DEPARTMENT OF ENERGY

10 CFR Part 430

[EERE–2019–BT–TP–0012]

RIN 1904–AD86

Energy Conservation Program: Test Procedure for External Power Supplies

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

ACTION: Final rule.

SUMMARY: This final rule amends the current U.S. Department of Energy test procedure for external power supplies by clarifying the scope of the test procedure more explicitly, providing more specific instructions for testing single-voltage external power supplies with multiple-output busses and external power supplies shipped without an output cord, providing instructions allowing for functionality unrelated to the external power supply circuit to be disconnected during testing so long as the disconnection does not impact the functionality of the external power supply itself, specifying test requirements for adaptive external power supplies that conform to the industry-based Universal Serial Bus Power Delivery specifications consistent with current test procedure waivers that DOE has already granted for these products, and reorganizing the test procedure to centralize definitions, consolidate generally applicable requirements, and better delineate requirements for single-voltage, multiple-voltage, and adaptive external power supplies.

DATES: The effective date of this rule is September 19, 2022. The final rule changes will be mandatory for product testing starting February 15, 2023. The incorporation by reference of certain other publications listed in this rule was approved by the Director of the Federal Register on September 24, 2015.

ADDRESSES: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, 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.

A link to the docket web page can be found at *www.regulations.gov/docket?D=EERE-2019-BT-TP-0012*. The docket web page contains instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact the Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

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SUPPLEMENTARY INFORMATION:

Table of Contents

I. Authority and Background

An external power supply (''EPS'') is a ''covered product'' for which the United States Department of Energy (''DOE'') is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6295(u)(1)(A)) DOE's energy conservation standards and test procedures for EPSs are currently prescribed at 10 CFR 430.32(w) and 10 CFR 430.23(bb), respectively. The following sections discuss DOE's authority to establish test procedures for EPSs 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. These products include EPSs, the subject of this document. (42 U.S.C. 6291(36)(A); 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

[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), which reflect the last statutory amendments that impact Parts A and A–1 of EPCA.

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

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 under EPCA (42 U.S.C. 6295(s)), and (2) making other representations about the efficiency of those products (42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to determine whether the products comply with any 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 shall 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 (as determined by the Secretary) or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

The Energy Policy Act of 2005 (''EPACT 2005''), Public Law 109–58 (Aug. 8, 2005), amended EPCA by adding provisions related to EPSs. Among these provisions were a definition of EPS and a requirement that DOE prescribe ''definitions and test procedures for the power use of battery chargers and external power supplies.'' (42 U.S.C. 6295(u)(1)(A)) DOE complied with this requirement by publishing a test procedure final rule to address the testing of EPSs to measure their energy efficiency and power consumption. 71 FR 71340 (Dec. 8, 2006) (codified at 10 CFR part 430, subpart B, appendix Z, ''Uniform Test Method for Measuring the Energy Consumption of External Power Supplies'').

The Energy Independence and Security Act of 2007 (''EISA 2007''), Public Law 110–140 (Dec. 19, 2007) later amended EPCA by modifying the EPS-related definitions found in 42 U.S.C. 6291. While section 135(a)(3) of EPACT 2005 had defined an EPS as ''an external power supply circuit that is used to convert household electric current into DC current or lower-voltage AC current to operate a consumer product,'' section 301 of EISA 2007 amended this definition further by creating a subset of EPSs called Class A EPSs. EISA 2007 defined this subset of products as those EPSs that, in addition to meeting several other requirements common to all EPSs, are ''able to convert [line voltage AC] to only 1 AC or DC output voltage at a time'' and have ''nameplate output power that is less than or equal to 250 watts.'' (42 U.S.C. 6291(36)(C)(i)) As part of these amendments, EISA 2007 prescribed minimum standards for these products (hereafter referred to as ''Level IV'' standards based on ENERGY STAR marking provisions detailed under 42 U.S.C. 6295(u)(3)(C)) and directed DOE to publish a final rule to determine whether to amend these standards.[3] (42 U.S.C. 6295(u)(3)(A) and (D)) EISA 2007 also required DOE to publish a second rule to determine whether the standards then in effect should be amended. (42 U.S.C. 6295(u)(3)(D)(ii))

EISA 2007 also amended EPCA by defining the terms ''active mode,'' ''standby mode,'' and ''off mode.'' 42 U.S.C. 6295(gg)(1)(A) EISA 2007 additionally authorized DOE to amend, by rule, the definitions for active, standby, and off mode, taking into consideration the most current versions of International Electrotechnical Commission (''IEC'') Standard 62301[4] and IEC Standard 62087.[5] 42 U.S.C. 6295(gg)(1)(B) EISA 2007 also amended EPCA to require that DOE amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already incorporates the standby mode and off mode energy consumption, or if such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)(A)) If an integrated test procedure is technically infeasible, DOE must prescribe separate standby mode and off mode energy use test procedures for the covered product, if a separate test is technically feasible. (*Id.*)

Following the amendments to EPCA under EISA 2007, Congress further amended EPCA to exclude EPSs used for certain security and life safety alarms and surveillance systems manufactured prior to July 1, 2017, from no-load standards. Public Law 111–360 (January 4, 2011). EPCA's EPS provisions were again amended by the Power and Security Systems (''PASS'') Act, which extended the rulemaking deadline and effective date established under the EISA 2007 amendments from July 1, 2015, and July 1, 2017, to July 1, 2021, and July 1, 2023, respectively. Public Law 115–78 (November 2, 2017); 131 Stat. 1256, 1256; 42 U.S.C. 6295(u)(3)(D)(ii)). The PASS Act also extended the exclusion of certain security and life safety alarms and surveillance systems from no-load standards until the effective date of the final rule issued under 42 U.S.C. 6295(u)(3)(D)(ii) and allows the Secretary to treat some or all EPSs designed to be connected to a security or life safety alarm or surveillance system as a separate product class or to further extend the exclusion. (42 U.S.C. 6295(u)(3)(E)(ii) and (iv))

Most recently, on January 12, 2018, the EPS Improvement Act of 2017, Public Law 115–115, amended EPCA to exclude the following devices from the EPS definition: power supply circuits, drivers, or devices that are designed exclusively to be connected to, and power (1) light-emitting diodes providing illumination, (2) organic light-emitting diodes providing illumination, or (3) ceiling fans using direct current motors.[6] (42 U.S.C. 6291(36)(A)(ii))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including EPSs, 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

[3] The international efficiency markings on which DOE's marking requirements are based consist of a series of Roman numerals (I–VI) and provide a global uniform system for power supply manufacturers to use that indicates compliance with a specified minimum energy performance standard. *www.regulations.gov/document?D=EERE-2008-BT-STD-0005-0218.*

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

[5] IEC 62087, *Audio, video and related equipment—Methods of measurement for power consumption* (Edition 1.0, Parts 1–6: 2015, Part 7: 2018).

[6] DOE amended its regulations to reflect the changes introduced by the PASS Act and EPS Improvement Act. 84 FR 437 (January 29, 2019).

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. The comment period on a proposed rule to amend a test procedure shall be at least 60 days and may not exceed 270 days in total. 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. (42 U.S.C. 6293(b)(2)). 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 final rule in satisfaction of the 7-year review requirement specified in EPCA. (42 U.S.C. 6293(b)(1)(A))

B. Background

DOE's existing test procedure for EPSs appear at 10 CFR part 430, subpart B, appendix Z, ''Uniform Test Method for Measuring the Energy Consumption of External Power Supplies'' (''appendix Z''). DOE most recently amended the test procedure for EPS in a final rule published on August 25, 2015 (the ''August 2015 Final Rule''). 80 FR 51424. The August 2015 Final Rule provided additional detail to appendix Z in response to comments received from industry regarding the testing of certain EPSs. 80 FR 51424, 51429–51433. DOE also updated references to the latest version of IEC 62301, ''Household electrical appliances—Measurement of standby power,'' Edition 2.0, 2011–01, and clarified its test procedure to better reflect evolving technologies. 80 FR 51424, 51431–51433, 51440.

Since the publication of the August 2015 Final Rule, DOE received a number of requests seeking waivers from the DOE test procedure involving certain EPS products. On June 8, 2017, and June 22, 2017, the Information Technology Industry Council (''ITI,'') on behalf of four petitioners—Apple, Inc. (''Apple,'') Microsoft Corporation (''Microsoft,'') Poin2 Lab (''Poin2,'') and Hefei Bitland Information Technology Co., Ltd. (''Bitland'')—filed petitions for waivers from the current DOE test procedure for EPSs under 10 CFR 430.27 for several basic models of adaptive EPSs that meet the voltage and current specifications of IEC Standard 62680–1–2 ''Universal serial bus interfaces for data and power—Part 1–2: Common components—USB Power Delivery'' (''IEC 62680–1–2''). (Hereafter, these devices are referred to as ''USB–PD'' EPSs.) IEC 62680–1–2 specifies the relevant performance and compatibility-related specifications for a universal serial bus (''USB'') system but does not, like some other IEC documents, prescribe any specific testing requirements. An adaptive EPS is one with an output bus that can alter its output voltage based on an established digital communication protocol with the end-use application without any user-generated action. In a notice published on July 24, 2017, DOE granted the petitions for interim waiver and specified an alternate test procedure the manufacturers were required to follow when testing and certifying the specific basic models for which the petitioners requested a waiver. 82 FR 34294. On March 16, 2018, DOE published a notice of decision and order announcing that it had granted the petitioners a waiver from the EPS test procedure for certain adaptive EPSs. 83 FR 11738. The decision and order required the petitioners to test and certify these models according to the alternate test procedure presented in the decision and order. *Id.* at 83 FR 11740. Subsequently, DOE published a series of decision and order notices granting the same alternate test procedure waiver to Huawei Technologies (83 FR 25448 (June 1, 2018)), Apple for two additional basic models (83 FR 50905 (October 10, 2018) and 83 FR 60830 (November 27, 2018)), and Anker (84 FR 59365 (November 4, 2019)) (Case Nos. 2017–014, 2018–005, 2018–010, 2019–005, respectively.)

On December 6, 2019, DOE published a notice of proposed rulemaking (''NOPR'') (the ''December 2019 NOPR''), in which it proposed to amend the test procedure for EPSs as follows: (1) adopt a definition of ''commercial and industrial power supply'' that would apply specific characteristics to help distinguish these power supplies from EPSs, as defined in EPCA, which are consumer products under the statute; (2) amend the definition of ''external power supply'' to expressly exclude any ''commercial and industrial power supply'' from the scope of the test procedure; (3) create a definition for USB–PD EPSs and amend their testing requirements, consistent with the issued waivers; (4) provide additional direction for testing single-voltage EPSs with multiple-output busses; (5) provide instructions to allow any functionality that is unrelated to the external power supply circuit to be disconnected during testing as long as the disconnection does not impact the functionality of the external power supply itself; and (6) reorganize the test procedure to remove redundant definitions, modify the definition of ''average active-mode efficiency,'' centralize definitions, consolidate generally applicable requirements, and better delineate requirements for single-voltage, multiple-voltage, and adaptive EPSs. 84 FR 67106, 67109. DOE held a public meeting on December 11, 2019, via a webinar to present the proposed amendments and provide stakeholders with further opportunity to comment.[7]

DOE received comments in response to the December 2019 NOPR from the interested parties listed in Table I.1.

TABLE I.1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE DECEMBER 2019 NOPR

Commenter(s)	Reference in this Final Rule	Docket No.	Commenter type
USB Implementers Forum	USB–IF	6	Trade Association.
Canadian Standards Association	CSA	8, 9	Efficiency Organization.
Pacific Gas and Electric, Southern California Edison, San Diego Gas and Electric; collectively, the California Investor-Owned Utilities.	CA IOUs	10	Utility Association.
Consumer Technology Association	CTA	11	Trade Association.

[7] The transcript of the public meeting is available at *www.regulations.gov/document?D=EERE-2019-BT-TP-0012-0004.*

TABLE I.1—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE DECEMBER 2019 NOPR—Continued

Commenter(s)	Reference in this Final Rule	Docket No.	Commenter type
National Electrical Manufacturers Association, American Lighting Association.	NEMA/ALA	12	Trade Association.
Information Technology Industry Council	ITI	13	Trade Association.

DOE subsequently issued a supplemental notice of proposed rulemaking (''SNOPR'') (the ''November 2021 SNOPR'') on November 2, 2021, to supplement (or, in certain instances, replace) the proposed amendments from the December 2019 NOPR with amendments that would provide as follows: (1) remove reference in the scope section of appendix Z to direct operation and indirect operation Class A EPSs because there is no distinction in how these EPSs are tested; (2) align the test procedure with the scope of the energy conservation standards set forth at 10 CFR 430.32(w)(1) more explicitly by excluding from testing devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product; (3) specify testing requirements for EPSs that are packaged without an output cord to provide explicitly that these EPSs are tested with an output cord that is recommended for use by the manufacturer; (4) modify the proposal from the December 2019 NOPR to define ''USB–PD'' EPS so as to include programmable power supplies (''PPSs'') and USB–PD EPSs with optional voltages and currents; and amend the definition of ''nameplate output power'' further to specify that USB–PD EPSs must be tested at the lowest nameplate output voltage, which can be as low as 3.3 volts for PPSs, rather than at 5 volts (as was proposed in the December 2019 NOPR); and (5) modify the December 2019 NOPR's proposal to no longer propose relocating the definitions of ''Class A external power supply,'' ''basic-voltage external power supply,'' ''direct operation external power supply,'' ''indirect operation external power supply,'' and ''low-voltage external power supply'' at 10 CFR 430.2 rather than include them in appendix Z. 86 FR 60376, 60379. DOE held a public meeting on December 13, 2021, via a webinar to present the proposed amendments in the November 2021 SNOPR and provide stakeholders with further opportunity to comment.[8]

DOE received comments in response to the November 2021 SNOPR from the interested parties listed in Table I.2.

TABLE I.2—LIST OF COMMENTERS WITH WRITTEN SUBMISSIONS IN RESPONSE TO THE NOVEMBER 2021 SNOPR

Commenter(s)	Reference in this Final Rule	Docket No.	Commenter type
Aohai	Aohai	18	Manufacturer
Association of Home Appliance Manufacturers, Consumer Technology Association, Outdoor Power Equipment Institute, Plumbing Manufacturers Institute, Power Tool Institute.	AHAM/CTA/OPEI/PMI/PTI	26	Trade Association.
Information Technology Industry Council	ITI	22	Trade Association.
National Electrical Manufacturers Association	NEMA	24	Trade Association.
Northwest Energy Efficiency Alliance, Appliance Standards Awareness Project, Natural Resources Defense Council.	NEEA/ASAP/NRDC	27	Efficiency Organization.
Pacific Gas and Electric, Southern California Edison, San Diego Gas and Electric; collectively, the California Investor-Owned Utilities.	CA IOUs	25	Utility Association.

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[9]

II. Synopsis of the Final Rule

This final rule amends the current EPS test procedure as follows:

(1) Adopts a definition of ''commercial and industrial power supply'' that would apply specific characteristics to help distinguish these power supplies from EPSs, as defined in EPCA; and amends the definition of ''external power supply'' to expressly exclude any ''commercial and industrial power supply.''

(2) Deletes the specific reference to direct operation EPSs and indirect operation Class A EPSs from the ''Scope'' section of the test procedure.

(3) Specifies explicitly that devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product are not subject to the test procedure.

(4) Provides additional direction for testing single-voltage EPSs with multiple-output busses and multiple-voltage adaptive EPSs.

(5) Provides instructions that functionality unrelated to the external power supply circuit is disconnected during testing so long as the disconnection does not impact the functionality of the external power supply itself.

(6) Specifies test provisions for adaptive EPSs that meet the voltage and current specifications of IEC 62680–1–2, consistent with current waivers granted to these products; defines ''USB–PD EPS'' in appendix Z; and revises the definition of nameplate output power to better accommodate such products.

(7) Requires EPSs that are not supplied with an output cord to be tested with an output cord recommended for use by the manufacturer.

(8) Improves overall readability of the test procedure by adding a new section 0 in appendix Z to specify applicable

[8] The transcript of the public meeting is available at *www.regulations.gov/document?D=EERE-2019-BT-TP-0012-0023.*

[9] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for EPSs. (Docket No. EERE–2019–BT–TP–0012, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document).

sections of industry standard incorporated by reference; reorganizing the test procedure to remove redundant definitions; modifying the definition of ''average active-mode efficiency;'' centralizing definitions; consolidating generally applicable requirements; and better delineating requirements for single-voltage, multiple-voltage, and adaptive EPSs.

The adopted amendments are summarized and compared to the test procedure provisions prior to these amendments in Table II.1 of this document. Both the history of the adopted amendments over the course of the rulemaking process and the reason for the changes are also summarized in Table II.1.

TABLE II.1—SUMMARY OF CHANGES IN THE AMENDED TEST PROCEDURE

Current DOE test procedure	December 2019 NOPR	November 2021 SNOPR	Amended test procedure	Attribution
Defines EPS as a power supply circuit used to convert household electric current into DC current or lower-voltage AC current to operate a consumer product.	Proposed to define a ''commercial and industrial power supply'' that would apply specific characteristics to distinguish these power supplies from EPSs; and amend the definition of ''external power supply'' to expressly exclude any ''commercial and industrial power supply.''.	Proposed to maintain the current definition of an EPS and instead use the proposed definition of a ''commercial and industrial power supply'' to exclude such products from the scope of appendix Z.	Defines a ''commercial and industrial power supply'' that will apply specific characteristics to distinguish these power supplies from EPSs; amends the definition of ''external power supply'' to expressly exclude any ''commercial and industrial power supply.'' 10 CFR 430.2.	Better define scope of test procedure in response to stakeholder inquiries.
Requires adaptive EPSs that meet the IEC 62680–1–2 specification to test at 3 amps for the 100% loading condition at the lowest operating output voltage of 5 volts.	Proposed to define an adaptive EPS that meets the voltage/current specifications of IEC 62680–1–2 as a ''USB–PD EPS'' and require that it be tested at 2 amps for the 100% loading condition at the lowest operating output voltage of 5 volts. Also proposed to define a USB Type-C connector.	Proposed to define an adaptive EPS that meets the voltage/current specifications of IEC 62680–1–2 as a ''USB–PD EPS'' and require that it be tested at 2 amps for the 100% loading condition at the lowest operating output voltage, which can be as low as 3.3 volts. Also proposed to define a USB Type-C connector.	Defines an adaptive EPS that meets the voltage/current specifications of IEC 62680–1–2 as a ''USB–PD EPS'' and requires that it be tested at 2 amps for the 100% loading condition at the lowest operating output voltage, which can be as low as 3.3 volts. Also defines a USB Type-C connector. 10 CFR part 430, subpart B, appendix Z, sec. 3, 6(a)(1)(iii)B, 6(b)(1)(iii)B.	Address waivers for adaptive EPSs and update to industry test standard.
Adaptive EPS instructions are currently a subsection within the single-voltage EPS testing instructions in section 4(a)(i)(E) of appendix Z.	Proposed to move instructions for non-adaptive EPSs to section 5 of appendix Z and add a new section 6 for testing all adaptive EPSs, with two sub-sections for single-voltage and multiple-voltage adaptive EPSs.	Not supplemented	Moves instructions for non-adaptive EPSs to section 5 of appendix Z and adds a new section 6 for testing all adaptive EPSs, with two sub-sections for single-voltage and multiple-voltage adaptive EPSs. 10 CFR part 430, subpart B, appendix Z, sec. 6.	Address waivers for adaptive EPSs, address stakeholder inquiries, and improve the readability of the test procedure.
Does not explicitly provide instructions for testing single-voltage EPSs with multiple-output busses.	Proposed to provide explicit instructions for testing single-voltage EPSs with multiple-output busses.	Not supplemented	Provides explicit instructions for testing single-voltage EPSs with multiple-output busses. 10 CFR part 430, subpart B, appendix Z, sec. 5(a)(1)(iv).	Address innovation in the marketplace and stakeholder inquiries.
Does not provide instructions for allowing functions unrelated to the external power supply circuit to be disconnected during testing.	Proposed to provide explicit instructions for disconnecting non-EPS functions during testing.	Not supplemented	Provides explicit instructions for disconnecting non-EPS functions during testing. 10 CFR part 430, subpart B, appendix Z, sec. 4(i).	Improve reproducibility of test results.
Does not explicitly exclude devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product.	Not discussed	Proposed to exclude devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product.	Excludes devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product. 10 CFR part 430, subpart B, appendix Z, sec. 2.	Address stakeholder inquiries.

TABLE II.1—SUMMARY OF CHANGES IN THE AMENDED TEST PROCEDURE—Continued

Current DOE test procedure	December 2019 NOPR	November 2021 SNOPR	Amended test procedure	Attribution
Does not explicitly provide instructions for testing EPSs that are not supplied with output cords.	Not discussed	Proposed to require EPSs that are not supplied with an output cord to test with an output cord recommended for use by the manufacturer.	Requires EPSs that are not supplied with an output cord to test with an output cord. 10 CFR part 430, subpart B, appendix Z, sec. 4(g).	Improve representativeness of the test procedure.
Defines ''nameplate output power'' as the value on the product's nameplate or manufacturer's documentation.	Proposed to redefine ''nameplate output power'' to provide an exception for USB–PD EPSs, which are tested at 10W. The exception permits adaptive EPSs meeting this specification to be tested using the same 10W level.	Proposed to further amend the definition of ''nameplate output power'' to specify that USB–PD EPSs must be tested at the lowest nameplate output voltage, which can be as low as 3.3 volts for PPSs, rather than at 5 volts.	Amends the definition of ''nameplate output power'' to specify that USB–PD EPSs must be tested at the lowest nameplate output voltage, which can be as low as 3.3 volts for PPSs, rather than at 5 volts. 10 CFR part 430, subpart B, appendix Z, sec. 3.	Address adaptive EPS waivers and stakeholder comments.
Contains redundant definitions that had been carried over from previous revisions of the test procedure but are no longer referenced.	Proposed to remove redundant definitions that are no longer referenced.	Not supplemented	Removes redundant definitions that are no longer referenced. 10 CFR part 430, subpart B, secs. 2e., h., l., m.,y.	Improve ease of reference and readability.
Numerous EPS related definitions are spread across multiple locations in the CFR.	Proposed to consolidate all EPS related definitions in appendix Z.	Proposed to retain all EPS related definitions at 10 CFR 430.2 except ''adaptive external power supply''.	Retains all EPS related definitions at 10 CFR 430.2 except ''adaptive external power supply''. 10 CFR part 430, subpart B, appendix Z, sec. 3.	Improve readability and applicability of the test procedure.
Does not include the definition of Class A EPSs in appendix Z.	Proposed to include the Class A EPS definition in appendix Z.	Proposed to retain the Class A EPS definition in 10 CFR 430.2 only and not include it in appendix Z.	Retains the Class A EPS definition in 10 CFR 430.2 only and not include it in appendix Z. 10 CFR 430.2.	Improve readability and applicability of the test procedure.
Defines ''average active-mode efficiency'' as the average of the loading conditions for which a unit can sustain output current.	Proposed to redefine ''average active-mode efficiency'' to explicitly reference the average of the active mode efficiencies measured at the loading conditions for which a unit can sustain output current.	Not supplemented	Redefines ''average active-mode efficiency'' to explicitly reference the average of the active mode efficiencies measured at the loading conditions for which a unit can sustain output current. 10 CFR part 430, subpart B, appendix Z, sec. 3.	Improve readability of the test procedure.
Contains repetitive instructions across multiple sections on uncertainty and resolution requirements for power measurements, room air speed and temperature conditions, input voltage source, product configuration, and wire gauge requirements for leads.	Proposed to consolidate these requirements that are applicable to all EPSs into a single section within appendix Z.	Not supplemented	Consolidates these requirements that are applicable to all EPSs into a single section within appendix Z. 10 CFR part 430, subpart B, appendix Z, sec. 4.	Improve readability of the test procedure.
Incorporates by reference IEC 62301 Ed. 2.0 in its entirety.	Proposed to specify sections of IEC 62301, applicable to the test procedure and to update the shorthand notation.	Not supplemented	Creates a new section 1 in appendix Z to note the particular sections from IEC 62301 that are applicable to appendix Z. 10 CFR part 430, subpart B, appendix Z, sec. 1.	Improve readability.

To the extent that DOE has determined that the amendments adopted in this final rule would impact the measured energy efficiency of an EPS, DOE notes in section III.H of this document that testing according to such amendments will not be required until such time as compliance is required with new and amended energy conservation standards, should such standards be established or amended. DOE has also determined that the amendments would not be unduly burdensome to conduct. Discussion of DOE's actions are addressed in detail in section III of this document.

The effective date for the amended test procedure adopted in this final rule is 30 days after publication of this document in the **Federal Register**. Representations of energy use or energy efficiency must be based on testing in accordance with the amended test procedures beginning 180 days after the publication of this final rule.

III. Discussion

In this test procedure final rule, DOE adopts amendments to the test procedure for EPSs at appendix Z. Specifically, this final rule adds a definition for ''commercial and industrial power supply'' to remove commercial and industrial power supplies from the definition of ''external power supply,'' thus excluding commercial and industrial power supplies from the EPS test procedure and energy conservation standards; removes references to direct and indirect operation Class A EPSs; excludes devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product; provides more specific instructions for testing single-voltage EPSs with multiple-output busses and EPSs shipped without an output cord; addresses adaptive EPSs that conform to the USB–PD specifications to test such EPSs in a manner more representative of their actual use; provides instructions allowing functionality unrelated to the external power supply circuit to be disconnected during testing so long as the disconnection does not impact the functionality of the external power supply itself; and reorganizes the test procedure to centralize definitions, consolidate generally applicable requirements, and better delineate requirements for single-voltage, multiple-voltage, and adaptive EPSs.

A. Scope of Applicability

1. Commercial and Industrial Power Supplies

In the December 2019 NOPR, DOE proposed to adopt a definition of ''commercial and industrial power supply'' that would apply specific characteristics to help distinguish these power supplies from EPSs, as defined in EPCA, and to amend the definition of ''external power supply'' to clarify that an ''commercial and industrial power supply'' would be excluded from the scope of this definition. 84 FR 67106, 67111. Power supplies that meet the definition of ''commercial and industrial power supply'' would, therefore, not be subject to the EPS test procedure. *Id.*

In the November 2021 SNOPR, DOE modified its approach and explained that it was proposing to instead maintain the current definition of an EPS and use the proposed definition of a ''commercial and industrial power supply'' to exclude such EPSs from the scope of the test procedure. 86 FR 60376, 60380. DOE notes, however, that the proposed regulatory text accompanying the November 2021 SNOPR reflected the same amendments proposed in the December 2019 NOPR with respect to commercial and industrial power supplies (*i.e.,* the proposed regulatory text in the November 2021 NOPR included a revised definition of ''external power supply'' that would expressly exclude any ''commercial and industrial power supply'').

The proposed definition of a ''commercial and industrial power supply'' incorporated specific characteristics provided in a guidance document published by DOE on December 20, 2017 (the ''December 2017 guidance'').[10] 84 FR 67106, 67111.

In response to the proposed definition in the December 2019 NOPR, the CA IOUs, NEMA/ALA, and ITI generally supported the proposed amendment to define and explicitly exclude commercial and industrial power supplies from the EPS test procedure and suggested further amendments to the definition. (CA IOUs, No. 10 at pp. 1–2; NEMA/ALA, No. 12 at pp. 4–5; ITI, No. 13 at pp. 3–4) The CA IOUs urged DOE to ensure that the definition is suitably distinct from an EPS, such that DOE may implement separate energy conservation standards for commercial and industrial power supplies in a future rulemaking. (CA IOUs, No. 10 at pp. 1–2)

NEMA/ALA suggested adding the following two additional criteria to the definition of a commercial and industrial power supply:

(1) If a power supply has an input power plug other than NEMA Type 1–15P or 5–15P, and;

(2) If a power supply categorized as Class A Equipment with respect to conducted emissions as described in Federal Communications Commission (''FCC'') part 15 regulations. (NEMA/ALA, No. 12 at pp. 4–5)

NEMA/ALA asserted that these additional criteria would further clarify the distinction between commercial and consumer products. (*Id.* at p.) In their view, the inclusion of the first suggested provision would help distinguish an EPS from an uninterruptible power supply while the inclusion of the second provision would dovetail with the FCC's categorization of Class A equipment as being commercial equipment. (*Id.* at pp. 4–5)

Regarding NEMA/ALA's first suggested additional criterion, DOE has identified EPSs in the marketplace that do not utilize the NEMA 1–15/5–15P plugs but are subject to EPS regulations. Therefore, DOE has determined that the suggested reference to NEMA 1–15 and 5–15 plugs would be an insufficient means of differentiation.

Regarding NEMA/ALA's second suggested additional criterion, DOE notes that criterion number 6(a) in the proposed definition of a commercial and industrial power supply references Class A equipment as defined by CISPR 11, which covers Class A equipment as defined in the FCC part 15 regulations. Therefore, incorporating this additional criterion into the definition would be redundant and is not necessary.

NEMA/ALA also suggested minor edits to the language of the ''commercial and industrial supply'' definition that they stated would provide technical accuracy. Specifically, NEMA/ALA recommended specifying the requirement for ''a 3-phase input power connection,'' as opposed to ''3-phase input power;'' modifying ''household current'' to ''household mains electricity;'' and referring to a connection as ''permanent'' as opposed to ''non-removable.'' (*Id.* at p. 4) NEMA/ALA asserted that it is inaccurate to refer to household mains electricity as ''household current'' because household current can vary depending on the voltage supplied and the amount of load connected; and the household voltage varies depending on the condition of the grid. (*Id.* at pp. 7–8).

[10] The guidance document is available in the rulemaking docket at *www.regulations.gov/document/EERE-2019-BT-TP-0012-0001.*

DOE agrees that using the term ''household mains electricity'' in the definition of commercial and industrial power supply is more appropriate than ''household current'' or other similar terms. With regards to NEMA/ALA's suggestion to replace use of the terms ''3-phase input power'' with ''3-phase input power connection'' and ''non-removable'' with ''permanent,'' DOE does not see a difference meaningful enough to warrant deviating from the definition proposed in the November 2021 SNOPR. In this final rule, DOE modifies the language of the adopted definition of a commercial and industrial power supply to replace ''household current'' with ''household mains electricity.''

ITI supported the amendment to define a commercial and industrial power supply but expressed concern that the definition does not contain language stating that a product may still be considered a commercial and industrial power supply even if it does not meet any of the criteria listed in the definition of a commercial and industrial power supply. (ITI, No. 13 at pp. 3–4) According to ITI, the omission of such language from the definition may expand the scope of EPS regulations if certain power supplies that were not previously regulated cannot meet the definition of a commercial and industrial power supply. (ITI, No. 13 at pp. 3–4; ITI, No. 22 at pp. 1–2)

As stated in the December 2017 guidance, the list of criteria is not intended to be exhaustive; [11] as a power supply that does not meet one or more of the eight criteria may still be considered a commercial or industrial power supply. Consistent with the December 2017 guidance, DOE clarifies in this final rule that a commercial and industrial power supply is one that is not distributed in commerce for use with a consumer product and *may* [emphasis added] include one of the listed criteria.

In response to the November 2021 SNOPR, NEEA/ASAP/NRDC agreed with DOE that commercial and industrial power supplies should not be included with the established EPS test procedure. NEEA/ASAP/NRDC stated there is an opportunity for significant energy savings with a separate set of standards and test procedure and encouraged DOE to consider commercial and industrial power supplies as a future rulemaking opportunity. (NEEA/ASAP/NRDC, No. 27 at pp. 7–9) DOE acknowledges the comment but notes that a discussion regarding standards and test procedures for commercial and industrial power supplies is outside the scope of this rulemaking.

In this final rule, DOE amends the definition of ''external power supply'' to expressly exclude ''commercial and industrial power supplies,'' consistent with the December 2017 guidance, as proposed in the December 2019 NOPR, and presented in the proposed regulatory text in the November 2021 SNOPR. A power supply that meets the definition of ''commercial and industrial power supply'' does not meet the definition of ''external power supply'' under EPCA—so long as the power supply is not, in fact, distributed in commerce for use with a consumer product—and is therefore not subject to the EPS test procedure or energy conservation standards.

The definition of a commercial and industrial power supply adopted in this final rule is as proposed in the December 2019 NOPR with edits reflecting the change in language from ''household current'' to ''household mains electricity'' and the addition of clarifying language that the criteria listed is not an exhaustive list.

2. Direct Operation and Indirect Operation EPSs

In section 1 of appendix Z, the scope of the EPS test procedure is specified with references to direct operation EPSs and indirect operation Class A EPSs. In the November 2021 SNOPR, DOE proposed to remove these references from the ''Scope'' section of appendix Z and instead state that the test procedure's scope includes all EPSs subject to the energy conservation standards set forth at 10 CFR 430.32(w)(1), except for those that meet the definition of a ''commercial and industrial power supply.'' 86 FR 60376, 60380. DOE noted that removing such references would not alter the scope or the applicability of appendix Z because the test procedure to test direct operation and indirect operation EPSs is the same for both types of EPSs, such that including these terms in the scope is unnecessary. *Id.*

In response to the November 2021 SNOPR, ITI and AHAM/CTA/OPEI/PMI/PTI stated they do not oppose removing the direct operation and indirect operation Class A EPSs references from appendix Z. (ITI, No. 22 at p. 1; AHAM/CTA/OPEI/PMI/PTI, No. 26 at p. 1) Similarly, NEEA/ASAP/NRDC also supported the removal of these references from appendix Z. (NEEA/ASAP/NRDC, No. 27 at pp. 1–2)

For the prior reasons discussed in section III.A.2 and in the November 2021 SNOPR, DOE is adopting its proposal to remove the current references to direct operation and indirect operation Class A EPSs within the ''Scope'' section of appendix Z.

3. Scope of Applicability for EPSs With Other Major Functions

As discussed in the November 2021 SNOPR, DOE understands there may be uncertainty as to the devices subject to the current test procedure. As noted in the November 2021 SNOPR, the test procedure applies to EPSs subject to the energy conservation standards at 10 CFR 430.32(w)(1). 86 FR 60376, 60380–60381. Devices are available on the market that are covered by the EPS definition but are not subject to the energy conservation standards and were not considered in the establishment of those standards (*e.g.,* a television that has a USB port that provides converted power). To provide further instruction regarding the scope of the test procedure, in addition to the proposed instruction regarding the disconnection of components and circuits unrelated to the EPS's functionality, the November 2021 SNOPR attempted to further clarify in the regulatory text which devices were to be excluded from the EPS test procedure. *Id.* at 86 FR 60381. Specifically, DOE proposed that devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product are not subject to the test procedure. *Id.* DOE intended for this proposed amendment to clarify that devices providing power conversion only as an auxiliary operation (*e.g.,* televisions, laptop computers, and home appliances with USB output ports) are not subject to the test procedure.

In response to the November 2021 SNOPR, ITI and AHAM/CTA/OPEI/PMI/PTI supported this proposal. (ITI, No. 22 at p. 2; AHAM/CTA/OPEI/PMI/PTI, No. 26 at p. 2) NEEA/ASAP/NRDC also supported excluding complex multifunction products that have a USB port (*e.g.,* televisions and desktop computers) from appendix Z but encouraged DOE to consider including simple multifunction EPSs, such as a motorized standing desk with USB ports, within its scope. (NEEA/ASAP/NRDC, No. 27 at p. 7)

[11] The December 2017 guidance states that a power supply that does not meet one or more of the eight criteria in the preceding paragraph may still fall outside of the definition of ''external power supply'' under EPCA. This guidance provides eight specific examples of circumstances where DOE will not consider a power supply to meet the definition of ''external power supply'' under EPCA. However, nothing in this guidance precludes a person from asserting that a specific power supply that does not meet one or more of these eight criteria nonetheless does not meet the definition of ''external power supply'' under EPCA.

The CA IOUs recommended that DOE remove its proposed exclusion of devices for which the primary load of the converted voltage is not delivered to a separate end-use product, asserting that the proposal would be challenging to apply and that its scope is exceptionally broad. Instead, the CA IOUs suggested that DOE exclude only USB-based products that have data transfer capabilities. The CA IOUs commented that, despite having data transfer capabilities, an exception may have to be made for a subset of power over ethernet products, stating that DOE already considers these products to be within the scope of EPS regulations. (CA IOUs, No. 25 at pp. 2–3) Furthermore, the CA IOUs suggested that DOE should evaluate the potential for regulating ''combination'' products with power conversion as a secondary function, citing possible energy savings that are technologically feasible and economically justified. *Id.*) The CA IOUs suggested four categories of such combination products and encouraged DOE to use these categories to explicitly include or exclude each type from scope. (*Id.* at pp. 3–4).

As noted in the November 2021 SNOPR, the test procedure applies to EPSs subject to the energy conservation standards at 10 CFR 430.32(w)(1). The products excluded under the proposal were not considered in the establishment of the energy conservation standards (*e.g.,* a television that has a USB port that also provides converted power). The supplemental proposal makes explicit that such products are not subject to the test procedure (and therefore not subject to the energy conservation standards). The lack of products in the Compliance Certification Database (''CCD'') for which the converted voltage within the device is not delivered to a separate end-use product indicates that the explicit exclusion is already understood by industry and, contrary to the assertions that the proposal is broad and would be difficult to apply, DOE expects the impact of this amendment to be minimal. For the reasons stated in the preceding discussion and the November 2021 SNOPR, DOE is adopting its proposal to exclude from the test procedure those power supplies for which the converted voltage within the device is not delivered to a separate end-use product.

Regarding the CA IOU's suggestion that DOE should exclude only USB-based products that have data transfer capabilities, DOE notes that the USB–PD specification, the primary purpose of which is to address devices that provide power to an external load, relies on digital communication (*i.e.,* data transfer capabilities) between the load and the power supply to determine the appropriate output voltage. Excluding products that have data transfer capabilities would exclude all USB–PD products from scope. Therefore, DOE is not excluding only USB-based products that have data transfer capabilities.

B. Industry Standards Incorporated by Reference

The test procedure for EPSs incorporates by reference the entire IEC 62301 Ed. 2.0 industry standard. However, only certain sections of the industry standard apply to the EPS test procedure. In the December 2019 NOPR, DOE proposed to add a new section — ''Incorporation by Reference''— in appendix Z to specify those sections of the industry standards that apply to the EPS test procedure. Further, DOE also proposed to identify this industry standard as ''IEC 62301–Z'' to indicate that the reference applies exclusively to appendix Z. 84 FR 67106, 67115. Additionally, in places where a reference to IEC 62301 Ed. 2.0 restates the requirement from that standard, DOE had proposed to remove those redundant references to the standard. DOE did not receive any comments regarding this proposal.

DOE notes that while the approach of using a special shorthand (IEC 62301–Z) was previously consistent with the nomenclature being used in other DOE test procedures that also incorporate by reference sections of IEC 62301 Ed. 2.0, DOE has since abandoned this approach in favor of simply referring to the standard as IEC 62301.

Consequently, DOE is adopting its proposal. This final rule establishes a section in appendix Z to index the provisions of IEC 62301 Ed. 2.0 applicable to the Federal test procedure. This final rule maintains the current approach of using the shorthand ''IEC 62301'' to refer to IEC 62301 Ed. 2.0.

C. EPS Configurations

1. Single-Voltage EPSs With Multiple-Output Busses

Stakeholders have raised questions regarding how to load an EPS that is able to convert to only one output voltage at a time and has multiple-output busses (*i.e.,* a single-voltage EPS with multiple-output busses). A single-voltage AC–DC EPS is designed to convert line voltage AC input into lower-voltage DC output and is able to convert to only one DC output voltage at a time. *See* appendix Z to subpart B of 10 CFR part 430. Thus, an EPS that can provide two or more DC outputs of the same voltage simultaneously or an EPS that can provide two or more different DC output voltages, but not simultaneously, would be considered a single-voltage EPS and be subject to the single-voltage EPS standards at 10 CFR 430.32(w). Accordingly, DOE stated in the December 2019 NOPR that a single-voltage EPS with multiple-output busses is a single-voltage EPS and must be tested according to section 3(a) of appendix Z with measurements taken as specified in section 4(a) of appendix Z. 84 FR 67106, 67113–67114. DOE previously explained during a November 21, 2014, public meeting to discuss the EPS test procedure (the ''November 2014 public meeting'') that these single-voltage EPSs are to be tested at the same loading conditions as conventional single-voltage EPSs, using multiple loads across the busses to draw the complete nameplate output current from the EPS itself. (Docket No. EERE–2014–BT–TP–0043, Public Meeting Transcript, No. 9, pp. 43–44) At the time of the November 2014 public meeting, single-voltage EPSs with multiple-output busses had limited availability in the marketplace, and therefore the more explicit direction discussed during the November 2014 public meeting was not included in the regulatory text.

Since the August 2015 Final Rule, single-voltage EPSs with multiple-output busses have become much more prevalent on the market, making it appropriate now to include more explicit directions for these EPSs. Therefore, DOE proposed in the December 2019 NOPR to specify that any EPS outputting the same voltage across multiple-output busses must be tested in a configuration such that all busses are simultaneously loaded to their maximum output at the 100% loading condition, utilizing the proportional allocation method [12] where necessary. 84 FR 67106, 67114. DOE stated that this additional detail in DOE's test procedure instructions is consistent with current industry practice. *Id.*

The CA IOUs supported this proposal and further recommended that DOE ensure that these directions accurately capture the maximum power, with all ports at the maximum output power achievable at the 100% loading condition, and derated according to the proportional allocation method when it

[12] For EPSs with multiple-output ports in which the sum of each port's nameplate output power exceeds the overall nameplate output power of the EPS, the proportional allocation method utilizes a derating factor to determine the current at each loading condition in order to ensure that the output power does not exceed the overall nameplate output power of the EPS during testing.

is not possible for an EPS to load each output bus to its maximum nameplate output power. (CA IOUs, No. 10 at p. 2)

DOE notes that the CA IOU's recommendation is adequately addressed by the proportional allocation method, which ensures that these EPSs are loaded to the maximum achievable output power, as specified on a unit's nameplate.

For the reasons previously described in this document and in the December 2019 NOPR, DOE adopts the amendments as proposed to specify in newly-added section 5(a)(1)(iv) of appendix Z that any EPS outputting the same voltage across multiple-output busses must be tested in a configuration such that all busses are simultaneously loaded to their maximum output at the 100% loading condition, utilizing the proportional allocation method where necessary.

2. Multiple-Voltage Adaptive EPSs

Following the August 2015 Final Rule, stakeholders inquired about how to test adaptive EPSs that operate as multiple-voltage EPSs. An adaptive EPS is an EPS that can alter its output voltage during active-mode based on an established digital communication protocol with the end-use application without any user-generated action. 10 CFR 430.2. A multiple-voltage EPS is an EPS that is designed to convert line voltage AC input into more than one simultaneous lower-voltage output. See appendix Z, section 2.k. An EPS with multiple-output busses for which one or more of the busses are adaptive is covered under the definitions of multiple-voltage EPS and adaptive EPS.

Currently, section 4(a)(i)(E) of appendix Z requires testing adaptive EPSs twice—once at the highest nameplate output voltage and once at the lowest nameplate output voltage. At each output voltage, adaptive EPSs are tested at the four loading conditions specified in Table 1 of appendix Z (100%, 75%, 50%, and 25%). Separately, section 4(b)(i)(B) of appendix Z requires testing multiple-voltage EPSs at four loading conditions (100%, 75%, 50%, and 25%) derated according to the proportional allocation method, with all busses loaded and tested simultaneously. Applying these two testing requirements, adaptive EPSs that operate as multiple-voltage EPSs must be tested once at the highest nameplate output voltage and once at the lowest nameplate output voltage, and for each test, all available busses must be loaded and derated according to the proportional allocation method. DOE also notes that such EPSs are subject to the multiple-voltage EPS standards.

DOE has also identified EPSs with multiple USB output ports at 5 volts and one or more adaptive outputs with a default voltage of 5 volts but whose output voltage varies according to the demand of the product connected to that port. Under the default operating condition, the EPS operates as a single-voltage EPS because it outputs only one voltage to all available ports. However, in a different operating condition, the adaptive output may provide a higher voltage while the other outputs remain at 5 volts. In this condition, the EPS operates as a multiple-voltage EPS because it is providing more than one output voltage simultaneously. For such a product, the definition of single-voltage EPS does not apply because the product is able to convert line voltage AC input into more than one simultaneous lower-voltage output, whereas a single-voltage EPS is able to convert to only one AC or DC output voltage at a time. *See* appendix Z, section 2. Instead, the definition of multiple-voltage EPS applies to such a product.

In the December 2019 NOPR, DOE proposed to add a new section 6(b) to appendix Z to explicitly address testing and certifying adaptive EPSs that operate as multiple-voltage EPSs. 84 FR 67106, 67111, 67114–67115. The proposed requirements for testing both single-voltage and multiple-voltage adaptive EPSs were similar to the requirements for testing all other single-voltage and multiple-voltage EPSs, including the incorporation of the alternate waiver test method that requires testing of USB–PD EPSs using 10 watts (W) at the 5 volt level, as discussed in section III.D in this document. DOE also proposed to amend the certification requirements for switch-selectable [13] and adaptive EPSs at 10 CFR 429.37(b)(2)(ii) and (b)(2)(iii) to clarify (by removing the term ''single-voltage'' from the section headings) that the requirements apply to both single-voltage as well as multiple-voltage switch-selectable and adaptive EPSs, respectively. *Id.* at 84 FR 67114.

As proposed in the December 2019 NOPR, an EPS that has both adaptive and non-adaptive output busses would be considered a multiple-voltage adaptive EPS and would be tested under the new section 6(b) of appendix Z. *Id.* at 84 FR 67114–67115. Both the adaptive and non-adaptive ports would be tested twice—first with the adaptive port at the highest nameplate output voltage and the non-adaptive ports at their fixed voltage, then again with the adaptive port at the lowest nameplate output voltage and the non-adaptive ports remaining at their fixed voltage. *Id.* As stated in the proposed appendix Z, at each of the two test voltages, the proportional allocation method would be used to derate the loading conditions where necessary. *Id.* at 84 FR 67128–67129.

The CA IOUs agreed with the proposed amendments for multiple-voltage adaptive EPSs and the alternate test procedure for multiple-voltage USB–PD EPSs included within the new section for multiple-voltage adaptive EPSs at section 6(b) of the new test procedure. (CA IOUs, No. 10 at p. 2)

For the reasons discussed in the prior paragraphs and in the December 2019 NOPR, DOE is adopting the changes related to multiple-voltage adaptive EPSs as proposed in the December 2019 NOPR, but notes that for multiple-voltage EPSs that also meet the definition of USB–PD, the alternate test method of testing at 10W at the 5 volt level is replaced with the updated alternate test method of testing at 2A at the lowest output voltage as proposed in the November 2021 SNOPR and discussed in section III.D of this document . However, DOE is not adopting the proposed amendments to the certification requirements. DOE may consider proposals to amend the certification requirements and reporting for EPS under a separate rulemaking regarding appliance and equipment certification.

3. EPSs With Other Major Functions

DOE has received questions about whether non-EPS-related functions are permitted to be disconnected during testing for products with USB ports. The existing test procedure at appendix Z specifies that EPSs must be tested in their final completed configuration. For example, the efficiency of a bare circuit board power supply (*i.e.,* a power supply without its housing or DC output cord) may not be used to characterize the efficiency of the final product. DOE recognizes that the requirement to test an EPS in its final completed configuration may result in measuring the energy use of more than just an EPS (the covered product) in cases where the EPS is a component of a product that serves one or more other major functions in addition to serving as an EPS.

Accordingly, in the December 2019 NOPR, DOE proposed to amend the test procedure to specify that components

[13] As defined in section 2 of appendix Z, a ''switch-selectable single voltage external power supply'' means a single-voltage AC–AC or AC–DC power supply that allows users to choose from more than one output voltage.

and circuits unrelated to the EPS functionality may be disconnected during testing as long as that disconnection does not impact the functionality of the EPS itself. 84 FR 67106, 67115. For example, as proposed, an EPS that also acts as a surge protector (*i.e.,* a power strip with surge protection and USB output ports) would be tested with the surge protector circuit disconnected if it is distinct from the USB circuit and does not impact the EPS's functionality (*i.e.,* the circuit from household AC input to the USB output). This proposed amendment would improve the accuracy of the EPS test procedure by allowing technicians to disconnect additional components and circuits unrelated to the EPS functionality that may affect the active mode efficiency or no-load performance of an EPS as tested according to the test procedure.

CTA, NEMA/ALA, and ITI supported amending the test procedure to allow the disconnection of non-EPS functions during testing. These stakeholders recommended that DOE include explicit directions for technicians on how to disconnect non-EPS functions. (CTA, No. 11 at pp. 2–3; NEMA/ALA, No. 12 at p. 6; ITI, No. 13 at p. 4) Specifically, CTA recommended that a ''hard,'' or physical, disconnection be acceptable regardless of whether the EPS has an external switch or other external mechanism to facilitate disconnection for the user. (CTA, No. 11 at pp. 2–3) NEMA/ALA stated that manufacturers should be allowed to modify EPSs by both bypassing and/or disconnecting circuits. (NEMA/ALA, No. 12 at p. 6) ITI suggested that DOE include language indicating that a disconnection may be performed externally via switch if present, or internally through a hardwire physical disconnection. (ITI, No. 13 at p. 4)

Conversely, the CA IOUs objected to disconnecting certain functions from an EPS. The CA IOUs asserted that the test procedure should capture the maximum potential power draw of an EPS and should thus require that EPSs be tested with all functions enabled. The CA IOUs also expressed concern with the introduction of possible loopholes as a result of language allowing for technicians to disconnect certain functions and urged DOE to carefully consider the amended language in order to minimize such loopholes. (CA IOUs, No. 10 at p. 3)

EPCA requires test procedures to be reasonably designed to produce test results which measure energy efficiency, energy use, or water use 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 the present case, DOE is amending the test procedure for EPSs. To the extent that a test procedure were to capture the energy use of a major function of a product other than that associated with an EPS, the resulting measured energy use would not be representative of the EPS, as that term is defined for the purpose of the energy conservation regulations. DOE notes that section 4(j) of the test procedure as amended in this final rule permits disconnection of a major function other than the EPS only if disconnecting such components does not affect the efficiency of the EPS and the ability of the product to convert household electric current into DC current or lower-voltage AC current.

DOE agrees that additional explicit instruction on how to disconnect other major functions would be helpful. To this end, DOE has added language in section 4(j) of appendix Z to clarify that other functions may be disconnected ''via a physical, or hardwire, disconnection or via a manual switch'' before testing; that the surge protection circuit may be ''physically'' disconnected during testing; and that a disconnection performed by a technician must be able to be replicated by a third-party test facility. These instructions will both assist the certification process as well as prevent inconsistent disconnections, thereby minimizing possible loopholes regarding the disconnection of components.

D. Adaptive EPSs

1. USB–PD EPSs

As discussed earlier in this document, DOE has issued test procedure waivers for several basic models of adaptive EPSs that meet the provisions of IEC 62680–1–2 (*i.e.,* USB–PD EPSs). (Case Nos. EPS–001 (Apple), EPS–002 (Microsoft), EPS–003 (Poin2 Labs), EPS–004 (Hefei Bitland), 2017–014 (Huawei), 2018–005 (Apple), and 2018–010 (Apple)).[14] The IEC 62680–1–2 specification contains the voltage, current, and digital communication requirements for the USB–PD system. Specifically, the USB–PD specification allows for the output voltage of a compatible EPS to adaptively change between 5 volts, 9 volts, 15 volts and 20 volts while allowing for currents up to 3 amps for the first three voltage levels and up to 5 amps at the 20-volt level upon request from a load using an established digital communication protocol. As a result, the USB–PD specification allows for seamless interoperability across multiple consumer products with different input voltage requirements such as a mobile phone, tablet, or laptop.

As described in the notice of decision and order granting waivers to Apple, Microsoft, Poin2, and Bitland, DOE determined that applying the DOE test procedure to USB–PD EPSs would yield results that would be unrepresentative of the active-mode efficiency of those products. 83 FR 11738, 11739. In granting the test procedure waivers, DOE concluded that, when using a USB–PD EPS to charge an end-use product at the lowest voltage level of 5 volts, the product would rarely draw more than 2 amps of current at 5 volts (*i.e.,* a power draw of more than 10W). *Id.* Nonetheless, for a USB–PD EPS with a nameplate output current of 3 amps, the DOE test procedure requires that the EPS's efficiency be measured at a current of 3 amps at the lowest voltage condition of 5 volts (*i.e.,* a power draw of 15W). As a result, the efficiency of such an EPS, when evaluated at that higher power draw (15W vs. 10W), would result in a measurement that is unrepresentative of the actual energy consumption characteristics of the USB–PD EPS being tested. *Id.*

USB–PD EPSs subject to the referenced waivers must be tested such that when testing at the lowest achievable output voltage (*i.e.,* 5 volts), the output current is 2 amps (corresponding to an output power of 10W) at the 100% loading condition. The 75%, 50%, and 25% loading conditions are scaled accordingly under this alternate procedure (*i.e.,* 1.5 amps, 1 amp, and 0.5 amps, respectively). When tested in this manner, the resulting power draws are 10W, 7.5W, 5W, and 2.5W—and stands in contrast to the test procedure at appendix Z, which requires power draws of 15W, 11.25W, 7.5W, and 3.75W at the 100%, 75%, 50%, and 25% loading conditions, respectively. *See id.* at 83 FR 11739–11740. As a result, DOE proposed to amend appendix Z to adopt the alternate test procedure established in the relevant test procedure waivers. 84 FR 67111–67113.

The CA IOUs supported the alternate test procedure for USB–PD EPSs, stating that previous manufacturer waivers and supporting field data validate the assertion that adaptive USB–PD products in the field would provide lower than their maximum rated current in low-voltage charging scenarios. (CA IOUs, No. 10 at p. 2) In addition, the CA IOUs suggested that the proposed 2-amp limit for USB–PD EPSs at the lowest nameplate output voltage be

[14] *See also* Case No. 2019–005. (Anker).

periodically revised to ensure that future generations of products with potentially different performance characteristics are also tested in a representative manner. (*Id.*)

For any waiver that DOE grants, it must also, as soon as practicable, amend its regulations to eliminate any need for the continuation of such waiver followed by the publication of a final rule. 10 CFR 430.27(l). Pursuant to DOE's test procedure waiver regulations and to improve the representativeness of the EPS test procedure, DOE is amending the EPS test procedure to adopt the alternate test procedure for USB–PD EPSs permitted in the previously granted test procedure waivers.

In response to the CA IOU's suggestion that DOE periodically revise the test procedure in response to changes in the products on the market, DOE notes that EPCA requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including EPSs, to determine whether amended test procedures would more accurately or fully comply with the requirements that the test procedures 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)). DOE will consider future generations of USB–PD EPSs on the market through ongoing evaluations of the test procedure consistent with these requirements.

2. Nameplate Output Power for Testing USB–PD EPSs

In conjunction with proposing to require testing of USB–PD EPSs at a maximum output current of 2 amps, corresponding to an output power of 10W at the 5-volt level, DOE also proposed in the December 2019 NOPR to amend the definition of nameplate output power in appendix Z to explicitly state that for USB–PD ports, the nameplate output power is 10W at the 5-volt level and as specified on the manufacturer's label or documentation at the highest voltage. 84 FR 67106, 67113. As proposed for all USB–PD EPSs, all of the required reported values would be provided, but with the loading conditions at the lowest operating voltage scaled such that the output current at the 100%, 75%, 50%, and 25% loading conditions would be set at 2 amps, 1.5 amps, 1 amp, and 0.5 amps, respectively. *Id.*

ITI expressed concern with what it characterized as DOE's approach to modifying the definition of nameplate output power in appendix Z, citing that the proposed amendment would introduce confusion and burden to manufacturers who are required to comply with other industry specifications for nameplate labels. (ITI, No. 13 at pp. 1–2) ITI asserted that the nameplate label for certain types of EPSs is strictly defined by the specification IEC 62368–1, ''Audio/video, information and communication technology equipment—Part 1: Safety requirements.'' This specification states that the measured input current or power at the rated voltage shall not exceed the rated current or power by more than 10%. ITI asserted that this requirement would cause USB–PD EPSs with a labeled output power of 10W (2 amps at 5 volts), but actually capable of outputting 15W (3 amps at 5 volts), to fail compliance testing for IEC 62368–1 because the tested current would exceed the nameplate value by more than 10%. Moreover, under IEC 62368–1, the available current must not exceed a maximum rated output of power delivery specification by more than 150% for ratings up to 2 amps after 5 seconds or 130% for ratings greater than 2 amps. Based on these provisions, ITI asserted that the proposed amendments related to an EPS's nameplate output power would conflict with requirements specified in IEC 62368–1. (*Id.* at p. 2)

DOE acknowledges that the definition of nameplate output power as proposed in the December 2019 NOPR may be understood to conflict with the relevant industry standard. The purpose of the proposed definition was to instruct manufacturers to test USB–PD EPSs using 10W at the 5-volt level regardless of what is represented on the nameplate or other manufacturer materials (*i.e.,* DOE did not intend for its proposal to require that manufacturers change the information provided on the nameplate). In this final rule, DOE amends the definition of nameplate output power as proposed in the November 2021 SNOPR to explicitly state that when testing an adaptive external power supply with USB–PD ports, in place of the nameplate output power at the lowest voltage, use an output power calculated as the product of its lowest nameplate output voltage and 2 amps for each USB–PD port and as specified on the manufacturer's label or documentation at the highest voltage. To prevent potential conflicts with other industry labeling requirements, DOE is also specifying that the definition only applies to DOE testing and certification requirements and is unrelated to the physical nameplate label or documentation of an EPS. With these adjustments to its proposed requirements, the amendment in this final rule to modify the definition of nameplate output power does not conflict with certification requirements of other industry standards, such as IEC 62368–1.

3. Supporting Definitions for USB–PD EPSs

In the December 2019 NOPR, DOE proposed to add definitions for USB–PD EPS and the physical USB Type-C connector that supports it in section 3 of appendix Z to reflect the voltage and current requirements specified in IEC 62680–1–2. 84 FR 67106, 67113. To define a USB–PD EPS, DOE presented two approaches and requested comment. *Id.*

The first approach proposed to define a USB–PD EPS as an adaptive EPS that utilizes a USB Type-C output port and uses a digital protocol to communicate between the EPS and the end-user product to automatically switch between an output voltage of 5 volts and one or more of the following voltages: 9 volts, 15 volts, or 20 volts. The USB–PD output bus must also be capable of delivering 3 amps at an output voltage of 5 volts, and the voltages and currents must not exceed any of the following values for the supported voltages: 3 amps at 9 volts; 3 amps at 15 volts; and 5 amps at 20 volts. Under this approach, DOE proposed also defining the term ''USB Type-C'' as ''the reversible 24-pin physical USB connector system that supports USB–PD and allows for the transmission of data and power between compatible USB products.'' *Id.*

The second approach considered referencing IEC 62680–1–2 in the USB–PD EPS and USB Type-C definitions. *Id.* With this approach, the definitions would reference either the entire industry standard or the individual pertinent sections.

In response to the December 2019 NOPR, the CA IOUs expressed concern with the proposed definitions for a USB–PD EPS and a USB Type-C Connector. Specifically, the CA IOUs stated that by specifying electrical and physical requirements in the definitions, future generations of USB–PD or similar devices would be excluded from the definition and thus the appropriate test procedure. (CA IOUs, No. 10 at p. 2) The CA IOUs recommended that DOE instead define a USB–PD EPS as an EPS that meets IEC 62680–1–2, or an equivalent specification. (*Id.*) The CA IOUs also recommended that DOE broaden the scope of the definition of a USB–PD EPS

in order to account for future generations of USB–PD EPSs. *Id.*

Also, in response to the December 2019 NOPR, ITI stated that the proposed definition of a USB–PD EPS does not take into account programmable power supplies (''PPSs''), which are defined in IEC 62680–1–2. (ITI, No. 13 at p. 3) According to ITI, PPSs are able to output a minimum voltage of 3.3 volts, in contrast to the minimum voltage of 5 volts as specified in the proposed definition of a USB–PD EPS. Additionally, ITI recommended that the proposed definition include USB–PD EPSs with different voltage and current requirements, including PPSs, than those voltages and currents specified in the proposed definition of a USB–PD EPS in the December 2019 NOPR. (*Id.*) ITI claimed that equating the requirement of testing at 2A to a power output at 10W does not apply to PPSs, which are capable of outputting 3.3V. (*Id.*)

In response to these comments, DOE updated its proposed definition of USB–PD EPS in the November 2021 SNOPR to refer to an adaptive EPS that utilizes a USB Type-C output port and uses a digital protocol to communicate between the EPS and the end-user product to automatically switch between any output voltage within the range of 3.3 volts to 20 volts. 86 FR 60376, 60384. The USB–PD output bus must be capable of delivering 3 amps at the lowest output voltage, and the currents must not exceed any of the following values for the supported voltages: 3 amps at 9 volts; 3 amps at 15 volts; and 5 amps at 20 volts. *Id.* DOE also proposed to revise the definition of nameplate output power, as discussed in section III.D.2 of this document. *Id.*

In response to these updated proposals, the CA IOUs again recommended that DOE adopt a definition of USB–PD that does not specify a maximum of 20V and 5A, asserting that this definition may soon be out of date, and suggested aligning the USB–PD standards with announcements from the USB Implementers Forum (''USB–IF''). (CA IOUs, No. 25 at pp. 5–6) The CA IOUs commented that the USB–IF has announced that USB–PD Specification Revision 3.1 would enable delivery of up to 240 Watts of power over Type-C (specifically, 48V at 20A). (*Id.* at p. 5)

DOE notes in response to the CA IOUs that in incorporating the waiver instructions to allow USB–PD adaptive power supplies to be tested at 2A for the 100% loading condition at the lowest voltage as described in section III.D.1, DOE first needed to define USB–PD to align with the products for which the waivers were initially granted. In doing so, DOE had carefully evaluated the definition published by USB–IF at the time to determine whether it was appropriate for use in describing the type of adaptive EPSs for which the alternate instructions would capture its energy performance more representatively. If DOE instead defined USB–PD to align with any forthcoming specification from USB–IF, it would not be able to ensure that the alternate instructions would continue to be representative. As such, in this final rule, DOE will adopt the definition of USB–PD as defined in the November 2021 SNOPR. DOE also notes that EPCA requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including EPSs, to determine whether amended test procedures would more accurately or fully comply with the requirements that the test procedures 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)). DOE will therefore consider future generations of USB–PD EPSs through on-going evaluations to ensure the alternate instructions continue to be appropriate.

In this final rule, DOE is amending its test procedure to establish definitions for USB–PD EPS and USB Type-C as proposed in the November 2021 SNOPR. DOE is also establishing the alternate test procedure for USB–PD EPSs to account for lower voltages that the latest specification of USB–PD can support. DOE will consider future generations of USB–PD EPSs through on-going evaluations of the market and its EPS test procedure.

4. Certification Requirements for Adaptive EPSs

In the December 2019 NOPR, DOE proposed to amend the certification requirements for USB–PD EPSs. 84 67106, 67113. The current certification requirements for adaptive EPSs require reporting the nameplate output power in W at the highest and lowest nameplate output voltages, among other reported values. 10 CFR 429.37(b)(2)(iii). Section 2 of appendix Z defines nameplate output power as the power output as specified on the manufacturer's label on the power supply housing or, if absent from the housing, as specified in documentation provided by the manufacturer. Under the current test procedure, for a USB–PD EPS, the nameplate output power at the lowest nameplate voltage of 5 volts would be 15W.

DOE is not adopting the proposed amendments to the certification requirements in this final rule. DOE may consider proposals to amend the certification requirements and reporting for EPS under a separate rulemaking regarding appliance and equipment certification.

DOE has also received general inquiries about the certification requirements related to adaptive EPSs that meet the definition of a low-voltage EPS [15] at one output voltage and the definition of a basic-voltage EPS [16] at another. In response to these inquiries, DOE clarifies that the certification templates [17] for EPSs require specifying—for each tested voltage—the applicable product group code, which includes an indication of whether the tested voltage meets the definition of low-voltage EPS or basic-voltage EPS.

For example, consider a direct-operation adaptive AC–DC EPS that can output 5W (5 volts, 1 amp) at its lowest nameplate output voltage, and 18W (9 volts, 2 amps) at its highest nameplate output voltage. This EPS is a low-voltage EPS at its lowest nameplate output voltage of 5 volts and a basic-voltage EPS at its highest nameplate output voltage of 9 volts. Accordingly, when certifying this EPS, the manufacturer would indicate in the certification template that the lowest nameplate output voltage corresponds to the product group code identified as ''Direct Operation, Adaptive, AC–DC, nameplate output voltage < 6 volts and nameplate output current >= 550 milliamps, 1 watt < nameplate output power <= 49 watts''; and that the highest nameplate output voltage corresponds to the product group code identified as ''Direct Operation, Adaptive, AC–DC, nameplate output voltage >= 6 volts or nameplate output current < 550 milliamps, 1 watt < nameplate output power < = 49 watts''.

E. Output Cords

The current EPS test procedure requires EPSs to be tested with the DC output cord supplied by the manufacturer. *See* appendix Z, section 4(a)(i)(A). DOE has stated that allowing an EPS to be tested without the power cord would ignore the losses associated

[15] DOE defines ''low-voltage EPS'' as an EPS with a nameplate output voltage less than 6 volts and nameplate output current greater than or equal to 550 milliamps. 10 CFR 430.2.

[16] DOE defines ''basic-voltage EPS'' as an EPS that is not a low-voltage external power supply. 10 CFR 430.2.

[17] DOE's certification templates are provided at *www.regulations.doe.gov/ccms/templates.*

with the cord and allow for an EPS that is less efficient than the efficiency standards intended. *See* 80 FR 51424, 51429 (August 25, 2015). Accordingly, DOE specified that EPSs must be tested with the output cord supplied by the manufacturer. *Id.* Appendix Z does not provide specific instructions for testing EPSs that are not supplied with output cords. In response to inquiries regarding how to test EPSs that are not shipped with a DC output cord, DOE proposed to amend the test procedure to explicitly state that if a wire or cord is not supplied by the manufacturer, then the EPS shall be tested at the output electrical contact that can be connected to a physical wire in the December 2019 NOPR. 84 FR 67106, 67124–67125. DOE did not receive any comments on this proposed amendment.

Since the analysis conducted in support of the December 2019 NOPR, DOE has observed an increasing number of EPSs that are not packaged or supplied with an accompanying DC output cord.[18] In the November 2021 SNOPR, DOE proposed that if an EPS is not supplied with an output cord, then the EPS must be tested with an output cord that is recommended for use by the manufacturer. In addition, DOE sought comments on whether the test procedure should specify testing with a DC output cord recommended for use by manufacturers, or whether DOE should specify electrical specifications for the type of cord. 86 FR 60376, 60382–60383. The illustrative example of output cord electrical specifications from the November 2021 SNOPR are presented in Table III.1.

TABLE III.1—ILLUSTRATIVE EXAMPLE OUTPUT CORD ELECTRICAL SPECIFICATIONS FROM NOVEMBER 2021 SNOPR

DC output current at 100% loading condition (amps)	Cord length (feet)	Conductor	American wire gauge
$0 < I \leq 1$	3	Copper	26
$1 < I \leq 2$	3	Copper	24
$2 < I \leq 3$	3	Copper	22
$3 < I \leq 4$	3	Copper	20
$4 < I \leq 5$	3	Copper	18
$I > 5$	3	Copper	16

DOE received multiple comments from stakeholders on this proposal in the November 2021 SNOPR. Aohai recommended testing with output cords based on their cable resistance rather than American wire gauge (''AWG''), stating that resistance is the key factor for efficiency rather than AWG size. (Aohai, No. 18 at p. 1) DOE acknowledges that resistance is a significant factor in determining the efficiency of output cords. Resistance of a cord is largely determined by three factors: cross-sectional area, material resistivity, and cable length. Table III.1 specifies the cross-sectional area with AWG, material resistivity with the use of copper, and cord length with an explicit value. DOE believes that specifying these three parameters would sufficiently define the resistance of the testing cable without requiring extra measurements or calculations during the testing procedure.

The CA IOUs stated that there are USB–PD devices with output power levels that are unable to be met with certain cords. Therefore, to ensure repeatable and accurate test results, the CA IOUs proposed that DOE provide specific output cable characteristics for testing USB–PD products rather than the manufacturer-recommended cable. (CA IOUs, No. 25 at p. 5) DOE acknowledges the existence of USB–PD products that require specific output cord requirements. DOE notes that by specifying testing with an output cord as recommended by the EPS manufacturer, the test procedure would measure the energy efficiency of an EPS in a manner representative of how they are used in everyday applications. If practical capabilities of a device are bound by the choice of output cord, a manufacturer would be able to account for this in its output cord recommendation.

AHAM/CTA/OPEI/PMI/PTI and NEEA/ASAP/NRDC supported DOE's proposal to test EPSs with the manufacturer-recommended cord in situations in which no output cord is supplied with the EPS. (NEEA/ASAP/NRDC, No. 27 at p. 4; AHAM/CTA/OPEI/PMI/PTI, No. 26 at p. 2) For instances in which no output cord is supplied or recommended, NEEA/ASAP/NRDC encouraged DOE to specify an output cord for testing, similar to Table III–I in the SNOPR. (NEEA/ASAP/NRDC, No. 27 at p. 4) AHAM/CTA/OPEI/PMI/PTI stated that they are evaluating the proposal for recommending electrical specifications and may provide further comment at a later date. (AHAM/CTA/OPEI/PMI/PTI, No. 26 at p. 2)

ITI supported testing with a DC output cord recommended for use by manufacturers during both the certification process and for assessment testing. ITI suggested that when a manufacturer is unable to specify a DC output cord, DOE should specify electrical specifications for the type of cord to be used for testing. ITI requested that DOE share the data used to make Table III–I in the November 2021 SNOPR. (ITI, No. 22 at pp. 2–3)

The values provided in Table III–I of the November 2021 SNOPR were illustrative examples of potential output cord characteristics based on DOE's observations of the EPS market. DOE sought input from industry on the electrical specifications, and/or whether there exists an industry standard that contains specifications for electrical cables, which DOE could incorporate by reference. 86 FR 60376, 60383. In response to its request, DOE did not receive any data or additional information.

In this final rule, DOE is finalizing its proposal to require that EPSs be tested with the output cord they are shipped with. For EPSs not shipped with an output cord, the EPS must be tested with a manufacturer's recommended output cord. For EPSs not shipped with an output cord and for which the manufacturer does not recommend an output cord, the amendments specify that the EPS must be tested with a 3-foot-long output cord with a conductor thickness that is minimally sufficient to carry the maximum required current.

[18] *See e.g.,* LENCENT USB Wall Charger Plug, 2Pack 17W 3-Port USB Plug Cube Portable Charger sold on *newegg.com, www.regulations.gov/document/EERE2019-BT-TP-0012-0015;* ORICO DCAP–5U 5-Port USB Wall Charger adapter sold on *newegg.com, www.regulations.gov/document/EERE-2019-BT-TP-0012-0014;* Sony Camera Charger UB10 USB to AC Power Adapter sold on *newegg.com, www.regulations.gov/document/EERE-2019-BT-TP-0012-0016.*

F. Other Proposed Amendments

DOE is adopting additional amendments to improve the overall readability and structure of the test procedure. Throughout appendix Z, DOE is removing definitions that are no longer relevant, centralizing the remaining definitions, consolidating generally applicable requirements, and harmonizing the instructions for single-voltage, multiple-voltage, and adaptive EPSs. These revisions improve the readability of the test procedure without resulting in substantive changes.

1. Organization of EPS Definitions

In the December 2019 NOPR, DOE proposed various amendments related to the EPS-related definitions located at 10 CFR 430.2 and appendix Z. 84 FR 67106, 67115. Stakeholders generally did not raise any concerns related to these proposed amendments but suggested further edits to certain definitions, as described in the following sections.

a. Removing Redundant EPS Definitions

In the December 2019 NOPR, DOE proposed to remove certain definitions that had been carried over from previous revisions of appendix Z but are no longer referenced in either the current or the proposed test procedure. *Id.* at 84 FR 67115. Specifically, DOE proposed to remove the definitions of ''apparent power,'' ''instantaneous power,'' ''nameplate input frequency,'' ''nameplate input voltage,'' and ''true power factor.''

DOE did not receive any comments regarding the removal of these redundant definitions and is amending its regulations consistent with the December 2019 NOPR.

Separately, CSA noted that DOE's proposal did not include a definition for ''single-voltage external power supply.'' (CSA, No. 9 at p. 1) DOE interprets this comment as referring to the definition for ''single-voltage external AC–DC power supply.'' DOE did not intend to remove this definition as part of the amendments presented in the December 2019 NOPR and the final rule continues to maintain that definition.

b. Location of EPS Definitions

In the December 2019 NOPR, DOE proposed moving all EPS-related definitions that are currently defined in 10 CFR 430.2 to the EPS test procedure at appendix Z. 84 FR 67106, 67115. Specifically, DOE proposed to move the definitions of ''adaptive external power supply,'' ''basic-voltage external power supply,'' ''direct operation external power supply,'' ''indirect operation external power supply,'' and ''low-voltage external power supply'' from 10 CFR 430.2 to appendix Z. In the December 2019 NOPR, DOE also proposed to include the definition of ''Class A external power supply'' in appendix Z while also retaining it at 10 CFR 430.2. *Id.* at 84 FR 67116. Furthermore, DOE proposed to add a sentence to the definition of an external power supply at 10 CFR 430.2, directing the reader to appendix Z for other EPS-related definitions to ensure that even though the EPS-related definitions were being moved to the test procedure, they would apply throughout 10 CFR part 430, including 10 CFR 430.32. *Id.* at 84 FR 67115. However, in the November 2021 SNOPR, DOE proposed to retain all but the definition of ''adaptive external power supply'' in their current location in 10 CFR 430.2 because these terms are not used elsewhere in the test procedure, superseding what was proposed in the December 2019 NOPR. 86 FR 60376, 60382. DOE noted that as these definitions were largely remaining in 10 CFR 430.2, the proposal to add a sentence to the definition of an external power supply would also no longer be required. *Id.*

DOE did not receive any comment on the proposals made in the November 2021 SNOPR. In this final rule, DOE is amending the test procedure to include the definition of ''adaptive external power supply'' as established in 10 CFR 430.2 in appendix Z as well to allow users of the test procedure to review the definition at once without having to navigate between multiple areas of the CFR. DOE is also finalizing its November 2021 SNOPR proposals to keep the definitions for ''basic-voltage external power supply,'' ''direct operation external power supply,'' ''indirect operation external power supply,'' ''low-voltage external power supply,'' and ''Class A external power supply'' in 10 CFR 430.2.

c. Revising Definition of Active Mode Efficiency

In the December 2019 NOPR, DOE proposed to modify the definition of ''average active-mode efficiency'' in appendix Z to explicitly state that the average active-mode efficiency is the average of the active mode efficiencies at the loading conditions for which an EPS can sustain the output current, rather than the average of the loading conditions. 84 FR 67106, 67115–67116. Under the proposal, this term would be defined as ''the average of the active mode efficiencies at the loading conditions (100%, 75%, 50%, and 25% of the unit under test's nameplate output current) for which that unit can sustain the output current.'' *Id.* As explained in the December 2019 NOPR, this proposal would not change the meaning of the definition; rather it would improve the readability of the test procedure. *Id.*

DOE did not receive any comments on this proposal and is adopting it in this final rule.

2. Consolidating Duplicative Test Requirements

Section 3 of appendix Z currently includes two subsections that specify the test apparatus and general instructions—section 3(a) specifies the requirements for single-voltage EPSs, and section 3(b) specifies the requirements for multiple-voltage EPSs. The requirements in these two subsections are largely the same. In the December 2019 NOPR, DOE proposed to combine these requirements and remove the separate subsections for single-voltage and multiple-voltage EPSs in order to provide a single, unified section for the test apparatus provisions and general instructions. 84 FR 67106, 67116.

DOE also proposed to consolidate the requirements regarding the required test load from sections 4(a)(i)(F) and 4(b)(i)(D) into a new section 4(f) of appendix Z, because this requirement would remain the same across all EPSs. *Id.* Similarly, DOE proposed to consolidate the requirements regarding how to attach power metering equipment from sections 4(a)(i)(A) and 4(b) into new sections 4(g) of appendix Z. *Id.*

The CA IOUs expressed their support for consolidating duplicative test requirements. (CA IOUs, No. 10 at p. 3)

For the reasons discussed in the December 2019 NOPR and in the preceding discussion, DOE adopts these amendments in this final rule. To improve readability of the test procedure, DOE however notes that this final rule further splits the consolidated requirements regarding how to attach power metering equipment into two sections 4(g) and 4(h) and, as a result, also renumbers all subsequent subsection in section 4.

3. Harmonizing Instructions for Single-Voltage and Multiple-Voltage EPSs

In the December 2019 NOPR, DOE proposed to amend sections 4(a) and 4(b) of appendix Z. 84 FR 67106, 67116. These sections provide testing requirements for single-voltage and multiple-voltage EPSs, respectively, and DOE proposed to harmonize these requirements. Applying both a similar structure and common set of instructions to these sections would improve the procedure's readability and

reduce the likelihood of procedural errors during testing. These proposed updates would retain the current testing requirements.

The CA IOUs agreed with DOE's amendments related to the harmonization of instructions for single-voltage and multiple-voltage EPSs (CA IOUs, No. 10 at p. 3)

For the reasons discussed in the December 2019 NOPR and the preceding discussion, DOE adopts these amendments in this final rule.

4. Unsustainable Loading Provisions

Section 4(a)(i)(C)2 of appendix Z specifies for single-voltage EPSs that if the EPS cannot sustain output at one or more of the loading conditions prescribed by the procedure (*i.e.,* 25%, 50%, 75%, and 100%), then it must be tested only at the loading conditions for which it can sustain output, and the average active-mode efficiency is calculated as the average of the loading conditions for which it can sustain the output. In the December 2019 NOPR, DOE proposed to clarify this existing requirement to state that of the outputs that are sustainable, the EPS must be tested at the loading conditions that allow for the maximum output power on that bus (*i.e.,* the highest output current possible at the highest output voltage). 84 FR 67106, 67116.

Further, DOE proposed to reorganize this provision of the test procedure pertaining to unsustainable loading conditions by moving the part of this instruction related to the efficiency calculation to a newly designated section 5(a)(1)(vi), which would specify the requirements for calculating the tested EPS's efficiency. *Id.* DOE also proposed to replicate the same requirements in the newly designated sections 5(b)(1)(vi), 6(a)(1)(vi), and 6(b)(1)(vi) for multiple-voltage, single-voltage adaptive, and multiple-voltage adaptive EPSs, respectively. *Id.*

In response to the December 2019 NOPR, CSA commented that DOE's proposed amendment related to unsustainable loading conditions in sections 5(a)(1)(vi)(C) and 5(b)(1)(vi)(C) is unclear and confusing. CSA asserted that these testing requirements should be applicable only to EPSs that are able to output an additional, higher, nameplate output voltage (*i.e.,* adaptive EPSs). CSA suggested that DOE include an example of an application where an EPS cannot sustain output at one or more of the loading conditions in order to provide additional clarity to the proposed testing requirements. (CSA, No. 8 at p. 1)

To provide additional direction, DOE is revising sections 5(a)(1)(vi)(C) and 5(b)(1)(vi)(C) to state that testing be performed at the loading condition that allows for the maximum output power on that bus *that can be sustained for the duration of the test* (*i.e.,* the highest *sustainable* output current possible at the highest output voltage on that bus). (Additional language from the proposed language shown in italics). While not referenced in the comment from CSA, sections 6(a)(1)(vi)(C) and 6(b)(1)(vi)(C) of appendix Z gave similar instructions for unsustainable loading conditions for adaptive EPSs. To be consistent, DOE is revising these sections to include the additional direction as well. Because this amendment will apply to all types of EPSs, DOE is also including it in the test procedure sections for non-adaptive EPSs as well as adaptive EPSs (sections 5(a)(1)(vi)(C), 5(b)(1)(vi)(C), 6(a)(1)(vi)(C), 6(b)(1)(vi)(C)).

5. Correcting Table References

In the December 2019 NOPR, DOE proposed to revise the current version of section 4(b)(i) of appendix Z to correct a reference error to refer to ''Table 2'' rather than ''Table 1,'' as currently referenced. 84 FR 67106, 67116.

DOE received no comments on this proposal and is adopting this amendment in this final rule.

6. Error in Proposed Regulatory Text

The proposed regulatory text included in the December 2019 NOPR contained an inadvertent error related to the proposed amendments for EPSs with other major functions. Specifically, in the December 2019 NOPR regulatory text, section 4(h) stated:

''(h) While external power supplies must be tested in their final, completed configuration in order to represent their measured efficiency on product labels or specification sheets, any functionality that is unrelated to the external power supply circuit may be disconnected during testing as long as the disconnection does not impact the functionality of the external power supply itself. Test the external power supply in its final configuration to the extent possible (within its enclosure and with all output cords that are shipped with it).'' *Id.* at 84 FR 67125.

However, DOE intended to keep the language of section 4(a)(i)(B) of the current DOE test procedure in the newly designated section 4(i) of the revised test procedure. Section 4(i) is intended to read as follows:

(i) External power supplies must be tested in their final, completed configuration in order to represent their measured efficiency on product labels or specification sheets. Although the same procedure may be used to test the efficiency of a bare circuit board power supply prior to its incorporation into a finished housing and the attachment of its DC output cord, the efficiency of the bare circuit board power supply may not be used to characterize the efficiency of the final product (once enclosed in a case and fitted with a DC). For example, a power supply manufacturer or component manufacturer may wish to assess the efficiency of a design that it intends to provide to an OEM for incorporation into a finished external power supply, but these results may not be used to represent the efficiency of the finished external power supply.

This final rule contains the correct language in new sections 4(i) and 4(j) as described. DOE has also added the phrase ''Except as provided in section 4(j)'' to the beginning of section 4(i) to account for the amendments made regarding the disconnection of certain components of EPSs. This correction does not change the testing requirements for manufacturers, as the requirements for allowing manufacturers to disconnect certain functions unrelated to the power conversion of an EPS is presented in section 4(j) as adopted in this final rule.

G. Measurement and Reporting

Additionally, commenters provided recommendations as to measurement and reporting of power factor for EPSs. The CA IOUs encouraged DOE to consider past and recent comments in support of the measurement and reporting of power factor, and the alignment of load points with the European Union Code of Conduct on External Power Supplies. (CA IOUs, No. 25 at p. 6) NEEA/ASAP/NRDC recommended that DOE measure and report power factor at all active loading conditions. NEEA/ASAP/NRDC asserted that measuring power factor would add little to no incremental test burden and that consideration of power factor has the potential for significant cost-effective energy savings using readily available technologies. (NEEA/ASAP/NRDC, No. 27 at pp. 5–6)

In an AC power system, power factor is defined as the ratio of the real power to the apparent power delivered to a load.[19] An EPS that results in a low power factor represents a load that draws more current than a load with a high-power factor for the same amount of useful work performed, with the higher currents resulting in increased losses in the distribution system. DOE

[19] IEC 62301 defines ''power factor'' as the ratio of the measured real power to the measured apparent power.

notes that it did not propose to include provisions for the measurement of power factor in the December 2019 NOPR or the November 2021 SNOPR and is therefore unable to adopt such a measurement in this final rule.

NEEA/ASAP/NRDC recommended that DOE require measurement and reporting of a 10% loading point separately from the active power measurement due to its frequent use in applications, current standards in Europe, and to provide an avenue for improved efficiency options. (NEEA/ASAP/NRDC, No. 27 at pp. 3–4)

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)) A 10% loading condition would not be a standby mode or off mode condition and, therefore, if adopted, it would need to be integrated into the current average active mode efficiency calculation, which currently averages the 25%, 50%, 75%, and 100% loading conditions. DOE currently does not have robust data demonstrating how an additional measurement at a 10% loading condition would improve the representativeness of an EPS during an average use cycle. Consequently, DOE is declining to amend its specified loading conditions to include a measurement at 10% load in this final rule at this time.

H. Effective and Compliance Dates

The effective date for the adopted test procedure amendment will be 30 days after publication of this final rule in the **Federal Register**. EPCA prescribes that all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with an amended test procedure, beginning 180 days after publication of the final rule in the **Federal Register**. (42 U.S.C. 6293(c)(2))

The 180-day mandate applies to all test procedure changes in this final rule with the exception of amendments related to testing EPSs that are not supplied with an output cord. Those requirements will not be required until such time as DOE were to amend the energy conservation standards for EPSs. As discussed previously in this document, appendix Z did not explicitly provide instructions for testing EPSs that are supplied without an output cord. Under the amended test procedure, a manufacturer will be required to test with a recommended output cord only at such time as compliance is required with amended energy conservation standards, should such standards be amended.

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 in this final rule, 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)(3). Recipients of any such waivers are 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. The amendments adopted in this document pertain to issues addressed by waivers granted to Apple, Microsoft, Poin2, Bitland, Huawei, and Anker for testing USB–PD EPSs (Case Nos. EPS–001, EPS–002, EPS–003, EPS–004, 2017–014, 2018–005, 2018–010, 2019–005). The waivers issued to Apple, Microsoft, Poin2, Bitland, and Huawei will expire on the date on which testing is required using the amended test procedure. At such time Apple, Microsoft, Poin2, Bitland, and Huawei will be required to test the EPSs subject to the waivers according to the amended Federal test procedure.

I. Test Procedure Costs

In this final rule, DOE amends the existing test procedure for EPSs by (1) clarifying the scope of the EPS test procedure at appendix Z by removing references to direct operation and indirect operation Class A EPSs and providing additional detail regarding the coverage of the test procedure; (2) providing supplemental detail for testing certain EPS configurations, including EPSs with multiple ports and EPS that include additional major functions; (3) addressing adaptive EPSs to reflect current industry testing standards and provide more representative results; (4) providing additional specification for the testing of EPSs that do not ship with an output cord; and (5) consolidating duplicative testing requirements, harmonizing testing requirements for single-voltage and multiple-voltage EPSs, and improving organization of the test provisions regarding unsustainable loading conditions. DOE has determined that these amendments will not be unduly burdensome for manufacturers to conduct.

DOE has determined that the test procedure, as amended by this final rule, would not impact testing costs. A further discussion of the cost impacts of the test procedure amendments are presented in the following paragraphs.

1. Scope of Applicability

DOE is codifying published guidance to more explicitly exclude from coverage of the test procedure power supplies that are used to operate non-consumer products. As DOE is codifying existing guidance, this amendment will not impact the scope of the test procedure. DOE is also removing references to direct operations EPS and indirect operation Class A EPSs from appendix Z. Removal of these references will not change the existing scope of the test procedure, and this amendment simply reflects that the test procedure requires both types of EPSs to be tested in the same way.

Additionally, DOE is clarifying that devices for which the primary load of the converted voltage within the device is not delivered to a separate end-use product are not subject to the EPS test procedure. As discussed in the prior sections of this document, the additional direction regarding the exclusion of EPSs for which the primary load of the converted voltage within the device is not delivered to a separate end-use product reflects the current application of the test procedure.

For the reasons discussed, DOE has determined that the amendments related to the scope of the test procedure will outline more precisely the existing scope of the test procedure but will not change its scope, and therefore will not increase testing costs.

2. EPS Configurations

DOE is providing more explicit instructions for testing single-voltage EPSs that have multiple-output busses. For these EPSs, the amendment will not change the existing testing requirements but will improve the readability of the existing requirements. This amendment

provides supplemental detail but does not require manufacturers to test EPSs any differently and will not result in any changes in the associated testing cost compared to the current test procedure. Further, DOE is clarifying the testing requirements for adaptive EPSs that also operate as multiple-voltage EPSs. These amendments will not change the existing testing requirements for these types of EPSs, but rather provide additional detail and more specific instructions for these types of EPSs, consistent with how such EPSs are currently tested and rated. Consequently, these amendments will not require re-testing or re-rating of any existing EPSs with both adaptive and non-adaptive ports. Accordingly, these amendments will not result in any additional costs compared to the current test procedure.

DOE is also providing further instructions on how to test EPSs that have other major functions. As proposed in the December 2019 NOPR and amended in this final rule, an EPS that has components and circuits unrelated to the EPS functionality may be disconnected during testing as long as that disconnection does not impact the functionality of the EPS itself. These amendments will provide supplemental detail but not require manufacturers to test EPSs any differently. DOE anticipates no change in the associated testing cost to result from this change compared to the current test procedure.

3. Adaptive EPSs

With respect to USB–PD EPSs, DOE is adopting amendments based on the previously described petitions for waiver that were granted for these products. In conjunction with these amendments, because EPSs are required to be tested at their nameplate output power, DOE is amending the definition of ''nameplate output power'' to provide an exception for USB–PD EPSs, which would be defined as the product of 2 amps and the lowest operating voltage. The final rule changes the operating point at which testing is performed but does not require any additional tests beyond those already required under the current test procedure. Hence, manufacturers would not incur any additional costs compared to the existing test procedure.

Manufacturers will be able to continue to rely on data generated under the test procedure, including any alternate test procedure permitted by DOE under a manufacturer-specific decision and order, using the amendments finalized in this final rule.

DOE also notes that manufacturers were required to submit waiver petitions for USB–PD EPS basic models that required testing under the alternate test procedure outlined in section III.D.1 of this section. Thus, the adopted amendments related to USB–PD EPSs do not increase test burden but instead codify the existing test procedure requirements for USB–PD EPSs as specified in the waiver decisions and orders already granted to Apple, Microsoft, Poin2, Bitland, Huawei, and Anker.

4. Output Cords

DOE is providing instructions for EPSs that are not shipped with an output cord, stating that the EPS must be tested with a manufacturer-recommended output cord. If a cord is not recommended, then the EPS will be tested with a 3-foot-long output cord with a conductor thickness that is minimally sufficient to carry the required maximum current. The extent to which this amendment would impact the measured energy use of EPSs that are currently certified is uncertain. As established in this final rule, testing to this provision will not be required until such time as compliance is required with amended energy conservation standards, should such standards be adopted. However, DOE does not expect the cost of testing an EPS with an output cord to be different than testing one without an output cord. DOE also does not expect manufacturers to incur costs associated with obtaining output cords as it is reasonable to assume manufacturers will already have cords used to develop their EPS designs. Hence, manufacturers would not incur any additional costs as a result of this amendment.

5. Additional Amendments

In addition to the amendments described, DOE is also revising the test procedure to improve its readability. These changes include, but are not limited to, centralizing definitions, correcting references, and adding additional text to clarify certain instructions. As these changes are meant to support the current test procedure and improve its implementation, DOE does not expect manufacturers to incur any additional burden or costs relative to the current test procedure.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Executive Order (''E.O.'') 12866, ''Regulatory Planning and Review,'' as supplemented and reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs (''OIRA'') in the Office of Management and Budget (''OMB'') has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit ''significant regulatory actions'' to OIRA for review. OIRA has determined that this final regulatory action does not constitute a ''significant regulatory action'' under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of a final regulatory flexibility analysis (''FRFA'') for any final rule where the agency was first required by law to publish a proposed rule 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 test procedure final rule pursuant to the Regulatory Flexibility Act and the procedures and policies previously discussed. DOE has concluded that this rule will not have a significant impact on a substantial number of small entities. The factual basis for this certification is set forth below. DOE did not receive any comments regarding the certification.

For manufacturers of EPSs, the Small Business Administration (''SBA'') has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 13 CFR part 121. 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-tablesize-standards.* EPS manufacturing is classified under NAICS 335999, ''all other miscellaneous electrical equipment and component manufacturing.'' The SBA sets a threshold of 500 employees or less for an entity to be considered as a small business in this category. This employment figure is enterprise-wide, encompassing employees at all parent, subsidiary, and sister corporations. DOE consulted the CCD (*i.e.,* DOE's Compliance Certification Database) to determine the total number of manufacturers that meet the SBA's definition of a ''small business.'' Due to the wide variety of applications that use EPSs, there were numerous EPS manufacturers listed in the CCD. DOE screened out companies that do not meet the SBA definition of a small business and also those that are entirely or largely foreign-owned and operated. DOE identified as many as 164 potential domestic small businesses manufacturing or otherwise selling EPSs. However, as previously stated, DOE does not expect that the amended test procedure will result in manufacturers incurring additional testing costs—accordingly, DOE does not expect increased costs for small businesses as a result of the amendments to the test procedure.

Therefore, DOE concludes that the cost effects accruing from the final rule would not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of a FRFA is not warranted. DOE has submitted a certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of EPSs 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 EPSs. (*See generally* 10 CFR part 429, subpart B.) 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.

DOE is not amending the certification or reporting requirements for EPSs in this final rule. Instead, DOE may consider proposals to amend the certification requirements and reporting for EPSs under a separate rulemaking regarding appliance and equipment certification. DOE will address changes to OMB Control Number 1910–1400 at that time, as necessary.

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 final rule, DOE establishes test procedure amendments that it expects will be used to develop and implement future energy conservation standards for EPSs. DOE has determined that this final 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 (August 10, 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 examined this final rule and determined that it will 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 final 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, this final 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 regulatory action resulting 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 *www.energy.gov/gc/office-general-counsel.* DOE examined this final 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 final rule will 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 regulation will 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 final 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 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 significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

This regulatory action is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, 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.

While the modifications to the test procedure for EPSs do not incorporate any new industry standards, DOE has nevertheless consulted both with the Attorney General and the Chairman of the FTC. Neither had any comments regarding DOE's proposed actions.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule before its effective date. The report will state that it has been

determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

N. Description of Materials Incorporated by Reference

In this final rule, DOE maintains the current incorporation by reference of IEC 62301 Ed. 2.0 in 10 CFR 430.3 and appendix Z to subpart B, creating a new section 0 in appendix Z, titled ''Incorporation by Reference,'' to enumerate the specific provisions of the standard that are applicable to the EPS test procedure in appendix Z. Specifically, section 0 of appendix Z would limit use of the material incorporated by reference to the following sections of IEC 62301:

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

Section 4.4.1, ''Power measurement uncertainty;''

Section 5.3.3, ''Average reading method;''

Annex B, ''Notes on the measurement of low power modes;'' and

Annex D, ''Determination of uncertainty of measurement.''

IEC 62301 is an industry-accepted standard for measuring the standby power of household electrical appliances. This standard continues to be reasonably available and can be obtained from the American National Standards Institute at the following address:

American National Standards Institute, 25 W 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4936, or by visiting *webstore.ansi.org.*

V. Approval of the Office of the Secretary

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

List of Subjects in 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 July 21, 2022, by Kelly J. Speakes-Backman, Principal Deputy 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 July 21, 2022.

Treena V. Garrett,

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

For the reasons stated in the preamble, DOE amends part 430 of chapter II of title 10, Code of Federal Regulations as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 2. Section 430.2 is amended by:

■ a. Removing the definition for ''Adaptive external power supply'';

■ b. Adding, in alphabetical order, a definition for ''Commercial and industrial power supply''; and

■ c. Revising the definition for ''External power supply.''

The addition and revision read as follows:

§ 430.2 Definitions.

* * * * *

Commercial and industrial power supply means a power supply that is used to convert electric current into DC or lower-voltage AC current, is not distributed in commerce for use with a consumer product, and may include any of the following characteristics:

(1) A power supply that requires 3-phase input power and that is incapable of operating on household mains electricity;

(2) A DC–DC-only power supply that is incapable of operating on household mains electricity;

(3) A power supply with a fixed, non-removable connection to an end-use device that is not a consumer product as defined under the Act;

(4) A power supply whose output connector is uniquely shaped to fit only an end-use device that is not a consumer product;

(5) A power supply that cannot be readily connected to an end-use device that is a consumer product without significant modification or customization of the power supply itself or the end-use device;

(6) A power supply packaged with an end-use device that is not a consumer product, as evidenced by either:

(i) Such device being certified as, or declared to be in conformance with, a specific standard applicable only to non-consumer products. For example, a power supply model intended for use with an end-use device that is certified to the following standards would not meet the EPCA definition of an EPS:

(A) CISPR 11 (Class A Equipment), ''Industrial, scientific and medical equipment—Radio-frequency disturbance—Limits and methods of measurement'';

(B) UL 1480A, ''Standard for Speakers for Commercial and Professional Use'';

(C) UL 813, ''Standard for Commercial Audio Equipment''; and

(D) UL 1727, ''Standard for Commercial Electric Personal Grooming Appliances''; or

(ii) Such device being excluded or exempted from inclusion within, or conformance with, a law, regulation, or broadly-accepted industry standard where such exclusion or exemption applies only to non-consumer products;

(7) A power supply distributed in commerce for use with an end-use device where:

(i) The end-use device is not a consumer product, as evidenced by either the circumstances in paragraph (6)(i) or (ii) of this definition; and

(ii) The end-use device for which the power supply is distributed in commerce is reasonably disclosed to the public, such as by identification of the end-use device on the packaging for the power supply, documentation physically present with the power supply, or on the manufacturer's or private labeler's public website; or

(8) A power supply that is not marketed for residential or consumer use, and that is clearly marked (or, alternatively, the packaging of the individual power supply, the shipping container of multiple such power supplies, or associated documentation physically present with the power supply when distributed in commerce is clearly marked) ''FOR USE WITH COMMERCIAL OR INDUSTRIAL EQUIPMENT ONLY'' or ''NOT FOR RESIDENTIAL OR CONSUMER USE,'' with the marking designed and applied so that the marking will be visible and legible during customary conditions for the item on which the marking is placed.

* * * * *

External power supply means an external power supply circuit that is used to convert household electric current into DC current or lower-voltage

AC current to operate a consumer product. However, the term does not include any ''commercial and industrial power supply'' as defined in this section, or a power supply circuit, driver, or device that is designed exclusively to be connected to, and power—

(1) Light-emitting diodes providing illumination;

(2) Organic light-emitting diodes providing illumination; or

(3) Ceiling fans using direct current motors.

* * * * *

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

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

* * * * *

(bb) *External Power Supplies.* The energy consumption of an external power supply, including active-mode efficiency expressed as a percentage and the no-load, off, and standby mode energy consumption levels expressed in watts, shall be measured in accordance with appendix Z of this subpart.

* * * * *

■ 4. Appendix Z is revised to read as follows:

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

Note: Starting on February 15, 2023, manufacturers must make any representations regarding the energy efficiency or power consumption of external power supplies based upon results generated under this appendix. Prior to that date, manufacturers must make any representations regarding the energy efficiency or power consumption of external power supplies based upon results generated under this appendix as it appeared at 10 CFR part 430, subpart B revised as of January 1, 2021. The provisions at section (4)(g) of this appendix regarding the testing of units for which a wire or cord is not provided by the manufacturer are not required for use until such time as compliance is required with any amended standards for external power supplies provided in § 430.32(w) that are published after January 1, 2021.

0. *Incorporation by reference.*

DOE incorporated by reference the entire standard for IEC 62301 in § 430.3; however, only enumerated provisions of this document are applicable to this appendix, as follows:

0.1 IEC 62301, (''IEC 62301''), Household electrical appliances—Measurement of standby power, (Edition 2.0, 2011–01), as follows:

(a) Section 4.3.2 ''Supply voltage waveform,'' as referenced in section 3 of this appendix;

(b) Section 4.4.1 ''Power measurement uncertainty,'' as referenced in section 4 of this appendix;

(c) Section 5.3.3 ''Average reading method,'' as referenced in sections 5 and 6 of this appendix;

(d) Annex B ''Notes on the measurement of low power modes,'' as referenced in section 4 of this appendix; and

(e) Annex D ''Determination of uncertainty of measurement,'' as referenced in section 4 of this appendix. 0.2 Reserved.

1. [Reserved]

2. *Scope:* This appendix covers the test requirements used to measure the energy consumption of external power supplies subject to the energy conservation standards set forth at § 430.32(w)(1). Additionally, this appendix does not apply to external power supplies for which the primary load of the converted voltage within the device is not delivered to a separate end-use product, *i.e.,* products in which the primary load of converted voltage is delivered within the device itself to execute the primary function of the device. Examples of excluded products may include, but are not limited to, consumer electronics with USB outputs and lighting products with USB outputs.

3. *Definitions:* The following definitions are for the purposes of understanding terminology associated with the test method for measuring external power supply energy consumption.

Active mode means the mode of operation when the external power supply is connected to the main electricity supply and the output is (or ''all outputs are'' for external power supplies with multiple outputs) connected to a load (or ''loads'' for external power supplies with multiple outputs).

Active mode efficiency is the ratio, expressed as a percentage, of the total real output power produced by a power supply to the real input power required to produce it. IEEE Standard 1515–2000, 4.3.1.1 (Reference for guidance only, see § 430.4.)

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

$$P = \frac{1}{T}\int_{0}^{T} v(t)i(t)dt$$

Adaptive external power supply means an external power supply that can alter its output voltage during active-mode based on an established digital communication protocol with the end-use application without any user-generated action.

Ambient temperature means the temperature of the ambient air immediately surrounding the unit under test.

Average Active-Mode Efficiency means the average of the active mode efficiencies at the loading conditions (100, 75, 50 percent, and 25 percent of unit under test's nameplate output current) for which that unit can sustain the output current.

Manual on-off switch is a switch activated by the user to control power reaching the device. This term does not apply to any mechanical, optical, or electronic switches that automatically disconnect mains power from the device when a load is disconnected from the device, or that control power to the load itself.

Minimum output current means the minimum current that must be drawn from an output bus for an external power supply to operate within its specifications.

Multiple-voltage external power supply means an external power supply that is designed to convert line voltage AC input into more than one simultaneous lower-voltage output.

Nameplate output current means the current output of the power supply as specified on the manufacturer's label on the power supply housing (either DC or AC) or, if absent from the housing, as provided by the manufacturer.

Nameplate output power means the power output of the power supply as specified on the manufacturer's label on the power supply housing or, if absent from the housing, as specified in documentation provided by the manufacturer. For an adaptive external power supply with USB–PD ports, in place of the nameplate output power at the lowest voltage, use an output power calculated as the product of its lowest nameplate output voltage and 2 amps for each USB–PD port and as specified on the manufacturer's label or documentation at the highest voltage. This definition only applies to DOE testing and certification requirements and is unrelated to the physical nameplate label or documentation of an EPS.

Nameplate output voltage means the voltage output of the power supply as specified on the manufacturer's label on the power supply housing (either DC or AC).

No-load mode means the mode of operation when an external power supply is connected to the main electricity supply and the output is (or ''all outputs are'' for a multiple-voltage external power supply) not connected to a load (or ''loads'' for a multiple-voltage external power supply).

Off-mode is the condition, applicable only to units with manual on-off switches, in which the external power supply is:

(1) Connected to the main electricity supply;

(2) The output is not connected to any load; and

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

Output bus means any of the outputs of the power supply to which loads can be connected and from which power can be drawn, as opposed to signal connections used for communication.

RMS means root mean square.

Single-voltage external AC–AC power supply means an external power supply that is designed to convert line voltage AC input into lower voltage AC output and is able to convert to only one AC output voltage at a time.

Single-voltage external AC–DC power supply means an external power supply that is designed to convert line voltage AC input into lower-voltage DC output and is able to convert to only one DC output voltage at a time.

Standby mode means the condition in which the external power supply is in no-load mode and, for external power supplies with manual on-off switches, all such switches are turned on.

Switch-selectable single voltage external power supply means a single-voltage AC–AC or AC–DC power supply that allows users to choose from more than one output voltage.

Total harmonic distortion (THD), expressed as a percentage, is the 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. THD of current is defined as:

$$THD = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + \cdots I_n^2}}{I_1}$$

where I_n is the RMS value of the nth harmonic of the current signal.

Unit under test (UUT) is the external power supply being tested.

USB Power Delivery (USB–PD) EPS means an adaptive EPS that utilizes a USB Type-C output port and uses a digital protocol to communicate between the EPS and the end-use product to automatically switch between any output voltage within the range of 3.3 volts to 20 volts. The USB–PD output bus must be capable of delivering 3 amps at the lowest output voltage, and the currents must not exceed any of the following values for the supported voltages: 3 amps at 9 volts; 3 amps at 15 volts; and 5 amps at 20 volts.

USB Type-C means the reversible 24-pin physical USB connector system that supports USB–PD and allows for the transmission of data and power between compatible USB products.

4. *Test Apparatus and General Instructions*

(a) Any power measurements recorded, as well as any power measurement equipment utilized for testing, shall conform to the uncertainty and resolution specifications in Section 4.4.1, ''Power measurement uncertainty,'' as well as Annexes B, ''Notes on the measurement of low power modes,'' and D, ''Determination of uncertainty of measurement,'' of IEC 62301.

(b) Carry out tests in a room that has an air speed close to the UUT of ≤0.5 m/s. Maintain ambient temperature at 20 ± 5 °C throughout the test. Do not intentionally cool the UUT, for example, by use of separately powered fans, air conditioners, or heat sinks. Test the UUT on a thermally non-conductive surface. Products intended for outdoor use may be tested at additional temperatures, provided those are in addition to the conditions specified and are noted in a separate section on the test report.

(c) If the UUT is intended for operation on AC line-voltage input in the United States, test it 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, do not test it. Ensure the input voltage is within ±1 percent of the above specified voltage and the input frequency is within ±1 percent of the specified frequency.

(d) The input voltage source must be capable of delivering at least 10 times the nameplate input power of the UUT as is specified in IEEE 1515–2000 (Referenced for guidance only, see § 430.4). Regardless of the AC source type, the THD of the supply voltage when supplying the UUT in the specified mode must not exceed 2 percent, up to and including the 13th harmonic. The peak value of the test voltage must be within 1.34 and 1.49 multiplied by its RMS value.

(e) Select all leads used in the test set-up with appropriate wire gauges and lengths to minimize voltage drops across the wires during testing. See Table B.2 — ''Commonly used values for wire gages [*sic*] and related voltage drops'' in IEEE 1515–2000 for further guidance.

(f) Test Load. To load the power supply to produce all active-mode loading conditions, use passive loads, such as rheostats, or active loads, such as electronic loads. Resistive loads need not be measured precisely with an ohmmeter; simply adjust a variable resistor to the point where the ammeter confirms that the desired percentage of nameplate output current is flowing. For electronic loads, adjust the desired output current in constant current mode rather than adjusting the required output power in constant power mode.

(g) Test the external power supply at the end of the wire or cord that connects to an end-use product, regardless of whether the end of the wire or cord is integrated into an end-use product or plugs into and out of an end-use product. If a separate wire or cord is provided by the manufacturer to connect the external power supply to an end-use product, use this wire or cord and perform tests at the end of the cord that connects to an end-use product. An external power supply that is not supplied with a wire or cord must be tested with a wire or an output cord recommended by the manufacturer. If the external power supply is not supplied with a wire or cord and for which the manufacturer does not recommend one, the EPS must be tested with a 3-foot-long output wire or cord with a conductor thickness that is minimally sufficient to carry the maximum required current.

(1) If the connection to an end-use product is removable, there are two options for connecting metering equipment to the output connection of the external power supply:

(i) Cut the cord immediately adjacent to the output connector, or

(ii) Attach leads and measure the efficiency from the output connector itself.

(2) If the connection to an end-use product is not removable, cut the cord immediately adjacent to the powered product and connect metering equipment at that point.

(h) Conduct the tests on the sets of output wires that constitute the output busses. If the product has more than two output wires, including those wires that are necessary for controlling the product, the manufacturer must supply a connection diagram or test fixture that will allow the testing laboratory to put the UUT into active mode. Figure 1 of this section provides one illustration of how to set up a single-voltage external power supply for testing; however, the actual test setup may vary pursuant to the type of external power supply being tested and the requirements of this appendix.

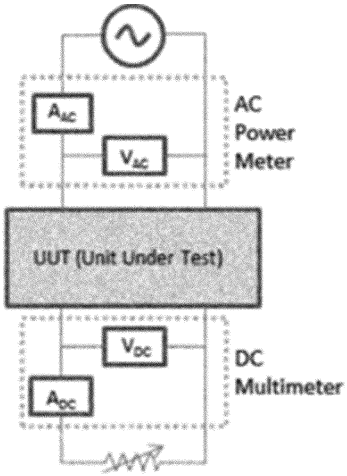

Figure 1. Example Connection Diagram for Single-Voltage External Power Supply Efficiency Measurements

(i) Except as provided in section 4(j) of this appendix, external power supplies must be tested in their final, completed configuration in order to represent their measured efficiency on product labels or specification sheets. Although the same procedure may be used to test the efficiency of a bare circuit board power supply prior to its incorporation into a finished housing and the attachment of its DC output cord, the efficiency of the bare circuit board power supply may not be used to characterize the efficiency of the final product (once enclosed in a case and fitted with a DC output cord). For example, a power supply manufacturer or component manufacturer may wish to assess the efficiency of a design that it intends to provide to an OEM for incorporation into a finished external power supply, but these results may not be used to represent the efficiency of the finished external power supply.

(j) If a product serves one or more other major functions in addition to converting household electric current into DC current or lower-voltage AC current, components of the product that serve other functions may be disconnected before testing so that test measurements do not include power used by other functions and as long as disconnecting such components do not affect the ability of the product to convert household electric current into DC current or lower-voltage AC current. For example, consider an EPS that also acts as a surge protector that offers outlets supplying AC household electric current and one or more USB outputs supplying DC current. If power is provided to the AC outlets through a surge protection circuit, but power to the USB outlet(s) is not, then the surge protection circuit may be disconnected from AC power during testing. Similarly, if a lighted manual on-off switch disconnects power only to the AC outlets, but not the USB outputs, then the manual on-off switch may be turned off and power to the light disconnected during testing. If a disconnection is performed by a technician, the disconnection must be able to be replicated by a third-party test facility.

5. *Test Measurement for all External Power Supplies Other than Adaptive External Power Supplies:*

(a) Single-Voltage External Power Supply

(1) Standby Mode and Active-Mode Measurement.

(i) Place in the ''on'' position any built-in switch in the UUT controlling power flow to the AC input and note the existence of such a switch in the final test report.

(ii) Operate the UUT at 100 percent of nameplate output current for at least 30 minutes immediately prior to conducting efficiency measurements. After this warm-up period, monitor 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 5 percent from the maximum value observed, the UUT is considered stable. If the UUT is stable, record the measurements obtained at the end of this 5-minute period. Measure subsequent loading conditions under the same 5-minute stability parameters. Note that only one warm-up period of 30 minutes is required for each UUT at the beginning of the test procedure. If the AC input power is not stable over a 5-minute period, follow the guidelines established by Section 5.3.3 of IEC 62301 for measuring average power or accumulated energy over time for both input and output.

(iii) Test the UUT at the nameplate output voltage(s) at the loading conditions listed in Table 1, derated per the proportional allocation method presented in section 5(a)(1)(iv) of this appendix. Conduct efficiency measurements in sequence from Loading Condition 1 to Loading Condition 4 as indicated in Table 1 of this section. For Loading Condition 5, place the UUT in no-load mode, disconnect any additional signal connections to the UUT, and measure input power.

TABLE 1—LOADING CONDITIONS FOR UNIT UNDER TEST

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

Note: The 2 percent allowance pertains to nameplate output current, not the calculated current value. For example, a UUT at Loading Condition 3 may be tested in a range from 48 percent to 52 percent of the derated output current.

(A) If testing of additional, optional loading conditions is desired, conduct that testing in accordance with this test procedure and subsequent to completing the sequence described in section 5(a)(1)(iii) of this appendix.

(B) Where the external power supply lists both an instantaneous and continuous output current, test the external power supply at the continuous condition only.

(C) If an external power supply cannot sustain output at one or more of the Loading Conditions 1–4 as specified in Table 1 of this section, test the external power supply only at the loading conditions for which it can sustain output.

(iv) Use the following proportional allocation method to provide consistent loading conditions for single-voltage external power supplies with multiple-output busses. For additional explanation (provided for guidance only), please refer to section 6.1.1 of the California Energy Commission's ''Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies Revision 6.7,'' March 2014.

(A) Consider a power supply with N output busses, each with the same nameplate output voltages V_1, * * *, V_N, corresponding output current ratings I_1, * * *, I_N, and a nameplate output power P. Calculate the derating factor D by dividing the power supply maximum output power P by the sum of the maximum output powers of the individual output busses, equal to the product of port nameplate output voltage and current I_iV_i, as follows:

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

(B) If D ≥1, then loading every port to its nameplate output current does not exceed the overall maximum output power for the power supply. In this case, load each output bus to the percentages of its nameplate output current listed in Table 1 of this section. However, if D <1, it is an indication that loading each port to its nameplate output current will exceed the overall maximum output power for the power supply. In this case, and at each loading condition, load each output bus to the appropriate percentage of its nameplate output current as listed in Table 1, multiplied by the derating factor D.

(v) Test switch-selectable single-voltage external power supplies twice—once at the highest nameplate output voltage and once at the lowest.

(vi) Efficiency calculation. Calculate and record efficiency at each loading point by dividing the UUT's measured active output power at a given loading condition by the active AC input power measured at that loading condition.

(A) Calculate and record average efficiency of the UUT as the arithmetic mean of the efficiency values calculated at Loading Conditions 1, 2, 3, and 4 in Table 1 of this section.

(B) If, when tested, a UUT cannot sustain output current at one or more of the loading conditions as specified in Table 1, the average active-mode efficiency is calculated as the average of the loading conditions for which it can sustain output.

(C) If the UUT can only sustain one output current at any of the output busses, test it at the loading condition that allows for the maximum output power on that bus (*i.e.,* the highest output current possible at the highest output voltage on that bus).

(vii) Power consumption calculation. The power consumption of Loading Condition 5 (no-load) is equal to the active AC input power (W) at that loading condition.

(viii) Off-Mode Measurement. If the UUT incorporates manual on-off switches, place the UUT in off-mode, and measure and record its power consumption at Loading Condition 5 in Table 1 of this section. The measurement of the off-mode energy consumption must conform to the requirements specified in section 5(a)(1) of this appendix, except that all manual on-off

switches must be placed in the ''off'' position for the off-mode measurement. The UUT is considered stable if, over 5 minutes with samples taken at least once every second, the AC input power does not drift from the maximum value observed by more than 1 percent or 50 milliwatts, whichever is greater. Measure the off-mode power consumption of a switch-selectable single-voltage external power supply twice—once at the highest nameplate output voltage and once at the lowest.

(b) Multiple-Voltage External Power Supply.

(1) Standby-Mode and Active-Mode Measurement.

(i) Place in the ''on'' position any built-in switch in the UUT controlling power flow to the AC input and note the existence of such a switch in the final test report.

(ii) Operate the UUT at 100 percent of nameplate output current for at least 30 minutes immediately prior to conducting efficiency measurements. After this warm-up period, monitor 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 percent from the maximum value observed, the UUT is considered stable. If the UUT is stable, record the measurements obtained at the end of this 5-minute period. Measure subsequent loading conditions under the same 5-minute stability parameters. Note that only one warm-up period of 30 minutes is required for each UUT at the beginning of the test procedure. If the AC input power is not stable over a 5-minute period, follow the guidelines established by Section 5.3.3 of IEC 62301 for measuring average power or accumulated energy over time for both input and output.

(iii) Test the UUT at the nameplate output voltage(s) at the loading conditions listed in Table 2 of this section, derated per the proportional allocation method presented in section 5(b)(1)(iv) of this appendix. Active or passive loads used for efficiency testing of the UUT must maintain the required current loading set point for each output voltage within an accuracy of ±0.5 percent. Conduct efficiency measurements in sequence from Loading Condition 1 to Loading Condition 4 as indicated in Table 2 of this section. For Loading Condition 5, place the UUT in no-load mode, disconnect any additional signal connections to the UUT, and measure input power.

TABLE 2—LOADING CONDITIONS FOR UNIT UNDER TEST

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

Note: The 2 percent allowance pertains to nameplate output current, not the calculated current value. For example, a UUT at Loading Condition 3 may be tested in a range from 48 percent to 52 percent of the derated output current.

(A) If testing of additional, optional loading conditions is desired, conduct that testing in accordance with this test procedure and subsequent to completing the sequence described in section 5(b)(1)(iii) of this appendix.

(B) Where the external power supply lists both an instantaneous and continuous output current, test the external power supply at the continuous condition only.

(C) If an external power supply cannot sustain output at one or more of the Loading Conditions 1–4 as specified in Table 2 of this section, test the external power supply only at the loading conditions for which it can sustain output.

(iv) Use the following proportional allocation method to provide consistent loading conditions for multiple-voltage external power supplies. For additional explanation (provided for guidance only), please refer to section 6.1.1 of the California Energy Commission's ''Proposed Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies Revision 6.7,'' March 2014.

(A) Consider a power supply with N output busses, and nameplate output voltages V_1, * * *, V_N, corresponding output current ratings I_1, * * *, I_N, and a maximum output power P as specified on the manufacturer's label on the power supply housing, or, if absent from the housing, as specified in the documentation provided with the unit by the manufacturer. Calculate the derating factor D by dividing the power supply maximum output power P by the sum of the maximum output powers of the individual output busses, equal to the product of bus nameplate output voltage and current I_iV_i, as follows:

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

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

(v) Minimum output current requirements. Depending on their application, some multiple-voltage power supplies may require a minimum output current for each output bus of the power supply for correct operation. In these cases, ensure that the load current for each output at Loading Condition 4 in Table 2 is greater than the minimum output current requirement. Thus, if the test method's calculated load current for a given voltage bus is smaller than the minimum output current requirement, the minimum output current must be used to load the bus. This load current shall be properly recorded in any test report.

(vi) Efficiency calculation. Calculate and record efficiency at each loading point by dividing the UUT's measured active output power at a given loading condition by the active AC input power measured at that loading condition.

(A) Calculate and record average efficiency of the UUT as the arithmetic mean of the efficiency values calculated at Loading Conditions 1, 2, 3, and 4, in Table 2 of this section.

(B) If, when tested, a UUT cannot sustain output current at one or more of the loading conditions as specified in Table 2 of this section, the average active mode efficiency is calculated as the average of the loading conditions for which it can sustain output.

(C) If the UUT can only sustain one output current at any of the output busses, test it at the loading condition that allows for the maximum output power on that bus (*i.e.,* the highest output current possible at the highest output voltage on that bus).

(vii) Power consumption calculation. The power consumption of Loading Condition 5 (no-load) is equal to the active AC input power (W) at that loading condition.

(2) Off-mode Measurement—If the UUT incorporates manual on-off switches, place the UUT in off-mode and measure and record its power consumption at Loading Condition 5 in Table 2 of this section. The measurement of the off-mode energy consumption must conform to the requirements specified in section (5)(b)(1) of this appendix, except that all manual on-off switches must be placed in the ''off'' position for the off-mode measurement. The UUT is considered stable if, over 5 minutes with samples taken at least once every second, the AC input power does not drift from the maximum value observed by more than 1 percent or 50 milliwatts, whichever is greater.

6. *Test Measurement for Adaptive External Power Supplies:*

(a) Single-Voltage Adaptive External Power Supply.

(1) Standby Mode and Active-Mode Measurement.

(i) Place in the ''on'' position any built-in switch in the UUT controlling power flow to the AC input and note the existence of such a switch in the final test report.

(ii) Operate the UUT at 100 percent of nameplate output current for at least 30 minutes immediately prior to conducting efficiency measurements. After this warm-up period, monitor 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 5 percent from the maximum value observed, the UUT is considered stable. If the UUT is stable, record the measurements obtained at the end of this 5-minute period. Measure subsequent loading conditions under the same 5-minute stability parameters. Note that only one warm-up period of 30 minutes is required for each UUT at the beginning of the test procedure. If the AC input power is not stable over a 5-minute period, follow the guidelines established by Section 5.3.3 of IEC 62301 for measuring average power or accumulated energy over time for both input and output.

(iii) Test the UUT at the nameplate output voltage(s) at the loading conditions listed in Table 3 of this section, derated per the proportional allocation method presented in section 6(a)(1)(iv) of this appendix. Adaptive external power supplies must be tested twice—once at the highest nameplate output voltage and once at the lowest nameplate output voltage as described in the following sections.

(A) At the highest nameplate output voltage, test adaptive external power supplies in sequence from Loading Condition 1 to Loading Condition 4, as indicated in Table 3 of this section. For Loading Condition 5, place the UUT in no-load mode, disconnect any additional signal connections, and measure the input power.

(B) At the lowest nameplate output voltage, with the exception of USB–PD EPSs, test all adaptive external power supplies in sequence from Loading Condition 1 to Loading Condition 4, as indicated in Table 3 of this section. For USB–PD adaptive external power supplies, at the lowest nameplate output voltage, test the external power supply such that for Loading Conditions 1, 2, 3, and 4, all adaptive ports are loaded to 2 amperes, 1.5 amperes, 1 ampere, and 0.5 amperes, respectively. All non-adaptive ports will continue to be loaded as indicated in Table 3 of this section. For Loading Condition 5, test all adaptive external power supplies by placing the UUT in no-load mode, disconnecting any additional signal connections, and measuring the input power.

TABLE 3—LOADING CONDITIONS FOR A SINGLE-VOLTAGE ADAPTIVE EXTERNAL POWER SUPPLY

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

Note: The 2 percent allowance pertains to nameplate output current, not the calculated current value. For example, a UUT at Loading Condition 3 may be tested in a range from 48 percent to 52 percent of the derated output current.

(C) If testing of additional, optional loading conditions is desired, conduct that testing in accordance with this test procedure and subsequent to completing the sequence described in section 6(a)(1)(iii) of this appendix.

(D) Where the external power supply lists both an instantaneous and continuous output current, test the external power supply at the continuous condition only.

(E) If an external power supply cannot sustain output at one or more of the Loading Conditions 1–4 as specified in Table 3 of this section, test the external power supply only at the loading conditions for which it can sustain output.

(iv) Use the following proportional allocation method to provide consistent loading conditions for single-voltage adaptive external power supplies with multiple-output busses. For additional explanation, please refer to section 6.1.1 of the California Energy Commission's ''Proposed Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies Revision 6.7,'' March 2014.

(A) Consider a power supply with N output busses, each with the same nameplate output voltages V_1, * * *, V_N, corresponding output current ratings I_1, * * *, I_N, and a maximum output power P as specified on the manufacturer's label on the power supply housing, or, if absent from the housing, as specified in the documentation provided with the unit by the manufacturer. Calculate the derating factor D by dividing the power supply maximum output power P by the sum of the maximum output powers of the individual output busses, equal to the product of port nameplate output voltage and current I_iV_i, as follows:

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

For USB–PD adaptive external power supplies, at the lowest nameplate output voltage, limit the contribution from each port to 10W when calculating the derating factor.

(B) If D ≥1, then loading every port to its nameplate output current does not exceed the overall maximum output power for the power supply. In this case, load each output bus to the percentages of its nameplate output current listed in Table 3 of this section. However, if D <1, it is an indication that loading each port to its nameplate output current will exceed the overall maximum output power for the power supply. In this case, and at each loading condition, each output bus will be loaded to the appropriate percentage of its nameplate output current listed in Table 3 of this section, multiplied by the derating factor D.

(v) Efficiency calculation. Calculate and record the efficiency at each loading point by dividing the UUT's measured active output power at that loading condition by the active AC input power measured at that loading condition.

(A) Calculate and record average efficiency of the UUT as the arithmetic mean of the efficiency values calculated at Loading Conditions 1, 2, 3, and 4 in Table 3 of this section.

(B) If, when tested, a UUT cannot sustain the output current at one or more of the loading conditions as specified in Table 3 of this section, the average active-mode efficiency is calculated as the average of the loading conditions for which it can sustain output.

(C) If the UUT can only sustain one output current at any of the output busses, test it at the loading condition that allows for the maximum output power on that bus (*i.e.,* the highest output current possible at the highest output voltage on that bus).

(vi) Power consumption calculation. The power consumption of Loading Condition 5 (no-load) is equal to the active AC input power (W) at that loading condition.

(2) Off-Mode Measurement—If the UUT incorporates manual on-off switches, place the UUT in off-mode and measure and record its power consumption at Loading Condition 5 in Table 3 of this section. The measurement of the off-mode energy consumption must conform to the requirements specified in section 6(a)(1) of this appendix, except that all manual on-off switches must be placed in the ''off'' position for the off-mode measurement. The UUT is considered stable if, over 5 minutes with samples taken at least once every second, the AC input power does not drift from the maximum value observed by more than 1 percent or 50 milliwatts, whichever is greater. Measure the off-mode power consumption of a single-voltage adaptive external power supply twice—once at the highest nameplate output voltage and once at the lowest.

(b) Multiple-Voltage Adaptive External Power Supply.

(1) Standby Mode and Active-Mode Measurement.

(i) Place in the ''on'' position any built-in switch in the UUT controlling power flow to the AC input and note the existence of such a switch in the final test report.

(ii) Operate the UUT at 100 percent of nameplate output current for at least 30 minutes immediately prior to conducting efficiency measurements. After this warm-up period, monitor 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 percent from the maximum value observed, the UUT is considered stable.

If the UUT is stable, record the measurements obtained at the end of this 5-minute period. Measure subsequent loading conditions under the same 5-minute stability parameters. Note that only one warm-up period of 30 minutes is required for each UUT at the beginning of the test procedure. If the AC input power is not stable over a 5-minute period, follow the guidelines established by Section 5.3.3 of IEC 62301 for measuring average power or accumulated energy over time for both input and output.

(iii) Test the UUT at the nameplate output voltage(s) at the loading conditions listed in Table 4 of this section, derated per the proportional allocation method presented in section 6(b)(1)(iv) of this appendix. Active or passive loads used for efficiency testing of the UUT must maintain the required current loading set point for each output voltage within an accuracy of ±0.5 percent. Adaptive external power supplies must be tested twice—once at the highest nameplate output voltage and once at the lowest nameplate output voltage as described in the following sections.

(A) At the highest nameplate output voltage, test adaptive external power supplies in sequence from Loading Condition 1 to Loading Condition 4, as indicated in Table 4 of this section. For Loading Condition 5, place the UUT in no-load mode, disconnect any additional signal connections, and measure the input power.

(B) At the lowest nameplate output voltage, with the exception of USB–PD EPSs, test all other adaptive external power supplies, in sequence from Loading Condition 1 to Loading Condition 4, as indicated in Table 4 of this section. For USB–PD adaptive external power supplies, at the lowest nameplate output voltage, test the external power supply such that for Loading Conditions 1, 2, 3, and 4, all adaptive ports are loaded to 2 amperes, 1.5 amperes, 1 ampere, and 0.5 amperes, respectively. All non-adaptive ports will continue to be loaded as indicated in Table 4 of this section. For Loading Condition 5, test all adaptive external power supplies by placing the UUT in no-load mode, disconnecting any additional signal connections, and measuring the input power.

TABLE 4—LOADING CONDITIONS FOR A MULTIPLE-VOLTAGE ADAPTIVE EXTERNAL POWER SUPPLY

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

Note: The 2 percent allowance pertains to nameplate output current, not the calculated current value. For example, a UUT at Loading Condition 3 may be tested in a range from 48 percent to 52 percent of the derated output current.

(C) If testing of additional, optional loading conditions is desired, conduct that testing in accordance with this test procedure and subsequent to completing the sequence described in section 6(b)(1)(iii) of this appendix.

(D) Where the external power supply lists both an instantaneous and continuous output current, test the external power supply at the continuous condition only.

(E) If an adaptive external power supply is operating as a multiple-voltage external power supply at only the highest nameplate output voltage or lowest nameplate output voltage, test this external power supply as a multiple-voltage adaptive external power supply at both the highest nameplate output voltage and the lowest nameplate output voltage.

(F) If an external power supply has both adaptive and non-adaptive ports, and these ports operate simultaneously at multiple voltages, ensure that testing is performed with all ports active at both the highest and lowest nameplate output voltage. For example, if an external power supply has a USB–PD adaptive output bus that operates at 5 volts and 20 volts and a second non-adaptive output bus that operates at 9 volts, test this EPS at the highest nameplate output voltage with both the adaptive and non-adaptive ports respectively loaded at 20 volts and 9 volts; likewise, test it at the lowest nameplate output voltage with both the adaptive and non-adaptive ports respectively loaded at 5 volts and 9 volts.

(G) If an external power supply cannot sustain output at one or more of the Loading Conditions 1–4 as specified in Table 4 of this section, test the external power supply only at the loading conditions for which it can sustain output.

(iv) Use the following proportional allocation method to provide consistent loading conditions for multiple-voltage adaptive external power supplies. For additional explanation, please refer to section 6.1.1 of the California Energy Commission's ''Proposed Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc Power Supplies Revision 6.7,'' March 2014.

(A) Consider a multiple-voltage power supply with N output busses, and nameplate output voltages V_1, * * *, V_N, corresponding output current ratings I_1, * * *, I_N, and a maximum output power P as specified on the manufacturer's label on the power supply housing, or, if absent from the housing, as specified in the documentation provided with the unit by the manufacturer. Calculate the derating factor D by dividing the power supply maximum output power P by the sum of the maximum output powers of the individual output busses, equal to the product of bus nameplate output voltage and current I_iV_i, as follows:

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

For USB–PD adaptive external power supplies, at the lowest nameplate output voltage, limit the contribution from each port to 10W when calculating the derating factor.

(B) If D ≥1, then loading every bus to its nameplate output current does not exceed the overall maximum output power for the power supply. In this case, load each output bus to the percentages of its nameplate output current listed in Table 4 of this section. However, if D <1, it is an indication that loading each bus to its nameplate output current will exceed the overall maximum output power for the power supply. In this case, at each loading condition, load each output bus to the appropriate percentage of its nameplate output current listed in Table 4 of this section, multiplied by the derating factor D.

(v) Minimum output current requirements. Depending on their application, some multiple-voltage adaptive external power supplies may require a minimum output current for each output bus of the power supply for correct operation. In these cases, ensure that the load current for each output at Loading Condition 4 in Table 4 of this section is greater than the minimum output current requirement. Thus, if the test method's calculated load current for a given voltage bus is smaller than the minimum output current requirement, use the minimum output current to load the bus. Record this load current in any test report.

(vi) Efficiency calculation. Calculate and record the efficiency at each loading point by dividing the UUT's measured active output power at that loading condition by the active AC input power measured at that loading condition.

(A) Calculate and record average efficiency of the UUT as the arithmetic mean of the efficiency values calculated at Loading Conditions 1, 2, 3, and 4 in Table 4 of this section.

(B) If, when tested, a UUT cannot sustain the output current at one or more of the loading conditions as specified in Table 4, the average active-mode efficiency is calculated as the average of the loading conditions for which it can sustain output.

(C) If the UUT can only sustain one output current at any of the output busses, test it at the loading condition that allows for the maximum output power on that bus (*i.e.,* the highest output current possible at the highest output voltage on that bus).

(vii) Power consumption calculation. The power consumption of Loading Condition 5 (no-load) is equal to the active AC input power at that loading condition.

(2) Off-mode Measurement—If the UUT incorporates manual on-off switches, place the UUT in off-mode, and measure and record its power consumption at Loading Condition 5 in Table 4 of this section. The measurement of the off-mode energy

consumption must conform to the requirements specified in section (6)(b)(1) of this appendix, except that all manual on-off switches must be placed in the ''off'' position for the off-mode measurement. The UUT is considered stable if, over 5 minutes with samples taken at least once every second, the AC input power does not drift from the maximum value observed by more than 1 percent or 50 milliwatts, whichever is greater. Measure the off-mode power consumption of a multiple-voltage adaptive external power supply twice—once at the highest nameplate output voltage and once at the lowest.

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