ENERGY STAR® Program Requirements Product Specification for Uninterruptible Power Supplies (UPSs)

Eligibility Criteria Draft 1, Version 2.0

Following is the Version 2.0 ENERGY STAR Product Specification for Uninterruptible Power Supplies (UPSs). A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

Note: EPA would like to note that the changes proposed for inclusion in Version 1.1 have been included in the Draft 1, Version 2.0 for reference. The changes proposed in Version 1.1 will go into effect once the update process is completed, which will be in advance of Version 2.0. At that time, products within the scope of the UPS test method codified at Appendix Y to Subpart B of 10 CFR 430, may utilize either Appendix Y to Subpart B of 10 CFR 430, or the ENERGY STAR Test Method for Uninterruptible Power Supplies, Rev. May-2012 until Version 2.0 takes effect. Not yet certified UPSs capable of operating at 115 V and 60 Hz that use NEMA 1-15P or 5-15P plug, may wish to certify to ENERGY STAR using the DOE UPS Final Rule to avoid retesting should they meet the Version 2.0 eligibility criteria. Please note that for both Version 1.1 and Version 2.0, products shall be tested in an EPA-recognized laboratory and reviewed by an EPA-recognized certification body before they can carry the label.

In Version 1.1, EPA proposes to harmonize definitions with the test method final rule, except where necessary to reflect the broader scope of the ENERGY STAR specification. Harmonized definitions are indicated with footnote references; a lack of a footnote reference indicates that there was no corresponding definition in the Final Rule. While most of the changes were editorial, the few substantive changes are further explained in noteboxes.

1 DEFINITIONS

For the purpose of this specification the following definitions apply:

A) Uninterruptible Power Supply (UPS)[1]: Combination of convertors, switches, and energy storage devices (such as batteries) constituting a power system for maintaining continuity of load power in case of input power failure.[2]

1) Power conversion mechanism:

a) Static UPS: UPS where solid-state power electronic components provide the output voltage.

b) Rotary UPS: UPS where one or more electrical rotating machines provide the output voltage.

i. Rotary UPS (RUPS) without Diesel: A rotary UPS that does not contain an integral diesel engine to supply power to the load during an input power failure..

ii. Diesel-coupled rotary UPS (DRUPS): A rotary UPS that contains an integral diesel engine that may be used to supply power to the load during an input power failure.

2) Power Output:

a) Alternating Current (Ac)-output UPS: UPS that supplies power with a continuous flow of electric charge that periodically reverses direction.

[1] 10 CFR 430, Subpart B, Appendix Y, Section 2.27, with modifications.
[2] Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or when distortion or interruptions are outside the limits specified for the UPS.

b) Direct Current (Dc)-output UPS: UPS that supplies power with a continuous flow of electric charge that is unidirectional.

i. Low-voltage Dc-output UPS/Rectifier: A Dc-output UPS with output voltage less than or equal to 60 V. Includes both individual rectifier units for dc applications and entire Dc-output UPS frames or systems, consisting of rectifier modules, controllers, and any other supporting components.

ii. High-voltage Dc-output UPS: A Dc-output UPS with output voltage greater than 60 V.

Note: Dc-output UPSs are also known as rectifiers. A rectifier is a product that converts alternating current to direct current to supply a load and an energy storage mechanism. For the purposes of this document, the term "Low-voltage Dc-output UPS/Rectifier" is used because a "rectifier" may also refer to an Ac-output UPS subsystem.

Note: EPA has proposed to divide the definition of Dc-output UPSs into Low-voltage Dc-output UPSs/Rectifiers and High-voltage Dc-output UPSs, to reflect their differing uses (data center versus telecommunications, respectively). EPA has drawn the dividing line at 60 V to reflect the traditional use of touch-safe dc voltages in the telecommunications industry and the expectation that forthcoming data center Dc-output UPSs operate at higher voltages for efficiency reasons. Similarly, EPA has retained "Rectifier" only in the Low-voltage definition to reflect that telecommunication Dc-output UPSs are currently sold and certified to ENERGY STAR as individual modules, while expecting data center Dc-output UPSs to be sold as complete systems, similar to Ac-output UPSs. EPA welcomes feedback on this proposal.

B) Modular UPS: A UPS comprised of two or more single UPS units, sharing one or more common frames and a common energy storage system, whose outputs, in Normal Mode of operation, are connected to a common output bus contained entirely within the frame(s). The total quantity of single UPS units in a modular UPS equals "n + r" where n is the quantity of single UPS units required to support the load; r is the quantity of redundant UPS units. Modular UPSs may be used to provide redundancy, to scale capacity or both.

C) Redundancy: Addition of UPS units in a parallel UPS to enhance the continuity of load power, and classified as follows.

1) N + 0: UPS that cannot tolerate any failures while maintaining Normal Mode operation. No redundancy.

2) N + 1: Parallel UPS that can tolerate the failure of one UPS unit or one group of UPS units while maintaining Normal Mode operation.

3) 2N: Parallel UPS that can tolerate the failure of one half of its UPS units while maintaining Normal Mode operation.

D) UPS Operational Modes:

1) Normal Mode: Stable mode of operation that the UPS attains under the following conditions:

a) Ac input supply is within required tolerances and supplies the UPS.

b) The energy storage system remains charged or is under recharge.

c) The load is within the specified rating of the UPS.

d) The Bypass is available and within specified tolerances (if applicable).

2) Stored Energy Mode: Stable mode of operation that the UPS attains under the following conditions:

a) Ac input power is disconnected or is out of required tolerance.

b) All power is derived from the energy storage system or, in the case of a DRUPS, from the integrated Diesel engine or a combination of both.

c) The load is within the specified rating of the UPS.

3) Bypass Mode: Mode of operation that the UPS attains when operating the load supplied via the Bypass only.

E) UPS Input Dependency Characteristics:

1) Voltage and Frequency Dependent (VFD) UPS[3]: A UPS that produces an AC output where the output voltage and frequency are dependent on the input voltage and frequency.[4]

2) Voltage Independent (VI) UPS[5]: A UPS that produces an AC output within a specific tolerance band that is independent of under-voltage or over-voltage variations in the input voltage without depleting the stored energy source. The output frequency of a VI UPS is dependent on the input frequency, similar to a voltage and frequency dependent system.

3) Voltage and Frequency Independent (VFI)[6]: A UPS where the device remains in normal mode producing an AC output voltage and frequency that is independent of input voltage and frequency variations and protects the load against adverse effects from such variations without depleting the stored energy source.

F) Single-normal-mode UPS: A UPS that functions in Normal Mode within the parameters of only one set of input dependency characteristics. For example, a UPS that functions only as VFI.

G) Multiple-normal-mode UPS: A UPS that functions in Normal Mode within the parameters of more than one set of input dependency characteristics. For example, a UPS that can function as either VFI or VFD.

H) Bypass: Power path alternative to the ac converter.

1) Maintenance Bypass (path): Alternative power path provided to maintain continuity of load power during maintenance activities.

2) Automatic Bypass: Power path (primary or stand-by) alternative to the indirect ac converter.

a) Mechanical Bypass: control is via a switch with mechanically separable contacts.

b) Static Bypass (electronic bypass): control is via an electronic power switch, for example transistors, thyristors, triacs or other semiconductor device or devices.

c) Hybrid Bypass: control is via switch with mechanically separable contacts in combination with at least one controlled electronic valve device.

I) Reference Test Load: Load or condition with a power factor of greater than 0.99 in which the output of the UPS delivers the active power (W) for which the UPS is rated.[7]

Note: The DOE UPS test procedure Final Rule specifies a near-unity power factor for the reference test load. This is more specific than the International Electrotechnical Commission (IEC) standard 62040-3, Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements, upon which the Version 1.0 ENERGY STAR definition was based. However, both the IEC standard and the ENERGY STAR specification subsequently require testing with a resistive (i.e., unity power factor) reference test load, so the end result is the same. Therefore, EPA has updated the definition to harmonize with the DOE definition.

[3] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.1
[4] This UPS architecture does not provide corrective functions like those in voltage independent and voltage and frequency independent systems.
[5] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.3
[6] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.2
[7] 10 CFR 430, Subpart B, Appendix Y, Section 2.24

J) Unit Under Test (UUT):

1) For UPSs capable of operating at 115 V and 60 Hz that use National Electrical Manufacturer Association (NEMA) 1-15P or 5-15P plug[8]: The combination of the UPS and battery being tested[9].

2) For all other UPSs: The UPS undergoing the test, configured as though for shipment to the customer, and including any accessories (e.g., filters or transformers) necessary to meet the test setup as specified in Section 3 of the ENERGY STAR Test Method.

Note: The scope of the DOE test procedure Final Rule is limited to "battery chargers [including UPSs] operating at either DC or United States AC line voltage (115V at 60Hz) . . . that utilize the standardized National Electrical Manufacturer Association (NEMA) plug, 1-15P or 5-15P, as specified in ANSI/NEMA WD 6-2016" and that "have an AC output". 10 CFR 430, Subpart B, Appendix Y, Section 1. EPA proposes that all other UPSs be tested to the ENERGY STAR test method, which does not require a battery connection, and thus the UUT definition would not include the battery.

K) Power Factor: Ratio of the absolute value of active power *P* to the apparent power *S.*

L) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR certification criteria, and (3) of a common basic design. For UPSs, acceptable variations within a product family include:

1) Number of installed modules;

2) Redundancy;

3) Type and quantity of input and output filters;

4) Number of rectifier pulses;

5) Energy storage system capacity and

6) For any diesel coupled rotary UPS, the diesel engine's make, model, and capabilities may vary. If sold in the US, the engine of the representative model must meet the requirements in Section 3.7 below.

M) Abbreviations:

1) A: Ampere

2) ac: Alternating Current

3) dc: Direct Current

4) DRUPS: Diesel coupled rotary UPS

5) RUPS: Rotary UPS

6) THD: Total Harmonic Distortion

7) UPS: Uninterruptible Power Supply

8) UUT: Unit Under Test

9) V: Volt

10) VFD: Voltage and Frequency Dependent

11) VFI: Voltage and Frequency Independent

12) VI: Voltage Independent

[8] 10 CFR 430, Subpart B, Appendix Y, Section 1, reworded
[9] 10 CFR 430, Subpart B, Appendix Y, Section 2.28, reworded

13) W: Watt

14) Wh: Watt-hour

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of an Uninterruptible Power Supply (UPS) as specified herein including Static and Rotary UPSs and Ac-output UPSs and Dc-output UPSs/Rectifiers are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2. Products eligible for certification under this specification include:

i) Consumer UPSs intended to protect desktop computers and related peripherals, and/or home entertainment devices such as TVs, set top boxes, DVRs, Blu-ray and DVD players;

ii) Commercial UPSs intended to protect small business and branch office information and communication technology equipment such as servers, network switches and routers, and small storage arrays;

i) Data Center UPSs intended to protect large installations of information and communication technology equipment such as enterprise servers, networking equipment, and large storage arrays; and,

ii) Telecommunications Dc-output UPSs/Rectifiers intended to protect telecommunication network systems located within a central office or at a remote wireless/cellular site.

2.2 Excluded Products

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

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

i. Products that are internal to a computer or another end-use load (e.g., battery-supplemented internal power supplies or battery backup for modems, security systems, etc.);

ii. Industrial UPSs specifically designed to protect critical control, manufacturing, or production processes or operations;

iii. Utility UPSs designed for use as part of electrical transmission and distribution systems (e.g. electrical substation or neighborhood-level UPSs);

iv. Cable TV (CATV) UPSs designed to power the cable signal distribution system outside plant equipment and connected directly or indirectly to the cable itself. The “cable” may be coaxial cable (metallic wire), fiber-optic, or wireless (e.g., “Wi-Fi”);

v. UPSs designed to comply with specific UL safety standards for safety-related applications, such as emergency lighting, operations or egress, or medical diagnostic equipment; and,

vi. UPSs designed for mobile, ship board, marine or airborne applications.

3 CERTIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with actual measured (unrounded) values. Only the final result of a calculation shall be rounded.

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

3.1.3 For UPSs capable of operating at 115 V and 60 Hz that use NEMA 1-15P or 5-15P plug, calculated efficiency values shall be rounded to one tenth of a percentage point, as specified in Section 4.3.5 of Appendix Y to Subpart B of 10 CFR 430 .

3.1.4 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

Note: EPA has clarified in Section 3.1.1 that if rounding is required (e.g., for reporting), then only the final results shall be rounded. This is consistent with other ENERGY STAR specifications. In addition, EPA has replaced the term "directly" with "actual" to maintain consistency with the language across all of the product categories.

In Section 3.1.2, EPA replaced the phrase "directly measured or calculated" with "exact" to maintain consistency with the other product categories in the program.

EPA has added the rounding requirement from Appendix Y to Section 3.1.3 to ensure consistency with the DOE test procedure. As under Version 1.0, EPA proposes that efficiency results for models not covered by DOE shall not be rounded prior to evaluation against the evaluation limits.

3.2 Energy Efficiency Requirements for Ac-output UPSs

3.2.1 Single-normal-mode UPSs: Average loading-adjusted efficiency (Eff_{AVG}), as determined per Appendix Y to Subpart B of 10 CFR 430, or if not applicable, as calculated per Equation 1, shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2, for the specified rated output power and input dependency characteristic.

Equation 1: Calculation of Average Efficiency for Ac-output UPSs and High-voltage Dc-output UPSs

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

Where:

- *Eff_{AVG} is the average loading-adjusted efficiency,*
- *$t_{n\%}$ is the proportion of time spent at the particular n% of the Reference Test Load, as specified in the loading assumptions in Table 1, and*
- *$Eff|_{n\%}$ is the efficiency at the particular n% of the Reference Test Load, as measured according to the ENERGY STAR Test Method.*

Table 1: Ac-output UPS Loading Assumptions for Calculating Average Efficiency

Rated Output Power, *P*, in watts (W)	Input Dependency Characteristic	Proportion of Time Spent at Specified Proportion of Reference Test Load, $t_{n\%}$			
		25%	50%	75%	100%
***P* ≤ 1500 W**	VFD	0.2	0.2	0.3	0.3
	VI or VFI	0	0.3	0.4	0.3
1500 W < *P* ≤ 10,000 W	VFD, VI, or VFI	0	0.3	0.4	0.3
***P* > 10,000 W**	VFD, VI, or VFI	0.25	0.5	0.25	0

Note: One stakeholder has suggested that the loading assumptions for datacenter VI models should be adjusted to account for 100% load. This stakeholder claims cloud providers typically load UPSs up to 95%, compared to colocation data centers, where the load is around 60–70%, even under N+1 redundancy. This is significant given the rapidly growing cloud data center market. EPA appreciates feedback on this comment and any relevant data, such as from remote monitoring of UPSs.

Table 2: Ac-output UPS Minimum Average Efficiency Requirement

Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), Where:
• *P* is the Rated Output Power in watts (W),
• E_{MOD} is an allowance of 0.004 for Modular UPSs applicable in the commercial 1500–10,000 W range, and
• ln is the natural logarithm.

Rated Output Power	Input Dependency Characteristic		
	VFD	**VI**	**VFI**
***P* ≤ 300 W**	$3.7 \times 10^{-5} \times P + 0.971$	0.985	$0.012 \times \ln(P) + 0.825$
300 W < *P* ≤ 1500 W	0.984		
1500 W < *P* ≤ 10,000 W	0.983-E_{MOD}	0.983-E_{MOD}	$0.016 \times \ln(P) + 0.797 - E_{MOD}$
***P* > 10,000 W**	0.920	0.940	$0.0059 \times \ln(P) + 0.890$

Note: EPA is proposing revised efficiency requirements to create more product differentiation and account for the DOE test method Final Rule. The ENERGY STAR criteria for UPSs last changed on August 1, 2012. Based on data collected through the Unit Shipment Data process, EPA believes that the market penetration of Ac-output UPSs is close to 100%. The revised requirements ensure that the ENERGY STAR specification continues to highlight efficient UPSs while ensuring a good selection of certified products.

In developing the above efficiency requirements, EPA first considered the impact of the DOE test method, which requires models within scope (rated output power less than 1875 W, the rating of NEMA 1-15P and 5-15 P plugs) to have the battery connected during testing. EPA had previously found that the efficiency of UPSs would decrease by 0.1 to 0.3 percentage points once the battery was connected, based on an analysis of ENERGY STAR (no battery) and CEC (battery connected) data.The efficiencies of models on the ENERGY STAR certified products list within the scope of the DOE test method Final Rule were reduced by 0.1 percentage point for Version 2.0 analysis. EPA used the lower end of the range in the Version 2.0 analysis to reflect the best performing products. Currently, EPA estimates that approximately 21% of products would meet the proposed levels. This includes 22% of all VFD products, 15% of VI products, and 25% of VFI products. This represents a broad range of products across all rated output power levels. These levels allow for a variety of different technologies to be used, including intelligent multi-mode operation and improved lead-acid batteries. EPA has estimated that the total shipment-weighted savings achieved by this proposal would be 286 kWh/year.

Although DOE's scope is limited to UPSs that use a NEMA-15P and 5-15P plug (and accordingly have a rated output power less than 1875W), in Draft 1, Version 2.0, EPA is proposing to maintain the same rated output power bins as in Version 1.0, i.e. the criteria changes at 1500 W. The alternative would be to align with DOE by extending the range of the ENERGY STAR Consumer product class to 1875 W. EPA believes that maintaining the same binning structure from Version 1.0 will continue to provide differentiation in this product category. In addition, it is believed there will be no impact to stakeholders.

EPA is also is proposing a modular allowance, E_{MOD}, to ensure that a range of modular models can also meet the proposed requirements. EPA believes that these products provide a unique utility to end-users, such as making N+1 or N+2 redundancy easier, which contributes to a higher load and increased efficiency during typical use. While these products are believed to be more efficient in real-world applications, the current test load conditions do not reflect this efficiency. EPA considered identifying separate criteria and load weightings, but does not believe that this is the best method to incorporate these products, due to limited data available and because the power conversion internals are the same across products.

In Version 1.0, EPA included an efficiency allowance for datacenter models with communications capabilities. After reviewing the data center efficiency data, EPA found that metering appears to be widespread and removing it will not negatively affect presence of this capability. Therefore, EPA has removed the metering allowance from the specification.

3.2.2 Multiple-normal-mode UPSs that Do Not Ship with the Highest Input Dependency Mode Enabled by Default: If the Multiple-normal-mode UPS does not ship with its highest input dependency mode enabled by default, its average loading-adjusted efficiency (Eff_{AVG}), as calculated per Equation 1, shall be greater than or equal to:

i. The Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2, for the rated output power and lowest input dependency mode provided by the UPS.

3.2.3 Multiple-normal-mode UPSs that Ship with the Highest Input Dependency Mode Enabled by Default: If the Multiple-normal-mode UPS does ship with its highest input dependency mode enabled by default, its average loading-adjusted efficiency (Eff_{AVG}), as calculated per Equation 2, shall be greater than or equal to:

i. The Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2 for the rated output power and lowest input dependency mode provided by the UPS.

Equation 2: Calculation of Average Efficiency for Multiple-normal-mode Ac-output UPSs

$$Eff_{AVG} = 0.75 \times Eff_{LOW} + 0.25 \times Eff_{HIGH}$$

Where:

- *Eff_{AVG} is the average loading-adjusted efficiency,*
- *Eff_{LOW} is the average loading-adjusted efficiency in the lowest input dependency mode (i.e., VFI or VI), as calculated per Equation 1, and*
- *Eff_{HIGH} is the average loading-adjusted efficiency in the highest input dependency mode (i.e., VFD), as calculated per Equation 1.*

Note: EPA has revised the two efficiency terms used in the above equation to *Eff_{LOW} and Eff_{HIGH}* to make it clear which one applies to which dependency mode.

Also, one stakeholder has commented that some newer UPS models have three different operating modes (with different input dependencies). This stakeholder has proposed the following average efficiency calculation for models with 3 active modes:

$$Eff_{AVG} = 0.30 \times Eff_{\mathrm{VFI}} + 0.55 \times Eff_{\mathrm{VI}} + 0.15 \times Eff_{VFD}$$

The weights in this equation were provided by a stakeholder's analysis, using 60 UPS models with three working normal modes, which were constantly remotely monitored and are currently working in the field. This stakeholder utilized a similar analysis to evaluate models with two normal working modes and provided initial feedback that the loading assumptions in Equation 2 are correct.

EPA is unaware of any product on the current ENERGY STAR certified product list with three active modes. This product type may increase the efficiency of the product while maintaining the reliability of a VFI and VFD UPS. EPA appreciates further stakeholder feedback on the prevalence of UPS models with three different operating modes, their utility and ability to offer further efficiency, and the need for an additional calculation for products of this type. In addition, EPA is interested if the proposal provided by the stakeholder is representative of the products usage.

3.3 Energy Efficiency Requirements for Dc-output UPSs/Rectifiers

3.3.1 High-voltage Dc-output UPSs: Average loading-adjusted efficiency (Eff_{AVG}) for High-voltage Dc-output UPSs/Rectifiers, as calculated per Equation 1, shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), in Table 3, subject to the following requirement.

i. High-voltage Dc-output UPSs shall be treated as VFI when referencing Table 1.

Note: EPA has added a separate section for high-voltage UPSs to reflect their testing at 25%, 50%, 75%, and 100% of output power per the new test procedure in Annex F of IEC 62040-5-3 Uninterruptible power systems (UPS) – Part 5-3: DC output UPS – Performance and test requirements and use and loading consistent with other data center UPSs.

EPA understands that these types of UPSs are not yet widely available, but may be used in datacenters, and therefore has proposed this requirement to provide a clear test and requirement were these products to become more widely available in the future. Until then, EPA is also proposing the same efficiency requirement as for Low-voltage Dc-output UPSs/Rectifiers, but welcomes data on how their performance may differ.

3.3.2 Low-voltage Dc-output UPSs/Rectifiers: Average loading-adjusted efficiency (Eff_{AVG}) for Low-voltage Dc-output UPSs/Rectifiers, as calculated per Equation 3 shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), in Table 3. This requirement shall apply to complete systems and/or individual modules. Manufacturers can qualify either, subject to the following requirements:

i. Complete systems that are also modular shall be qualified as Modular UPS Product Families with a particular model of module installed,

ii. Certification of individual modules will have no bearing on the certification of modular systems unless the entire systems are also qualified as specified above.

Equation 3: Calculation of Average Efficiency for Low-voltage Dc-output UPSs

$$Eff_{AVG} = \frac{Eff|_{30\%} + Eff|_{40\%} + Eff|_{50\%} + Eff|_{60\%} + Eff|_{70\%} + Eff|_{80\%}}{6}$$

Table 3: High Voltage Dc-output UPS and Low-voltage Dc-output UPS/Rectifier Minimum Average Efficiency Requirement

Minimum Average Efficiency Requirement (Eff_{AVG_MIN})
0.955

Note: In Draft 1, Version 2.0, EPA has maintained the same efficiency requirements for both high-voltage and low-voltage Dc-output UPSs. Some stakeholders shared that similar designs are being used for both 48 V and 380 V Dc-output UPS products, resulting in comparable efficiency. EPA sees the technical rationale for this, but will consider additional feedback and data from stakeholders.

3.4 Power Factor Requirements

3.4.1 The measured input power factor at 100 percent of the Reference Test Load shall meet the minimum level specified in Table 4: UPS Minimum Input Power Factor Requirement for all VFI and VI Normal Modes required for certification.

Table 4: UPS Minimum Input Power Factor Requirement

Minimum Power Factor Requirement
0.90

3.5 Standard Information Reporting Requirements

Note: EPA proposes to remove Section 3.5, Standard Information Reporting Requirements. Shortly after the publication of Version 1.0, EPA transitioned to a richer dataset interface, making the power and performance data sheet (PPDS) requirement obsolete.

3.6 Communication and Measurement Requirements

Note: EPA proposes to remove the communications and measurement requirements in light of the proposal, above, to remove the 1 percentage point efficiency incentive for metering. However, EPA could consider retaining some of the communication and measurement requirements as part of an optional "Connected Functionality" element of the specification that would be available to the full suite of products covered by this specification. The connected criteria in other product categories, such as pool pumps, includes communication with entities outside of the U.P.S., open access, energy consumption reporting, remote management, demand response, information to consumers, and are intended to enable further energy savings through feedback to the user related to operation of the device and demand response.

Remote management and demand response capability are the most significant differences from the Version 1.0 UPS Communication and Measurement requirements. Products must be capable of responding to consumer authorized remote requests. They must also receive, interpret, and act upon grid signals by adjusting their electrical load. Similarly, a UPS could briefly disconnect from the grid during periods of extremely high demand.

EPA is interested in stakeholder feedback in developing optional connected requirements for inclusion in the Version 2.0 specification. In particular, EPA is interested in learning more about the following areas:

1. Is there stakeholder benefit in defining connected functionality for UPS products?

2. Are utilities interested in connected functionality in UPS products? Is there more significant interest in consumer products compared with commercial products or vice versa?

3. Are UPS a good fit for demand response programs?

4. Is there a way to cycle off the load for moments and save energy without threatening performance?

5. Is there potential to incorporate diagnostics support within any connected criteria that would provide utility to the end user?

3.7 Diesel Coupled Rotary UPS Emissions Requirements

3.7.1 Diesel coupled rotary UPS systems intended for sale in the US must demonstrate that their diesel engines are in compliance with Clean Air Act regulations, 40 CFR part 60 subpart IIII. Compliance shall be demonstrated via presentation of a certificate of conformity with this regulation at the time of certification.

i. Systems intended for sale outside the US are not subject to this requirement.

ii. Only the representative model(s) for testing, as specified in Section 4.2, shall demonstrate compliance with Clean Air Act regulations.

Note: EPA has noted that the number of products with natural-gas fired generators has increased relative to diesel coupled rotary UPS products. EPA is interested in further information regarding the natural-gas fired generator market and its potential growth. In addition, EPA is interested in further information regarding the market for diesel coupled rotary UPS products and if use cases for diesel and natural gas differ?

In addition, EPA is aware of some applications for a solar energy back-up with storage and would like to solicit stakeholder feedback on the viability of these products in any or all UPS applications. EPA is particularly interested in the growth or potential growth of this market, specific challenges to the expansion of this segment of the market , and how, if applicable, the use case of a UPS with a solar energy back-up differs from natural gas or diesel back-up products.

4 TESTING

4.1 Test Methods

4.1.1 When testing UPSs, the test methods identified in Table 5 shall be used to determine ENERGY STAR certification.

Table 5: Test Methods for ENERGY STAR Certification

Product Type	Test Method
UPSs capable of operating at 115 V and 60 Hz that use NEMA 1-15P or 5-15P plug	Uniform Test Method for Measuring the Energy Consumption of Battery Chargers incorporated in Appendix Y to Subpart B of 10 CFR 430, Section 4: Testing Requirements for Uninterruptible Power Supplies
All other UPSs	ENERGY STAR Version 2.0 Test Method for Uninterruptible Power Supplies, Rev. March-2017.

4.2 Number of Units Required for Testing

4.2.1 Representative Models shall be selected for testing by either the sampling requirements defined in 10 CFR 429.25, which references 10 CFR 429.11, or the following requirements:

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

ii. For certification of a Modular UPS Product Family where models vary by number of installed modules, the manufacturer shall select the maximum and minimum configurations to serve as Representative Models—i.e., a modular system shall meet the eligibility criteria in both its maximum and minimum non-redundant configurations. If the maximum and minimum configuration Representative Models meet the ENERGY STAR certification criteria at their respective output power levels, all intermediate configuration models within a Modular UPS Product Family may be qualified for ENERGY STAR.

iii. For certification of a UPS Product Family where the models are related by a characteristic other than the number of installed modules, the highest energy using configuration within the Product Family shall be considered the Representative Model with the exception of energy storage system variations—the manufacturer may select any energy storage system for the test, within the requirements of the ENERGY STAR Test Method. Other products within a Product Family do not have to be tested for certification, but they are expected to meet relevant ENERGY STAR certification criteria and may be subject to verification testing sometime after initial certification.

4.2.2 A single unit of each Representative Model shall be selected for testing.

4.2.3 All tested units shall meet ENERGY STAR certification criteria.

5 EFFECTIVE DATE

5.1.1 Effective Date: The Version 2.0 ENERGY STAR UPS specification shall take effect on **Month xx, 2018**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

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

Note: EPA is interested in further recognizing UPS partners that effectively promote and facilitate the recycling of sealed lead-acid batteries, especially among consumers. The version 1.0 specification lists recycling information as a reporting requirement, and while 73% of models on the QPL list “Yes” for manufacturer take back program, only 36% have a take back program URL listed. EPA would like to increase the number of products that include the recycling service details. Additionally, EPA is researching further ways to highlight recycling efforts on the ENERGY STAR website. EPA currently is exploring the option of highlighting information on lead-acid battery recycling, such as why to recycle and how and where to recycle. EPA is further interested in assessingstakeholder interest to participate in this initiative and any further suggestions or alternative ideas stakeholders may have. Improving the recycling rates for lead-acid batteries used with UPSs can lead to significant environmental benefits.