion of time spent at reference test load n% as specified in Table 4.3.1

$Eff|_{n\%}$ = the measured efficiency at reference test load n%

TABLE 4.3.1—LOAD WEIGHTINGS

Rated output power (W)	UPS Architecture	Portion of time spent at reference load			
		25%	50%	75%	100%
P ≤1500 W	VFD VI or VFI	0.2	0.2	0.3	0.3
		* 0	0.3	0.4	0.3
P >1500 W	VFD, VI, or VFI	* 0	0.3	0.4	0.3

* Measuring efficiency at loading points with 0 time weighting is not required.

(b) Round the calculated efficiency value to one tenth of a percentage point.

5. Testing Requirements for Open-Placement Wireless Chargers

5.1. Standard Test Conditions and UUT Setup Requirements

The technician will set up the testing environment according to the test conditions as specified in sections 3.1.2, 3.1.3, and 3.1.4 of this appendix. The unit under test will be configurated according to section 3.2.1 and all other non-battery charger related functions will be turned off according to section 3.2.4.

5.2. Active Mode Test

[Reserved]

5.3. No-battery Mode Test

(a) Connect the UUT to mains power and place it in no-battery mode by ensuring there are no foreign objects on the charging surface (*i.e.,* without any load).

(b) Monitor the AC input power for a period of 5 minutes to assess the stability of the UUT. If the power level does not drift by more than 1% from the maximum value observed, the UUT is considered stable.

(c) If the AC input power is not stable, follow the specifications in section 5.3.3. of IEC 62301 for measuring average power or accumulated energy over time for the input. If the UUT is stable, record the measurements of the AC input power over a 5-minute period.

(d) Power consumption calculation. The power consumption of the no-battery mode is equal to the active AC input power (W).

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