DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[EERE–2017–BT–TP–0012]

RIN 1904–AD47

Energy Conservation Program: Test Procedure for Room Air Conditioners

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

ACTION: Notice of proposed rulemaking.

SUMMARY: The U.S. Department of Energy (DOE) proposes to amend the test procedure for room air conditioners (''room ACs'') to address updates to the industry standards that are incorporated by reference, provide for the testing of variable-speed room ACs to better reflect their relative efficiency gains at lower outdoor temperatures as compared to single-speed room ACs, and to provide specifications and minor corrections that would improve repeatability, reproducibility, and overall readability of the test procedure. Because there are no testing modifications proposed for single-speed room ACs, DOE expects that the proposed changes will not affect the measured energy use for these models. For variable-speed room ACs, the proposed changes will improve the representativeness of the measured energy use of these models. As part of this proposal, DOE is announcing a public meeting to collect comments and data on its proposal.

DATES:

Meeting: DOE will hold a webinar on Wednesday, July 8, 2020, from 10:00 a.m. to 3:00 p.m. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants. If no participants register for the webinar, then it will be cancelled. DOE will hold a public meeting on this proposed test procedure if one is requested by June 25, 2020.

Comments: DOE will accept comments, data, and information regarding this proposal no later than August 10, 2020. See section V, ''Public Participation,'' for details.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at *http://www.regulations.gov.* Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2017–BT–TP–0012, by any of the following methods:

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

(2) *Email: RoomAC2017TP0012@ee.doe.gov.* Include the docket number EERE–2017–BT–TP–0012 or regulatory information number (RIN) 1904–AD47 in the subject line of the message.

(3) *Postal Mail:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 287–1445. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.

(4) *Hand Delivery/Courier:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza SW, 6th Floor, Washington, DC 20024. Telephone: (202) 287–1445. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

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

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

The docket web page can be found at *https://www.regulations.gov/docket?D=EERE-2017-BT-TP-0012.* The docket web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section V of this document for information on how to submit comments through *http://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Mr. Bryan Berringer, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–0371. Email: *ApplianceStandardsQuestions@ee.doe.gov.*

Ms. Sarah Butler, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW, Washington, DC 20585–0121. Telephone: (202) 586–1777. Email: *Sarah.Butler@hq.doe.gov.*

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

SUPPLEMENTARY INFORMATION: DOE proposes to incorporate by reference the following industry standards into 10 CFR part 430:

(1) American National Standards Institute (ANSI)/Association of Home Appliance Manufacturers (AHAM) RAC–1–2015, (ANSI/AHAM RAC–1–2015), ''Room Air Conditioners;'' ANSI approved May 13, 2015.

(2) ANSI/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 16–2016, (ANSI/ASHRAE Standard 16–2016), ''Method of Testing for Rating Room Air Conditioners, Packaged Terminal Air Conditioners, and Packaged Terminal Heat Pumps for Cooling and Heating Capacity;'' ANSI approved October 31, 2016.

(3) ANSI/ASHRAE Standard 41.1–2013, (ANSI/ASHRAE Standard 41.1), ''Standard Method for Temperature Measurement;'' ANSI approved January 30, 2013.

(4) ANSI/ASHRAE Standard 41.2–1987 (RA 1992), (ANSI/ASHRAE Standard 41.2–1987 (RA 1992)), ''Standard Methods for Laboratory Airflow Measurement;'' ANSI reaffirmed April 20, 1992.

(5) ANSI/ASHRAE Standard 41.3–2014 (''ANSI/ASHRAE Standard 41.3–2014''), ''Standard Methods for Pressure Measurement;'' ANSI approved July 3, 2014.

(6) ANSI/ASHRAE Standard 41.6–2014, (ANSI/ASHRAE Standard 41.6–2014), ''Standard Method for Humidity Measurement;'' ANSI approved July 3, 2014.

(7) ANSI/ASHRAE Standard 41.11–2014, (ANSI/ASHRAE Standard 41.11–2014), ''Standard Methods for Power Measurement;'' ANSI approved July 3, 2014.

(8) International Electrotechnical Commission (IEC) Standard 62301, (IEC Standard 62301 Second Edition), ''Household electrical appliances—Measurement of standby power, (Edition 2.0);''.

Copies of ANSI/AHAM RAC–1–2015 can be obtained from the Association of Home Appliance Manufacturers at *https://www.aham.org/ht/d/Store/.* Copies of ANSI/ASHRAE Standard 16–

2016, ANSI/ASHRAE Standard 41.1–2013, ANSI/ASHRAE Standard 41.2–1987, ANSI/ASHRAE Standard 41.3–2014, ANSI/ASHRAE Standard 41.6–2014, and ANSI/ASHRAE Standard 41.11–2014 can be obtained from the American National Standards Institute at *https://webstore.ansi.org/.* Copies of IEC Standard 62301 can be obtained from *http://webstore.iec.ch.*

See section IV.N for additional information on these standards.

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I. Authority and Background

Room ACs are included in the list of ''covered products'' for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6292(a)(2)) DOE's energy conservation standards and test procedure for room ACs are currently prescribed at 10 CFR 430.32(b) and 10 CFR 430.23(f), respectively. The following sections discuss DOE's authority to establish test procedures for room ACs 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 or the Act),[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 room ACs, the subject of this document. (42 U.S.C. 6292(a)(2))

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

The Federal testing requirements consist of test procedures that manufacturers of covered products must use as the basis for: (1) Certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6295(s)), and (2) making 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 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. (See 42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6297(d))

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

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

[1] All references to EPCA in this document refer to the statute as amended through America's Water Infrastructure Act of 2018, Public Law 115–270 (Oct. 23, 2018).

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

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

62087 [4] as applicable. (42 U.S.C. 6295(gg)(2)(A))

If DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2)) EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including room ACs, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A) and (3)) If the Secretary determines, on his 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 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. DOE is publishing this notice of proposed rulemaking (NOPR) pursuant to the 7-year review requirement specified in EPCA. (42 U.S.C. 6293(b)(1)(A))

B. Background

DOE's existing test procedure for room ACs appears at Title 10 of the CFR part 430, subpart B, appendix F (''Uniform Test Method for Measuring the Energy Consumption of Room Air Conditioners'' (''appendix F'')), and the room AC performance metric calculations are codified at 10 CFR 430.23(f). The test procedure for room ACs was established on June 1, 1977 (hereafter the ''June 1977 final rule'') and was subsequently redesignated and editorially amended on June 29, 1979. 42 FR 27896 (June 1, 1977); 44 FR 37938 (June 29, 1979).

1. The January 2011 Final Rule

The Energy Independence and Security Act of 2007 (Public Law 110–140; EISA 2007) directed DOE to amend its energy efficiency test procedures for all covered products to include measures of standby mode and off mode energy consumption. (42 U.S.C. 6295(gg)(2)(A)) In compliance with these requirements, on January 6, 2011, DOE published a final rule (hereafter the ''January 2011 Final Rule''), amending the room AC test procedure to include measurements of standby mode and off mode power and to introduce a new combined efficiency metric, Combined Energy Efficiency Ratio (CEER), that accounts for energy consumption in active mode, standby mode and off mode. 76 FR 971. DOE also incorporated into its regulations a new industry test method, International Electrotechnical Commission (IEC) Standard 62301, ''Household electrical appliances—Measurement of standby power (first edition June 2005)'' (''IEC Standard 62301 First Edition''), to measure the standby and off mode energy consumption. In addition to IEC Standard 62301 First Edition, the January 2011 Final Rule updated references to test methods developed by the American National Standards Institute (ANSI), the Association of Home Appliance Manufacturers (AHAM) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The current room AC test procedure incorporates by reference three industry test methods: (1) ANSI/AHAM RAC–1–2008, ''Room Air Conditioners'' (ANSI/AHAM RAC–1–2008),[5] (2) ANSI/ASHRAE Standard 16–1983 (RA 2009), ''Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners'' (ANSI/ASHRAE Standard 16–2009),[6] and (3) IEC Standard 62301 First Edition.[7]

2. The June 2015 Request for Information

On June 18, 2015, DOE published a request for information (RFI) (hereafter the ''June 2015 RFI'') regarding the energy conservation standards and test procedure for room ACs. 80 FR 34843. In addition to soliciting information regarding the energy conservations standards, the June 2015 RFI discussed and sought comment on the following aspects of the room AC test procedure: (1) Potential updates to the energy efficiency metric that would address performance in additional operating modes; (2) alternate methods for measuring cooling mode performance; (3) measuring heating mode performance and any relevant test methods, temperature conditions, or test burden; (4) methods for measuring performance at reduced cooling loads and the prevalence of units on the market with components optimized for efficient operation at reduced cooling loads; (5) testing and certification of units that can operate on multiple voltages; and (6) the energy usage associated with connected functionality. 80 FR at 34846–34848 (June 18, 2015). In response to the June 2015 RFI, DOE received comments from interested parties pertaining to the room AC test procedure, which are summarized throughout this NOPR.[8]

3. The August 2017 RFI

On August 4, 2017, DOE published another RFI (hereafter the ''August 2017 RFI'') regarding the test procedure for room ACs. 82 FR 36349. Following publication of the June 2015 RFI, DOE identified additional topics and questions for which it sought feedback, specifically regarding amendments to the room AC test procedure to harmonize with the recently established portable air conditioner (''portable AC'') test procedure, to clarify test setup and temperature conditions, to reference updated industry test procedures for room ACs, and on any additional topics that might inform DOE's decisions in a future test procedure rulemaking. DOE also welcomed further comments on the topics raised in the June 2015 RFI and on other issues relevant to the conduct of such a rulemaking that were not specifically identified in that document.

AHAM opposed harmonizing the room AC test procedure with the portable AC test procedure, claiming that harmonization would not assist consumers in making purchasing decisions, mainly because the two products have different consumers and are used for significantly different applications, based on recent consumer survey data. (AHAM, No. 3 at pp. 1–4) [9]

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

[5] Copies can be purchased from *http://webstore.ansi.org.*

[6] Copies can be purchased from *http://www.techstreet.com.*

[7] Copies can be purchased from *http://webstore.iec.ch.*

[8] All public comments are located in the room AC energy conservation standards rulemaking docket: *http://www.regulations.gov/#!docketDetail;D=EERE-2014-BT-STD-0059.*

[9] A notation in the form ''AHAM, No. 3 at pp. 1–4'' identifies a written comment: (1) Made by the Association of Home Appliance Manufacturers; (2) recorded in document number 3 that is filed in the docket of the current room AC test procedure

According to AHAM, the survey suggested that room ACs are purchased for homes without central air conditioning (''central AC''), where cost is a key factor, and where portability is not. AHAM also stated that room ACs are typically used for primary cooling, whereas portable ACs are used for supplemental cooling (*i.e.,* in addition to a central AC). AHAM claimed that the significant design difference between room ACs and portable ACs (specifically, that room ACs are installed in the barrier between the conditioned and unconditioned space, whereas portable ACs are installed entirely within the conditioned space) leads to drastically different design decisions on the size, weight, and shape of the product, impacting available design options for improving efficiency as well as the physical limitations on testing the products. Therefore, according to AHAM, harmonizing the test procedures for room ACs and portable ACs would result in consumer confusion and increased burden for manufacturers. *Id.* DOE notes that the proposals in this document regarding test procedure updates for room ACs were not considered on the basis of similarities or differences between room ACs and portable ACs. However, in development of the portable AC test procedure, DOE relied on data for room ACs in instances in which data specific to portable ACs were lacking. In the current rulemaking, DOE considered such data for room ACs during development of the proposed amendments to the room AC test procedure.

The Appliance Standards Awareness Project, Alliance to Save Energy, American Council for an Energy-Efficient Economy, Consumer Federation of America, Natural Resources Defense Council, Northeast Energy Efficiency Partnerships, Northwest Energy Efficiency Alliance, and Northwest Power and Conservation Council (hereafter the ''Joint Advocates'') and the Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas and Electric, and Southern California Edison (hereafter the ''California IOUs'') both noted that harmonizing the room AC and portable AC test procedures would allow for a comparison between the two products, which they agreed provide a similar function and consumer utility. (Joint Advocates, No. 6 at p. 1; California IOUs, No. 5 at p. 2) Nonetheless, neither supported aligning the room AC test procedure with the current portable AC test procedure.

The California IOUs expressed concern that the benefit of harmonization might not outweigh the negative impacts of an additional cooling mode test condition for room ACs; namely, that adding a second test condition would obscure the determination of peak load energy consumption and would be detrimental for the effective determination of room AC energy demand impact during peak usage times, which is of significant importance to the California IOUs. (California IOUs, No. 5 at p. 2) The Joint Advocates noted that the portable AC test procedure does not capture part-load performance and thus would not capture the benefits of technologies that improve part-load performance, such as variable-speed compressors. In light of this, rather than aligning the room AC test procedure with the portable AC test procedure, the Joint Advocates urged DOE to incorporate part-load performance into the room AC test procedure and the portable AC test procedure. (Joint Advocates, No. 6 at pp. 1–3) As discussed in sections III.E through III.K of this document, DOE is not proposing any significant changes to the room AC test procedure at this time for single-speed room ACs, which represent the majority of room AC configurations on the market today. Specifically, as discussed in section III.E.1.e of this document, DOE considered multiple test conditions as well as constant-cooling-load-based [10] or dynamic-cooling-load-based tests [11] as an alternative to the existing constant-temperature single outdoor condition room AC test procedure and has initially determined that such amendments would not be warranted for single-speed room ACs. However, DOE proposes in this document to adopt specific testing requirements for room ACs that use variable-speed compressors (''variable-speed room ACs'') to better represent their relative efficiency compared to single-speed room ACs, as described further in section III.C of this document.

4. The LG and Midea Waivers

On June 29, 2018, DOE announced receipt of a petition for waiver and application of an interim waiver from LG Electronic USA, Inc. (''LG''), in which LG sought an exemption from the DOE test procedure for room ACs, which appears in appendix F for certain room AC models with variable-speed capabilities (hereafter the ''LG Petition for Waiver'').[12] 83 FR 30717 (June 29, 2018). According to LG, the current DOE test procedure for room ACs, which provides for testing at full-load performance only, does not take into account the benefits of variable-speed room ACs at part-load conditions, and misrepresents their actual energy consumption. LG suggested an alternate test procedure for its variable-speed room ACs, which provided for testing each unit at four different outdoor temperatures instead of a single outdoor temperature, with the unit compressor speed fixed at each temperature. LG's approach for the alternate test procedure was derived from the current DOE test procedure for central ACs (10 CFR part 430, subpart B, appendix M (''appendix M'')). As discussed in a notice of petition for waiver and notice of grant of interim waiver (hereafter the ''Grant of LG Interim Waiver''), DOE initially agreed with LG's claim that the DOE test procedure evaluates the variable-speed models listed in the LG Petition for Waiver in a manner that is unrepresentative of their energy use. 83 FR 30717, 30719. DOE also reviewed the alternate procedure proposed by LG and based on that review determined that LG's suggested procedure would allow for the accurate measurement of the energy use for the listed variable-speed room ACs. Therefore, DOE granted an interim waiver to LG to use LG's suggested alternate test procedure for LG's listed variable-speed room AC models, with an additional specification of how to determine the intermediate compressor speed. On May, 8, 2019, DOE published a Decision and Order (hereafter the ''LG Waiver''), granting a waiver for four variable-speed basic models with the condition that LG must test and rate these models according to an alternate test procedure that was substantively consistent with that suggested by LG, and report product-specific information that reflects the alternate test procedure. 84 FR 2011.

rulemaking (Docket No. EERE–2017–BT–TP–0012) and available for review at *https://www.regulations.gov;* and (3) which appears on pages 1 through 4 of document number 3.

[10] Constant-cooling-load-based tests fix the amount of heat to the indoor test room by the reconditioning equipment, generally less than the test unit's nominal cooling capacity, while the indoor test room temperature is permitted to change and is controlled by the test unit according to its thermostat setting, which is fixed throughout testing.

[11] Dynamic-cooling-load-based tests vary the amount of heat added to the indoor test room by the chamber reconditioning equipment, while the indoor test room temperature is permitted to change and is controlled by the test unit and fixed thermostat setting, thereby measuring how a unit reacts to changing load conditions.

[12] All published documents directly related to the waiver are available in docket EERE–2018–BT–WAV–0006. (*https://www.regulations.gov/document?D=EERE-2018-BT-WAV-0006.*)

The alternate test procedure required under the LG Waiver differs from that required in the Grant of LG Interim Waiver as follows: (1) Removing the allowance to use a psychrometric chamber (which would be consistent with an air-enthalpy testing approach) instead of a calorimeter chamber, (2) adding definitions for each fixed compressor speed, (3) adjusting the annual energy consumption and operating cost calculations that provide the basis for the information presented to consumers on the EnergyGuide Label, and (4) requiring that compressor speeds be set in accordance with instructions submitted by LG on April 2, 2019.[13] DOE determined that those changes were necessary to ensure better repeatability and reproducibility of the LG Waiver test procedure, as well as representativeness of the results. 84 FR 20111.

On March 25, 2019, GD Midea Air Conditioning Equipment Co. LTD. (''Midea'') submitted a petition for waiver and application for interim waiver from the room AC test procedure for six room AC models with variable-speed capabilities.[14] Midea sought a test procedure exemption consistent with the approach DOE allowed in the Grant of LG Interim Waiver. DOE reviewed Midea's petition and, based on that review, initially agreed that Midea's suggested procedure, with the same modifications DOE included in the LG Waiver, would allow for the accurate measurement of the energy use for the listed variable-speed room AC models. Therefore, on December 13, 2019, DOE granted Midea an interim waiver from the room AC test procedure (hereafter the ''Grant of Midea Interim Waiver'') for the models listed in Midea's petition, using the alternate test procedure required in the LG Waiver, which published subsequent to Midea's petition for waiver. 84 FR 68159.

Pursuant to 10 CFR 430.27(l), following the grant of any waiver, DOE must publish in the **Federal Register** a notice of proposed rulemaking to amend its regulations so as to eliminate the need for continuation of the waiver. As soon thereafter as practicable, DOE must publish in the **Federal Register** a final rule. *Id.* The waiver would then terminate on the effective date of the final rule. 10 CFR 430.27(h)(2).

II. Synopsis of the Notice of Proposed Rulemaking

In this NOPR, DOE proposes amendments to the existing test procedures for room ACs to: (1) Update to the latest versions of industry test methods that are incorporated by reference; (2) adopt new testing provisions for variable-speed room ACs that reflect the relative efficiency gains at reduced cooling loads compared to single-speed room ACs; (3) adopt new definitions consistent with these two proposed amendments; and (4) provide specifications and minor corrections to improve the test procedure repeatability, reproducibility, and overall readability.

DOE has tentatively determined that the proposed amendments would both provide more representative efficiency measurements for variable-speed room ACs and not alter the measured efficiency of single-speed room ACs, which constitute the large majority of units on the market. DOE has also tentatively determined that the proposed test procedure would not be unduly burdensome to conduct. DOE's proposed actions are summarized in Table II–1 and addressed in detail in section III of this document.

TABLE II–1—SUMMARY OF CHANGES IN PROPOSED TEST PROCEDURE RELATIVE TO CURRENT TEST PROCEDURE

Current DOE test procedure	Proposed test procedure	Attribution
References industry standards— • ANSI/AHAM RAC–1–2008, • ANSI/ASHRAE Standard 16–2009, and • IEC Standard 62301 First Edition.	Updates references to applicable sections of: • ANSI/AHAM RAC–1–2015, • ANSI/ASHRAE Standard 16–2016 (including relevant cross-referenced industry standards), and • IEC Standard 62301 Second Edition.	Industry test procedure updates.
Testing, calculation of CEER metric, and certification for all room ACs based on single temperature rating condition.	Testing, calculation of CEER metric, and certification for variable-speed room ACs based on additional reduced outdoor temperature test conditions.	In response to the LG Waiver.
—Definition of ''room air conditioner'' does not explicitly include function of providing cool conditioned air to an enclosed space, and references ''prime,'' an undefined term, to describe the source of refrigeration —''Cooling mode'' is an undefined term. Definitions—	—Adds the word ''cooled'' in the definition of ''room air conditioner'' to describe the conditioned air a room AC provides and removes ''prime'' from the definition. —Adds definition for ''cooling mode''.	Added by DOE (clarification).
Appendix F does not explicitly identify the scope of the test procedure.	Creates new section indicating the appendix applies to the energy performance of room ACs.	Added by DOE (specifies the applicability of the test procedure).
Provides that test unit be installed in a manner similar to consumer installation.	—References ANSI/ASHRAE Standard-2016, specifying that the perimeter of louvered room ACs be sealed to the separating partition, consistent with common testing practice. —Specifies that non-louvered room ACs be installed inside a compatible wall sleeve, with the manufacturer-provided installation materials.	Industry test procedure update and added by DOE (additional installation specifications).
Calculations for average annual energy consumption, combined annual energy consumption, energy efficiency ratio (EER), and CEER are located in 10 CFR 430.23(f).	—Moves calculations for CEER and annual energy consumption for each operating mode into appendix F. —Removes EER calculation and references entirely, as it is obsolete.	Added by DOE (improve readability).

[13] The instructions provided by LG on April 2, 2019 were marked as confidential and, as such, were treated as confidential. The document is located in the docket at *https://www.regulations.gov/document?D=EERE-2018-BT-WAV-0006-0010.*

[14] All published documents directly related to the interim waiver are available in docket EERE–2019–BT–WAV–0009 (*https://www.regulations.gov/docket?D=EERE-2019-BT-WAV-0009.*)

III. Discussion

A. Room Air Conditioner Definition

DOE defines a ''room air conditioner'' as a consumer product, other than a packaged terminal air conditioner, which is powered by a single-phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating. 10 CFR 430.2.

DOE does not propose any changes to the room AC definition in this NOPR that would modify the current scope of covered products. However, as described further below, DOE proposes minor adjustments to the room AC definition to ensure the definition does not inadvertently apply to new products introduced on the market. The proposed revised definition would harmonize with the wording of definitions for other DOE covered products, which DOE believes will help avoid any potential confusion or unintentional overlap in scope of coverage between room ACs and any other products.

In the June 2015 RFI, DOE noted that other consumer products, including portable ACs and dehumidifiers, are also self-encased, powered by a single-phase electric current, refrigeration-based, and deliver conditioned air to an enclosed space, thereby meeting many of the criteria in the room AC definition. DOE also noted, however, that the definition of a room AC specifies that the unit is designed to be mounted in a window or through a wall, which excludes portable ACs and dehumidifiers. DOE suggested in the June 2015 RFI that explicitly excluding other products was unnecessary because of the distinction based on mounting. 80 FR 34843, 34845 (June 18, 2015). AHAM agreed that the room AC definition need not be updated to explicitly exclude other products and further suggested that adding these exclusions would be confusing. (AHAM, June 2015 RFI, No. 5 at p. 2) General Electric Appliances (GE) supported AHAM's comments. (GE, June 2015 RFI, No. 6 at p. 1) [15]

Based on DOE's considerations in the June 2015 RFI, and given that no commenters objected to DOE's suggestion, DOE does not propose to add exclusions for other consumer products in the room AC definition.

In the June 2015 RFI, DOE also noted that some room ACs may have other functions beyond the cooling, heating, and ventilation functions currently specified in the room AC definition. These additional functions could include air circulation, where air from within the room is circulated without bringing air from the outside into the room; and air cleaning, where electrostatic filtration, ultraviolet radiation, or ozone generators clean the air as it circulates through the unit. 80 FR 34843, 34845 (June 18, 2015). DOE received no comments related to the inclusion of other functions in the room AC definition in response to the June 2015 RFI. DOE understands that these functions do not represent the key functionality of a room AC, and therefore is not proposing that these functions be addressed in the room AC definition at this time.

DOE proposes to add the term ''cooled'' to the room AC definition, so that it refers to a system that ''. . . delivers *cooled,* conditioned air to an enclosed space . . .'' (emphasis added). DOE believes that this revised wording would better represent the key function of a room AC, and would avoid any potential for the room AC definition to cover other indoor air quality systems that could be described as ''conditioning'' the air, but that would not be appropriately included within the scope of coverage of a room AC.

Additionally, as described previously, the current definition of room AC specifies that it includes a prime source of refrigeration. DOE contends that using the word ''prime'' to describe the source of refrigeration in the current definition is extraneous and could be construed as referring to a ''primary'' refrigeration system, a distinction that could inadvertently exclude future products that implement a different technology as the primary source of air conditioning, while implementing a refrigeration loop as the ''secondary'' means of cooling or heating. Primary and secondary means of conditioning air are not uncommon in certain refrigeration products and chiller systems; in fact, some room ACs with heating functionality implement a resistance heater as a supplemental form of heating to the primary heat pump, for use under extreme temperature conditions. DOE also notes that the recently codified portable AC definition was not limited to products with a prime source of refrigeration. For these reasons, DOE proposes to remove the word ''prime'' from the room AC definition.

DOE proposes to incorporate by reference ASHRAE Standard 16 and ANSI/AHAM RAC–1. In particular, Section 3 of ASHRAE Standard 16–2016 contains several definitions for terms defined in EPCA and DOE regulations: Room air conditioner, packaged terminal air conditioner, and packaged terminal heat pump. Where there is a conflict with the EPCA definition, the EPCA definition controls. DOE elsewhere proposes general language to make clear that regulatory text drafted by DOE takes precedence over conflicting language in a document incorporated by reference. Therefore, DOE proposes to include a statement in new Section 0 ''Incorporation by Reference,'' in appendix F as follows: ''If there is any conflict between any industry standard(s) and this appendix, follow the language of the test procedure in this appendix, disregarding the conflicting industry standard language.''

DOE also proposes to reorganize the room AC definition to improve its readability. As noted above, the minor editorial revisions and specifications discussed in this section are not intended to modify the scope of the room AC definition.

In summary, DOE proposes to modify the room AC definition in 10 CFR 430.2 to read as follows:

''*Room air conditioner* means a window-mounted or through-the-wall-mounted encased assembly, other than a 'packaged terminal air conditioner,' that delivers cooled, conditioned air to an enclosed space, and is powered by single-phase electric current. It includes a source of refrigeration and may include additional means for ventilating and heating.

DOE requests comment on the proposed amendments to the room AC definition in 10 CFR 430.2.

DOE also proposes to further specify the scope of coverage of appendix F by adding a new beginning section stating that appendix F covers the test requirements used to measure the energy performance of room ACs. In doing so, DOE would clearly limit the scope of products tested in accordance with appendix F, and would harmonize appendix F with test procedures for other similar covered products, which also include similar introductory statements of scope.

DOE requests comment on the proposed new beginning section to appendix F that would explicitly state the scope of coverage.

B. Industry Test Standards

The DOE room AC test procedure in appendix F references the following two industry standards as the basis of the cooling mode test: ANSI/AHAM RAC–

[15] GE stated that it supports the comments submitted by AHAM in response to the June 2015 RFI in their entirety and adopted them by reference.

1–2008 and ANSI/ASHRAE Standard 16–2009. ANSI/AHAM RAC–1–2008 provides the specific test conditions and associated tolerances, while ANSI/ASHRAE Standard 16–2009 describes the test setup, instrumentation and procedures used in the DOE test procedure. The cooling capacity, efficiency metric, and other indicators are then calculated based on the results obtained through the application of these test methods, described in appendix F and 10 CFR 430.23(f).

New versions of ANSI/AHAM RAC–1 and ANSI/ASHRAE Standard 16 have been released since the publication of the current DOE test procedure. DOE assessed the updated versions of these standards to determine if any updates to the DOE test procedure were warranted.

1. ANSI/AHAM RAC–1

The cooling mode test in appendix F is conducted in accordance with the testing conditions, methods, and calculations in Sections 4, 5, 6.1, and 6.5 of ANSI/AHAM RAC–1–2008, as summarized in Table III–1.

TABLE III–1—SUMMARY OF ANSI/AHAM RAC–1–2008 SECTIONS REFERENCED IN APPENDIX F

ANSI/AHAM RAC–1–2008 Section	Description
4	General test requirements, including power supply and test tolerances
5	Test conditions and requirements for a standard measurement test
6.1	Determination of cooling capacity in British thermal units per hour (Btu/h)
6.5	Determination of electrical input in watts (W)

Since DOE last revised its room AC test procedure in 2011, ANSI/AHAM RAC–1 has been updated and the current standard was released in 2015 as ANSI/AHAM RAC–1–2015, ''Room Air Conditioners'' (ANSI/AHAM RAC–1–2015).

In the August 2017 RFI, DOE asserted that the updates to ANSI/AHAM RAC–1 appear to provide added specificity but would not substantively impact the results of DOE's cooling mode test. Specifically, ANSI/AHAM RAC–1–2015 introduced new provisions for the measurement of standby and off mode power in Section 6.3, as well as the calculations for annual energy consumption and CEER in Sections 6.4 – 6.8. Because those updates do not impact the sections relevant to appendix F, DOE noted that it expects that updating the references to ANSI/AHAM RAC–1–2015 in appendix F would not substantively affect test results or test burden. 82 FR 36349, 36353 (Aug. 4, 2017).

Friedrich Air Conditioning (Friedrich) and AHAM supported updating the reference to ANSI/AHAM RAC–1–2015. (Friedrich, No. 2 at p. 6; AHAM, No. 3 at p. 6) AHAM encouraged DOE to limit any revisions to the room AC test procedure to updating the referenced industry test methods to the most recent versions. (AHAM, No. 3 at p. 2)

Although ANSI/AHAM RAC–1–2015 maintains the same general organization as ANSI/AHAM RAC–1–2008, ANSI/AHAM RAC–1–2015 adds test requirements and conditions for standby and off mode, and heating mode in sections 4 and 5, respectively. Because the DOE test procedure already addressed standby and off mode testing prior to their inclusion in the latest version of the ANSI/AHAM RAC standard and the DOE test procedure does not address heating mode, which is now included in ANSI/AHAM RAC–1–2015, and to avoid confusion regarding the appropriate applicability of ANSI/AHAM RAC, DOE proposes to update the existing references to Sections 4 and 5 of ANSI/AHAM RAC–1–2008 with references to only to the cooling mode-specific subsections of ANSI/AHAM RAC–1–2015: Sections 4.1, 4.2, 5.2.1.1, and 5.2.4.

DOE also notes that the provisions in ANSI/AHAM RAC–1–2015 for measuring electrical power input appear in Section 6.2, rather than Section 6.5 of ANSI/AHAM RAC–1–2008. To reflect this change in section numbers, DOE proposes to update appendix F to reference Section 6.2 of ANSI/AHAM RAC–1–2015 to determine the electrical power input in cooling mode. Because there is no change in substance, simply adjusting the section number cannot affect the test conduct, burden, or results.

DOE requests comment on the proposal to incorporate by reference ANSI/AHAM RAC–1–2015 to adjust the section references in appendix F to limit references to cooling mode-specific sections (by excluding standby, off mode, and heat mode sections), and to update the section reference for measuring electrical power input.

2. ANSI/ASHRAE Standard 16

Appendix F currently references the 1983 version of ANSI/ASHRAE Standard 16, which was reaffirmed in 2009, for cooling mode temperature conditions, methods, and calculations. ANSI/AHAM RAC–1–2015 also references the 1983 version of ANSI/ASHRAE Standard 16 reaffirmed in 2009.

In the August 2017 RFI, DOE noted that a new version of ANSI/ASHRAE Standard 16, published in 2016 (ANSI/ASHRAE Standard 16–2016). ANSI/ASHRAE Standard 16–2016 made a number of updates to the industry standard, including an air-enthalpy test approach as an alternative to the calorimeter approach, heating mode testing, additional clarification on placement of air samplers and thermocouples, stability requirement definitions, and new figures for additional tests and to also improve previous figures. The general cooling mode methodology, however, remains unchanged. 82 FR 36349, 36353 (Aug. 4, 2017). The addition of the air-enthalpy approach provides more flexibility in conducting the tests, and the heating mode test is based on the tests previously included in ANSI/ASHRAE Standard 58–1986 ''Method of Testing for Rating Room Air Conditioner and Packaged Terminal Air Conditioner Heating Capacity.''

AHAM supported updating appendix F to reference ANSI/ASHRAE Standard 16–2016, excluding the adoption of Sections 7.1(b) – (d), which contain the air-enthalpy method and Section 7.1.2, which contains the heating mode test). (AHAM, No. 3 at pp. 6 – 7) AHAM suggested that ANSI/ASHRAE Standard 16–2016 provides additional clarification on placement of air samplers and thermocouples, adds stability requirement definitions, adds new figures for additional tests, and fixes old figures. (*Id.*) DOE recognizes that the general calorimeter test methodology is unchanged in ANSI/ASHRAE Standard 16–2016 and has tentatively determined that the additional detail and clarifying updates would improve the repeatability and reproducibility of test results. First, ANSI/ASHRAE Standard 16–2016 provides best practices for thermocouple and air sampler placement, recognizing that the unique characteristics of each test chamber will result in particular air flow and temperature gradients in the chamber, influenced by the interaction of the reconditioning equipment and the test unit. These practices address the distances for placing the air sampler from the unit discharge points and thermocouple spacing on the air sampling device. Second, Figure 1 and Figure 2 of ANSI/ASHRAE Standard 16 are also updated with additional details and references. Third, Section 5 of ANSI/ASHRAE Standard 16–2016 includes additional provisions regarding instrument calibration and accuracy.

Fourth, ANSI/ASHRARE Standard 16–2016 requires measuring data at more frequent intervals to minimize the sensitivity of the final average value to variations in individual data points, resulting in a more repeatable and reproducible test procedure. DOE expects that requiring more frequent data measurements will have minimal impact on testing burden because most testing laboratories are already using a data acquisition system that has the capability to take more frequent measurements. For these reasons, DOE contends that the improvements in ANSI/ASHRAE Standard 16–2016 warrant inclusion in the updates to appendix F.

DOE requests comment on the proposal to incorporate relevant sections of ANSI/ASHRAE Standard 16–2016 into appendix F.

ANSI/ASHRAE Standard 16–2016 also updates requirements for the accuracy of instruments. The 2009 reaffirmation of ANSI/ASHRAE Standard 16 requires, in section 5.4.2, accuracy to ±0.5 percent of the quantity measured for instruments used for measuring all electrical inputs to the calorimeter compartments. ANSI/ASHRAE Standard 16–2016, in section 5.6.2, includes more specific language (*e.g.,* explicitly mentioning the power input to the test unit, heaters, and other cooling load contributors). To ensure that the electrical input for all key equipment is properly measured, DOE proposes to incorporate these requirements and maintain the requirement of accuracy to ±0.5 percent of the quantity measured for instruments used for measuring all electrical inputs, to the test unit, all reconditioning equipment, and any other equipment that operates within the calorimeter walls.

DOE requests comment on the proposal to incorporate the requirements of ANSI/ASHRAE Standard 16–2016 while maintaining that an accuracy of ±0.5 percent of the quantity measured is applicable to all devices measuring electrical input for the room AC test procedure.

3. ANSI/ASHRAE Standards 41.1, 41.2, 41.3, 41.6, and 41.11

ANSI/ASHRAE Standard 16–2016 references certain industry standards in specifying certain test conditions and measurement procedures. DOE is also proposing to incorporate those industry standards specified in the relevant sections of ANSI/ASHRAE Standard 16–2016. Specifically, DOE is proposing to incorporate by reference: ANSI/ASHRAE Standard 41.1–2013, ''Standard Method for Temperature Measurement, as referenced in ANSI/ASHRAE Standard 16–2016 section 5.1.1 for all temperature measurements except for dew-point temperature; ANSI/ASHRAE Standard 41.2–1987 (RA 1992), ''Standard Methods for Laboratory Airflow Measurement,'' as referenced in Section 5.5.1 of ANSI/ASHRAE Standard 16–2016 for airflow measurements; ANSI/ASHRAE Standard 41.3–2014, ''Standard Methods for Pressure Measurement,'' as referenced in section 5.2.5 of ANSI/ASHRAE Standard 16–2016 for the prescribed use of pressure measurement instruments; ANSI/ASHRAE Standard 41.6–2014, ''Standard Method for Humidity Measurement,'' as referenced in section 5.1.2 of ANSI/ASHRAE Standard 16–2016 for measuring dew-point temperatures using hygrometers; and ANSI/ASHRAE Standard 41.11–2014, ''Standard Methods for Power Measurement,'' as referenced in section 5.6.4 of ANSI/ASHRAE Standard 16–2016 regarding the use and application of electrical instruments during tests. Incorporating these standards will clarify which versions of the standards are required to conduct tests according to the procedure in appendix F.

DOE requests comment on the proposal to incorporate ANSI/ASHRAE Standard 41.1–2013, ANSI/ASHRAE Standard 41.2–1987 (RA 1992), ANSI/ASHRAE Standard 41.3–2014, ANSI/ASHRAE Standard 41.6–2014, and ANSI/ASHRAE Standard 41.11–2014 in appendix F.

C. Variable-Speed Room Air Conditioner Test Procedure

Historically, room ACs have been designed using a single-speed compressor, which operates at full cooling capacity while the compressor is on. To match the cooling load of the space, which in most cases is less than the full cooling power of the compressor, a single-speed compressor cycles on and off. This cycling behavior introduces inefficiencies due to the surge in power draw at the beginning of each ''on'' cycle, before the compressor reaches steady-state performance. Variable-speed room ACs became available on the U.S. market in 2018. These units employ an inverter compressor that can reduce its speed to match the observed cooling load. Accordingly, a variable-speed compressor runs continuously, adjusting its speed up or down as required, thereby avoiding compressor cycling.

The current DOE test procedure measures the performance of a room AC while operating under a full cooling load; *i.e.,* the compressor is operated continuously in its ''on'' state. As a result, the DOE test does not capture any inefficiencies due to compressor cycling. Consequently, the efficiency gains that can be achieved by variable-speed room ACs due to the avoidance of cycling losses are not measured by the current test procedure. DOE proposes to amend its room AC test procedure to include a methodology for determining and applying a ''performance adjustment factor'' for variable-speed room ACs to reflect the avoidance of cycling losses that would be experienced in a representative consumer installation.

DOE conducted investigative testing comparing the performance of a variable-speed room AC with a single-speed room AC under reduced cooling load conditions. DOE installed each room AC in a calorimeter test chamber, set the unit thermostat to 80 degrees Fahrenheit (°F), and applied a range of fixed cooling loads to the indoor chamber.[16] [17] The calorimeter chamber was configured so that the indoor chamber temperature could vary, thereby allowing the test unit to maintain the target indoor chamber temperature by adjusting its cooling operation in response to the changing temperature of the indoor chamber.[18] Figure III–1 shows the efficiency gains and losses for the range of reduced cooling loads tested for each unit, relative to the performance of each unit as tested using appendix F under a full cooling load.[19]

[16] A cooling load is ''applied'' by adjusting and fixing the rate of heat added to the indoor test chamber to a level at or below that of the nominal cooling capacity of the test unit.

[17] This approach aims to represent a consumer installation in which the amount of heat added to a room may be less than the rated cooling capacity of the room AC (*e.g.,* electronics or lighting turned off, people or pets leaving the room, and external factors such as heat transfer through walls and windows reducing with outdoor temperature).

[18] DOE notes that this test chamber configuration differs from the configuration used in appendix F. Appendix F uses a constant-temperature configuration, in which the indoor chamber temperature is held fixed (*i.e.,* the indoor temperature does not drop while the room AC is operational).

[19] For single-speed room ACs under appendix F, the thermostat is typically set as low as possible to ensure that the unit does not cycle on and off during the cooling mode test period.

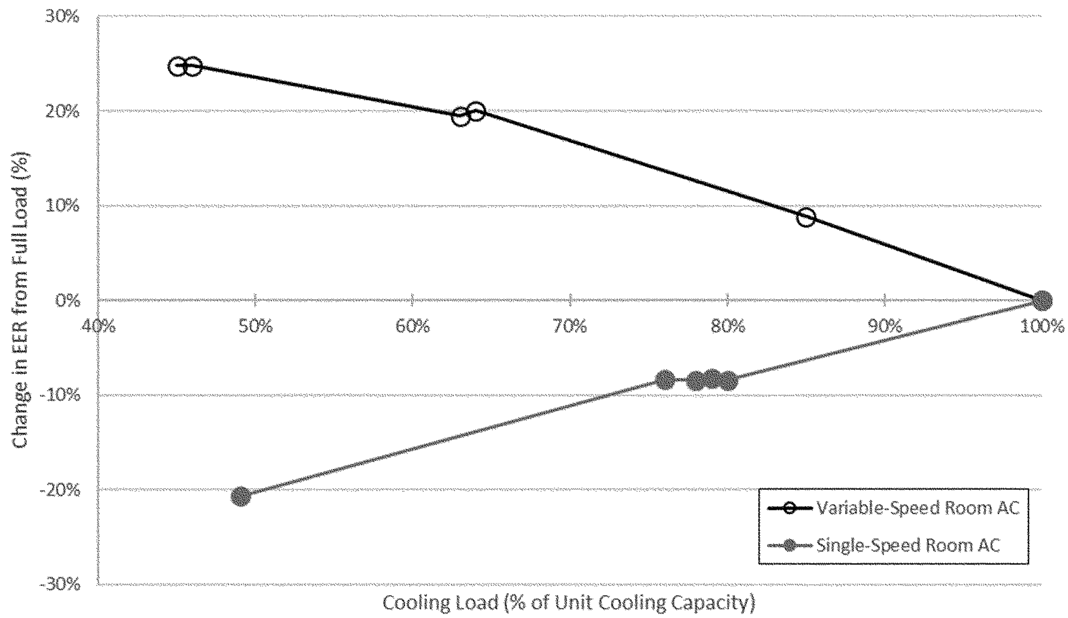

Figure III-1 Change in EER for Reduced Cooling Loads

In Figure III–1, the distance of each data point from the x-axis represents the change in efficiency relative to the full-load efficiency for each unit. (The data points at 100-percent cooling load correspond to the appendix F test conditions.) The single-speed room AC efficiency decreases in correlation with a reduction in cooling load, reflecting cycling losses that become relatively larger as the cooling load decreases. In contrast, the efficiency of the variable-speed room AC increases as the cooling load decreases, reflecting the lack of cycling losses and inherent improvements in compressor efficiency associated with lower compressor speeds. These results demonstrate that the current test procedure does not account for significant efficiency gains that variable-speed room ACs can achieve under reduced temperature conditions.

1. Methodology

To measure the efficiency gains for variable-speed room ACs that are not captured by the current DOE test procedure, DOE considered the alternate test procedure provided in the LG Waiver and the Grant of Midea Interim Waiver (collectively, ''the waivers'') for specified basic models of variable-speed room ACs. 84 FR 20111 (May 8, 2019) and 84 FR 68159 (December 13, 2019). The alternate test procedure provides a methodology for obtaining a CEER value by adjusting the CEER value as tested at the 95 °F test condition according to appendix F using a ''performance adjustment factor'' (PAF).

Conceptually, the approach for variable-speed room ACs involves measuring performance over a range of four test conditions with fixed compressor speeds, which collectively comprise representative use. These temperature conditions were derived from the DOE test procedure for central ACs with variable-speed compressors and include three reduced-temperature test conditions—under which variable speed room ACs perform more efficiently than single-speed room ACs—and the test condition specified in the current test procedure. The single-speed room AC test procedure, however, does not factor in the reduced-temperature test conditions under which single-speed units also will perform more efficiently (although not as well as variable-speed room ACs). As a result, comparing variable-speed performance at all test conditions against a single-speed unit at the highest-temperature test condition would not yield a fair comparison. The PAF represents the average relative benefit of variable-speed over single-speed across the whole range of test conditions. It is applied to the measured variable-speed room AC performance only at the high-temperature test condition to provide a comparison to the single-speed existing CEER metric based on representative use.

The steps for determining a variable-speed room AC's PAF are summarized as follows:

- Measure the capacity and energy consumption of the sample unit at the single test condition used for single-speed room ACs (95 °F dry-bulb outdoor temperature), with the compressor speed fixed at the maximum (full) speed.
- Measure the capacity and energy consumption of the sample unit at three additional test conditions (92 °F, 87 °F, and 82 °F dry-bulb outdoor temperature),[20] with compressor speed fixed at full, intermediate, and minimum (low) speed, respectively.[21] Using theoretically determined adjustment factors,[22] calculate the equivalent performance of a single-speed room AC with the same cooling capacity and electrical power input at the 95 °F dry-bulb outdoor temperature, with no cycling losses (*i.e.,* a ''theoretical comparable single-speed'' room AC) for each of the three test conditions.
- Calculate the annual energy consumption in cooling mode at each of the four cooling mode test conditions for a variable-speed room AC, as well as for a theoretical comparable single-speed room AC with no cycling losses. This theoretical single-speed room AC would perform the same as the variable-speed test unit at the 95 °F test

[20] The additional reduced-temperature conditions are described further in section III.C.2 of this document.

[21] The compressor speeds are described further in section III.C.3 of this document.

[22] These adjustment factors are described further in section III.C.4 of this document.

condition, but perform differently at the other test conditions.

- Calculate an individual CEER value at each of the four cooling mode test conditions for the variable-speed room AC, as well as for a theoretical comparable single-speed room AC with no cycling losses.
- Using cycling loss factors derived from an industry test procedure,[23] calculate an adjusted CEER value at each of the four cooling mode test conditions for a theoretical comparable single-speed room AC, which includes cycling losses.
- Using weighting factors [24] representing the fraction of time experienced at each test condition in representative real-world operation, calculate a weighted-average CEER value (reflecting the weighted-average performance across the four test conditions) for the variable-speed room AC, as well as for a theoretical comparable single-speed room AC.
- Using these weighted-average CEER values for the variable-speed room AC and a theoretical comparable single-speed room AC, calculate the PAF as the percent improvement of the weighted-average CEER value of the variable-speed room AC compared to a theoretical comparable single-speed room AC.[25] This PAF represents the improvement resulting from the implementation of a variable-speed compressor.

DOE's proposed approach to addressing the performance improvements associated with variable-speed room ACs is consistent with the test procedures required in the waivers. The following sections of this document describe each aspect of the proposal in greater detail.

2. Test Conditions

As discussed previously, variable-speed room ACs provide improved performance at reduced cooling loads by reducing the compressor speed to match the load, thereby avoiding compressor cycling and associated cycling inefficiencies. DOE recognizes that throughout the cooling season, room ACs operate under various outdoor temperature conditions. DOE also asserts that these varying outdoor conditions present a range of reduced cooling loads in the conditioned space, under which a variable-speed room AC would perform more efficiently than a theoretical comparable single-speed room AC.

To measure this improved performance, DOE proposes a test procedure for variable-speed room ACs that adds three test conditions (92 °F, 87 °F, and 82 °F dry-bulb outdoor temperature) to the current 95 °F, consistent with the test conditions in the waivers. DOE notes that these temperatures represent potential outdoor temperature conditions between the current 95 °F test condition and the indoor setpoint of 80 °F (below which no active cooling would be necessary). These additional test conditions are also consistent with the representative temperatures for bin numbers 6, 5, and 4 in Table 19 of DOE's test procedure for central ACs at appendix M.

DOE requests comment on the proposal to adopt for all variable-speed room ACs these additional test conditions from test procedures required in the waivers for variable-speed room ACs.

3. Variable-Speed Compressor Operation

The DOE test procedure maintains fixed test conditions in the indoor chamber and requires configuring the test unit settings to achieve maximum cooling capacity. As a result, units under test constantly operate at their full cooling capacity, even at the reduced outdoor temperature test conditions described in section III.C.2 of this document, without the compressor cycling (for single-speed units) or compressor speed reduction (for variable-speed units) that would be expected under real-world operation. Therefore, DOE proposes additional test procedure adjustments, beyond reduced outdoor temperature test conditions, to fully represent the potential efficiency gains associated with variable-speed room ACs at reduced cooling loads.

As described previously, in a typical consumer installation, reduced outdoor temperatures would result in reduced indoor cooling loads. A test that would provide constant reduced cooling loads could be considered, but as discussed below in section III.E.1.e of this document, DOE concludes such a test would not be feasible at this time. Therefore, to better represent what would occur in typical consumer usage at reduced outdoor temperatures, DOE proposes to test variable-speed room ACs by fixing a particular compressor speed at each of the outdoor test conditions, as described further in the following sections.

a. Compressor Speeds

To ensure the compressor speeds are representative of actual speeds at the expected cooling loads at each of the outdoor test conditions, DOE proposes to require that the compressor speed be set to full speed at the two highest outdoor temperature test conditions (based on test A_{Full} at 95 °F and test B_{Full} at 92 °F), at intermediate compressor speed at the 87 °F test condition (based on test E_{Int}), and at low compressor speed at the 82 °F test condition (based on test D_{Low}), consistent with the tests and requirements in Table 8 of the 2017 version of Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 210/240, (AHRI Standard 210/240), ''Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment,'' which specifies representative test conditions and the associated compressor speeds for variable-speed unitary air conditioners. DOE also proposes to add definitions for ''full compressor speed'', ''intermediate compressor speed'', and ''low compressor speed'', which specify how each speed would be determined, as described further in section III.D of this document.

DOE requests comment on the proposal to require fixing the compressor speed settings for variable-speed room ACs to full speed at the 95 °F and 92 °F test conditions, intermediate speed at the 87 °F test condition, and low speed at the 82 °F test condition, in accordance with the requirements in Table 8 of AHRI Standard 210/240.

b. Instructions for Fixing Compressor Speeds

DOE understands that setting and maintaining a specific room AC compressor speed is not typically possible without special control instructions from manufacturers. Therefore, because maintaining fixed compressor speeds is critical to the repeatability of the variable-speed room AC test procedure, DOE proposes that manufacturers provide in each certification report for a variable-speed room AC basic model all necessary instructions to maintain the compressor speeds required for each test condition when testing that basic model. These include the compressor frequency set points at each test condition, instructions necessary to maintain the compressor speeds required for each test condition, and the control settings used for the variable components.

DOE requests comment on the proposal to require that manufacturers provide in their certification reports the

[23] The derivation of these cycling loss factors is described in more detail in section III.C.5 of this document.

[24] These ''fractional temperature bin'' weighting factors are described in more detail in section III.C.6 of this document.

[25] The performance adjustment factor is described in more detail in section III.C.7 of this document.

control settings for each variable-speed room AC basic model required to achieve the fixed compressor speed for each test condition.

c. Boost Compressor Speed

DOE is aware that a variable-speed room AC's full compressor speed may not be its fastest speed. In particular, the fastest compressor speed may be one that is automatically initiated and used for a brief period of time to rapidly reduce the indoor temperature to within typical range of the set point. This compressor speed is referred to as ''Boost Compressor Speed'' in AHRI Standard 210/240 and is defined as a speed faster than full compressor speed, at which the unit will operate to achieve increased capacity. DOE understands that boost compressor speed operation is typically limited in duration and would not significantly contribute to annual energy consumption, as manufacturers have described it as used for limited periods of time on occasions where the indoor room temperature is far out of normal operating range of the set point. Once the indoor room temperature is within the typical operating range of the setpoint, the room AC returns to the ''Full Compressor Speed,'' as defined in AHRI Standard 210/240. AHRI Standard 210/240 does not measure boost compressor speed energy use, and in a final rule published on June 8, 2016, DOE declined to include provisions for measuring boost compressor speed energy use in the central AC test procedure. 81 FR 36992, 37029. Accordingly, DOE does not propose to measure boost compressor speed performance and energy consumption in appendix F at this time because of the expected insignificant impact on annual energy consumption and performance, to harmonize with the industry approach for variable-speed compressor testing, and because DOE has previously opted to forgo including it for other air conditioning products. *Id.*

DOE requests comment on the proposal not to address boost compressor speed performance and energy consumption in appendix F at this time.

4. Capacity and Electrical Power Adjustment Factors

In the proposed approach, a capacity adjustment factor is used to estimate the increased cooling capacity of a room AC at lower outdoor temperature conditions, using a linear extrapolation based on the measured capacity at the 95 °F test condition. Similarly, an electrical power adjustment factor is used to estimate the reduced electrical power draw of a room AC at lower outdoor temperature conditions, using a linear extrapolation based on the measured electrical power draw at the 95 °F test condition. To determine these two adjustment factors, DOE used the MarkN model to model room AC performance at reduced outdoor temperature conditions. These modeling results suggested linear capacity and electrical power adjustment factors of 0.0099 per °F and 0.0076 per °F, respectively.

To confirm the validity of these modeled adjustment factors, DOE tested a sample of 14 single-speed room ACs at a range of reduced outdoor temperature test conditions (92 °F, 87 °F, and 82 °F) and compared the predicted values of cooling capacity and electrical power with the measured values at each test condition. Table III–2 and Table III–3 summarize the results for cooling capacity and electrical power, respectively.

TABLE III–2—COMPARISON BETWEEN MODELED AND TESTED COOLING CAPACITY

Unit	92 °F			87 °F			82 °F		
	Model (Btu/h)	Tested (Btu/h)	Diff. (%)	Model (Btu/h)	Tested (Btu/h)	Diff. (%)	Model (Btu/h)	Tested (Btu/h)	Diff. (%)
1	5,890	5,850	−0.6	6,170	6,070	−1.8	6,460	6,300	−2.5
2	10,920	10,810	−0.9	11,440	11,060	−3.4	11,970	11,330	−5.4
3	12,160	12,340	+1.5	12,740	12,880	+1.1	13,330	13,320	−0.1
5	12,430	12,320	−0.9	13,030	12,640	−3.0	13,620	12,890	−5.7
6	8,660	8,490	−2.0	9,070	8,570	−5.9	9,490	8,680	−9.3
7	12,400	12,180	−1.8	13,000	12,310	−5.6	13,590	12,360	−10.0
8	5,360	5,410	+0.8	5,620	5,590	−0.6	5,880	5,770	−1.9
9	5,760	5,640	−2.0	6,030	5,850	−3.2	6,310	6,000	−5.3
10	5,440	5,530	+1.6	5,700	5,730	+0.6	5,960	5,790	−3.0
11	6,520	6,410	−1.7	6,830	6,490	−5.2	7,140	6,520	−9.6
12	6,350	6,320	−0.5	6,650	6,500	−2.4	6,960	6,820	−2.0
13	8,150	8,180	+0.4	8,540	8,530	−0.1	8,930	9,080	+1.6
14	8,830	8,630	−2.3	9,260	8,960	−3.2	9,680	9,090	−6.5
15	21,860	22,440	+2.6	22,920	23,270	+1.5	23,970	24,260	+1.2
Average			−0.4			−2.2			−4.2

Note: Unit 4 was not included because it is a variable-speed unit and the modeling factors are only applicable to single-speed units that do not adjust performance at reduced outdoor temperature conditions.

TABLE III–3—COMPARISON BETWEEN MODELED AND TESTED ELECTRICAL POWER DRAW

Unit	92 °F			87 °F			82 °F		
	Model (W)	Tested (W)	Diff. (%)	Model (W)	Tested (W)	Diff. (%)	Model (W)	Tested (W)	Diff. (%)
1	414	412	+0.6	398	393	+1.3	382	375	+1.9
2	894	887	+0.8	859	846	+1.6	825	807	+2.2
3	989	984	+0.5	950	938	+1.3	912	895	+2.0
5	1,080	1,073	+0.7	1,038	1,024	+1.4	996	978	+1.8
6	705	701	+0.6	677	668	+1.4	650	636	+2.2
7	1,116	1,106	+0.9	1,073	1,046	+2.6	1,030	993	+3.7
8	433	430	+0.7	416	412	+1.0	399	394	+1.3
9	435	430	+1.1	418	413	+1.2	401	392	+2.3
10	435	435	+0.2	418	417	+0.2	401	403	-0.4
11	537	535	+0.5	517	510	+1.3	496	483	+2.6
12	514	514	0.0	494	492	+0.4	474	470	+0.9
13	643	638	+0.8	618	610	+1.3	593	584	+1.5

TABLE III–3—COMPARISON BETWEEN MODELED AND TESTED ELECTRICAL POWER DRAW—Continued

Unit	92 °F			87 °F			82 °F		
	Model (W)	Tested (W)	Diff. (%)	Model (W)	Tested (W)	Diff. (%)	Model (W)	Tested (W)	Diff. (%)
14	647	646	+0.2	622	615	+1.1	597	585	+1.9
15	2,074	2,068	+0.3	1,993	2,006	−0.6	1,912	1,935	−1.2
Average			+0.6			+1.1			+1.6

Note: Unit 4 was not included because it is a variable-speed unit and the modeling factors are only applicable to single-speed units that do not adjust performance at reduced outdoor temperature conditions.

The results in Table III–2 generally indicate close agreement (*i.e.,* less than 5 percent difference on average) between the modeled cooling capacity (based on an adjustment factor of 0.0099 per °F) and the measured capacity at each test condition. On average, the tested cooling capacity was within 0.4 percent of the modeled value at the 92 °F test condition, 2.2 percent at the 87 °F test condition, and 4.2 percent at the 82 °F test condition.

Similarly, the results in Table III–3 generally indicate close agreement between the modeled electrical power draw (based on an adjustment factor of 0.0076 per °F) and the measured electrical power draw at each test condition. On average, the tested electrical power draw was within 0.6 percent of the modeled value at the 92 °F test condition, 1.1 percent at the 87 °F test condition, and 1.6 percent at the 82 °F test condition.

DOE has tentatively determined that the average difference of less than 5 percent between the modeled values and the experimental values confirms the validity of these modeled adjustment factors. Therefore, DOE proposes using the modeled adjustment factors of 0.0099 per °F and 0.0076 per °F for capacity and electrical power, respectively, to calculate the theoretical comparable single-speed room AC performance at reduced outdoor temperature test conditions.

DOE requests comment on the proposal to use the capacity and electrical power adjustment factors of 0.0099 per °F and 0.0076 per °F, respectively.

5. Cycling Loss Factors

To represent the cycling losses of a theoretical comparable single-speed room AC at reduced outdoor temperature test conditions and expected reduced cooling loads, DOE identified cycling loss factors to apply to the interim CEER values at each of the four cooling mode test conditions for a theoretical comparable single-speed room AC. Table III–4 shows the proposed cycling loss factors for each of the four proposed test conditions.

TABLE III–4—PROPOSED CYCLING LOSS FACTORS

Test condition	Evaporator inlet air, °F		Condenser inlet air, °F		Cycling loss factor
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	
Test Condition 1	80	67	95	75	1.0
Test Condition 2	80	67	92	72.5	0.971
Test Condition 3	80	67	87	69	0.923
Test Condition 4	80	67	82	65	0.875

These cycling loss factors are based on the default cycling loss factors in Section 11.2 of AHRI Standards 210/240. The cycling loss factor at the 82 °F test condition for a theoretical comparable single-speed room AC is consistent with the default cooling degradation coefficient of 0.25, which corresponds to a part-load (cycling loss) factor of 0.875, as determined in Section 11.2 of AHRI Standard 210/240. The remaining cycling loss factors for the other test conditions are consistent with linear interpolation between the cycling loss factor of 0.875 at the 82 °F test condition and the cycling loss factor of 1.0 at the 95 °F test condition, at which no cycling is expected.

DOE requests comment on the proposal to implement cycling loss factors consistent with AHRI Standard 210/240 to represent the expected performance of a theoretical comparable single-speed room AC at reduced outdoor temperature test conditions.

6. Test Condition Weighting Factors

In the proposed approach, the four interim CEER values representing each of the four cooling mode test conditions are combined, using four weighting factors, into a single weighted-average CEER value. The resulting weighted-average CEER value represents the weighted-average performance across the range of outdoor test conditions. DOE calculated weighting factors based on the fractional temperature bin hours in Table 19 of DOE's test procedure for central ACs at appendix M. DOE identified the fractional temperature bin hours representing the four test conditions in the proposed approach, and normalized these four values from appendix M so that they sum to 1.00.

Table III–5 shows the proposed weighting factors for each of the four proposed test conditions.

TABLE III–5—PROPOSED TEMPERATURE CONDITION WEIGHTING FACTORS

Test condition	Evaporator inlet air, °F		Condenser inlet air, °F		CEER weighting factor
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	
Test Condition 1	80	67	95	75	0.05
Test Condition 2	80	67	92	72.5	0.16

TABLE III–5—PROPOSED TEMPERATURE CONDITION WEIGHTING FACTORS—Continued

Test condition	Evaporator inlet air, °F		Condenser inlet air, °F		CEER weighting factor
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	
Test Condition 3	80	67	87	69	0.31
Test Condition 4	80	67	82	65	0.48

DOE requests comment on the proposed weighting factors associated with each of the outdoor test conditions.

7. Performance Adjustment Factor

The final step in the proposed approach is to calculate the PAF, representing the improvement over a theoretical comparable single-speed room AC resulting from the implementation of a variable-speed compressor. The PAF would be calculated as the percent improvement of the weighted-average CEER value of the variable-speed room AC compared to the weighted-average CEER value of a theoretical comparable single-speed room AC under the four defined test conditions.

After calculating the PAF, it would be multiplied by the CEER value of the variable-speed unit when tested at the 95 °F test condition according to appendix F, resulting in the final CEER metric for the variable-speed room AC.

DOE expects that the variable-speed room AC CEER values would be comparable to single-speed room AC CEER values as a result of applying the adjustment factor to the variable-speed room AC CEER value determined in accordance with the current single-speed test method in appendix F. By adjusting the variable-speed room AC CEER values to be comparable to single-speed room AC CEER values, consumers will have the information they need to understand the relative efficiency of both types of room AC.

DOE requests comment on the proposed calculations to determine a PAF, which would adjust the CEER of a variable-speed room AC to appropriately account for its efficiency improvements relative to a theoretical comparable single-speed room AC under varying operating conditions.

8. Air-Enthalpy Test Alternative

DOE recognizes the additional test burden associated with testing variable-speed room ACs at multiple test conditions as proposed. In an effort to minimize that additional test burden, the Grant of LG Interim Waiver test procedure provided that LG could optionally test its variable-speed room ACs using the air-enthalpy method. Following the publication of the Grant of LG Interim Waiver, DOE conducted investigative testing to further analyze the air-enthalpy method and its suitability for testing room ACs. As described below, this testing demonstrated that this method was unrepresentative and inconsistent, and remedying these deficiencies would be unduly burdensome.

DOE tested nine room ACs according to the air-enthalpy procedure prescribed by ANSI/ASHRAE Standard 37–2009, ‘‘Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment.’’ DOE constructed plenums to match the cross sectional area of each room AC evaporator and condenser exhaust, with instrumented ducts connected to each. A variable-speed fan at the end of each duct was used to maintain a zero static pressure at the test unit exhaust. Tests were conducted in accordance with the indoor and outdoor test conditions specified in appendix F, and the instrumentation in the duct measured the psychrometric characteristic of the air in addition to the air flow rate to obtain the cooling capacity. To determine whether there was reasonable correlation between the two sets of results and, thus, whether the air-enthalpy procedure would be a viable alternative approach, DOE compared the cooling capacities measured according to this air-enthalpy method to the capacities obtained via the calorimeter method currently specified in appendix F. Table III–6 shows the measured cooling capacity and efficiency obtained for each of these eight test units using the air-enthalpy and calorimeter methods, and highlights the differences in results between the two approaches.

TABLE III–6—COOLING CAPACITY AND EFFICIENCY USING THE AIR-ENTHALPY METHOD AND THE CALORIMETER METHOD

Unit #	Indoor air flow (CFM)	Calorimeter capacity (Btu/h)	Air-enthalpy capacity (Btu/h)	Capacity difference (%)	Calorimeter EER (Btu/Wh)	Air-enthalpy EER (Btu/Wh)	EER difference (%)
8	131	5,210	4,803	−7.8	11.8	10.6	−9.7
9	161	5,591	5,059	−9.5	12.6	11.3	−10.1
10	126	5,284	4,908	−7.1	11.9	10.9	−8.0
11	147	5,228	4,715	−9.8	10.8	9.7	−10.7
12	152	6,164	5,650	−8.3	11.7	10.6	−9.4
13	197	7,914	7,814	−1.3	12.0	11.8	−1.8
14	227	8,576	8,165	−4.8	13.0	12.4	−4.1
15	459	2,1233	2,1626	+1.8	10.0	10.1	+0.7

The results in Table III–6 indicate a range of differences between the air-enthalpy method and the calorimeter methods, for both cooling capacity and efficiency, which appears to correlate with the evaporator exhaust, or indoor, air flow rate from each unit. Five of the eight units (Units 8 through 12) demonstrated relatively poor agreement between the two methods, with an average decrease in cooling capacity of 8.5 percent and an average decrease in efficiency of 9.4 percent when using the air-enthalpy method. These units all had indoor air flow rates at or below 161 cubic feet per minute (CFM). Conversely, the unit with the largest air flow rate of 459 CFM (Unit 15) showed a small increase in capacity and efficiency when tested using the air-enthalpy method. The remaining two units (Units 13 and 14) had air flow rates between 161 CFM and 459 CFM, and showed only a modest decrease of less than 5 percent in both capacity and efficiency.

DOE asserts that these results depend on the measurement apparatus available to the testing laboratory for the air-enthalpy method. DOE understands that air-enthalpy test equipment currently used by testing laboratories is not typically designed to accurately measure air conditioning products with airflow rates lower than approximately 200 CFM because typical test equipment is optimized for larger air conditioners with significantly higher airflow rates. The results for Units 8 through 12 support this assertion: All of these had evaporator airflows substantively below 200 CFM, and the performance for each unit measured using the air-enthalpy and calorimeter approaches differed by more than five percent on average. DOE is aware that air-enthalpy equipment that is optimized to measure units with airflow between 50 and 500 CFM exists. However, such equipment may be costly to design, develop, and produce, because it is not readily available and may require custom manufacturing. In addition, the air-enthalpy method does not measure any heat transfer within and through the unit chassis, while the calorimeter test does. Because of the unrepresentative and inconsistent results obtained with the air-enthalpy test equipment that testing laboratories are likely to already own, as well as the higher cost and limited availability of equipment that would be necessary to obtain consistent results for all room ACs of differing airflow rates, DOE contends that the air-enthalpy test method would be unduly burdensome for testing laboratories to implement for room ACs at this time. DOE further notes that, in the waivers, DOE did not allow the air-enthalpy test method as an alternative to the calorimeter test method due to the concerns outlined above. 84 FR 20111 (May 8, 2019), 84 FR 68159 (Dec. 13, 2019). Therefore, DOE is not proposing in this NOPR to allow testing of variable-speed room ACs using the air-enthalpy test method.

DOE seeks comment on the proposal to not include an optional alternative air-enthalpy test method for variable-speed room ACs in appendix F.

9. Product Specific Reporting Provisions

As described, the proposed amendment to Appendix F to test variable-speed room ACs at multiple cooling mode test conditions would require testing each unit with a fixed compressor speed at each test condition. To ensure test reproducibility, DOE is proposing to require, in 10 CFR 429.15, manufacturers to provide DOE all necessary instructions to maintain the compressor speeds required for each test condition for a variable-speed basic model, as additional product-specific information pursuant to 10 CFR 429.12 (b)(13). DOE expects that this requirement would add a *de minimis* incremental burden to the existing reporting requirements.

DOE requests comment on the proposal to include in 10 CFR 429.15 compressor frequencies and control settings as additional product-specific information for certification of each variable-speed room AC basic model.

10. Estimated Annual Operating Cost Calculation

In conjunction with the proposed amendments for testing variable-speed room ACs, DOE is proposing corresponding amendments to the calculation that provides the basis of the annual energy consumption and operating cost information presented to consumers on the EnergyGuide Label. These changes would allow for an appropriate comparison of the annual energy consumption and operating costs between single-speed room ACs and variable-speed room ACs. As such, DOE proposes that for variable-speed room ACs, the average annual energy consumption used in calculating the estimated annual operating cost in 10 CFR 430.23(f) would be a weighted average of the annual energy consumption at each of the four test conditions in newly added Table 1 of appendix F and the annual energy consumption in inactive mode or off mode. DOE proposes, however, that the electrical power input reported for variable-speed room ACs for purposes of certification in 10 CFR 429.15(b)(2) would be the value measured at the 95 °F rating condition, to maintain consistency with the cooling capacity measured at the same condition.

DOE requests comment on the proposal to calculate estimated annual operating cost for variable-speed room ACs using a weighted-average annual energy consumption based on the four cooling mode test conditions in the proposed, new Table 1 of appendix F. DOE also requests comment on the proposal to report variable-speed room AC input power for certification purposes using the value measured at the 95 °F rating condition.

11. Potential Cost Impacts

The test procedure amendments proposed above would result in additional test burden and cost for testing variable-speed room ACs, mainly due to the additional time associated with testing cooling mode performance of variable-speed room ACs under four total test conditions, compared to the single cooling mode test currently required in appendix F. Under the LG Waiver, LG is already testing its variable-speed room ACs using the proposed approach and accordingly would incur no additional cost due to the proposed test procedure amendments. Likewise, under the Grant of Midea Interim Waiver, Midea is also already testing its variable-speed room ACs using the proposed approach and so would not incur any additional cost either due to the proposed test procedure amendments. DOE is not aware of other manufacturers of variable-speed room ACs, although the additional burden described above would be applicable to any entities that begin manufacturing a variable-speed room AC and introduce it to the U.S. market. Given that variable-speed room ACs are not available in the U.S. market from any other manufacturers besides LG and Midea, the proposed test procedure amendments in this NOPR regarding variable-speed room ACs would not result in any additional cost to manufacturers.

D. Definitions

DOE proposes to add a number of definitions to appendix F to accompany the proposed amendments described in this document. None of these proposed definitions would modify the current scope of covered products. The following sections describe each proposed definition in detail.

DOE proposes to define three key terms that currently appear in Appendix F but have no definitions: cooling mode, cooling capacity, and combined energy efficiency ratio. Although room ACs may sometimes operate in other modes as discussed further in section III.E of this proposed rule, the room AC CEER metric determined in appendix F is based primarily on performance in cooling mode, and several of the proposed amendments also reference ''cooling mode.'' DOE proposes to establish the following definitions for cooling mode, cooling capacity, and combined energy efficiency ratio in appendix F:

''Cooling mode'' means an active mode in which a room air conditioner has activated the main cooling function according to the thermostat or temperature sensor signal or switch (including remote control).

''Cooling capacity'' means the amount of cooling, in Btu/h, provided to an indoor conditioned space, determined in Section 4.1 of appendix F.

''Combined energy efficiency ratio'' is the energy efficiency of a room air conditioner as measured in Btu/Wh and determined in Section 5.2.2 of appendix F for single-speed room air conditioners and Section 5.3.12 of appendix F for variable-speed room air conditioners.

To accompany the proposed amendments affecting variable-speed basic models, DOE proposes to define single-speed and variable-speed room ACs as follows:

''Single-speed room air conditioner'' means a type of room AC that cannot automatically adjust the compressor speed based on detected conditions.

''Variable-speed room air conditioner'' means a type of room AC that can automatically adjust compressor speed based on detected conditions.

In addition, DOE proposes to establish definitions for the three compressor speeds required for variable-speed testing. DOE proposes to refer to these compressor speeds as ''full,'' ''intermediate,'' and ''low'' based on the test procedure terminology of AHRI Standard 210/240. The proposed definitions are as follows:

''Full compressor speed (full)'' means the compressor speed at which the unit operates at full load test conditions, achieved by following the instructions certified by the manufacturer.

''Intermediate compressor speed (intermediate)'' means a compressor speed higher than the low compressor speed by one third of the difference between low compressor speed and full compressor speed with a tolerance of plus 5 percent (designs with non-discrete speed stages) or the next highest inverter frequency step (designs with discrete speed steps), achieved by following the instructions certified by the manufacturer.

''Low compressor speed (low)'' means the compressor speed at which the unit operates at low load test conditions, achieved by following the instructions certified by the manufacturer, such that $Capacity_4$, the measured cooling capacity at test condition 4 in Table 1 of appendix F, is not less than 47 percent and not greater than 57 percent of $Capacity_1$, the measured cooling capacity with the full compressor speed at test condition 1 in Table 1 of appendix F.

DOE is proposing a definition for low compressor speed based on the definition in AHRI Standard 210/240. To ensure that the low and intermediate compressor speeds result in representative cooling capacity under reduced loads, as explained in the following paragraphs, DOE is additionally proposing that the low compressor speed definition require that the test unit's measured cooling capacity at Test Condition 4, specified in Table III–5 of this document, be not less than 47 percent and not greater than 57 percent, of the measured cooling capacity when operating at the full compressor speed at Test Condition 1, also specified in Table III–5 of this document.

DOE developed this range based on the Building Load Calculation, Equation 11.60, in AHRI Standard 210/240, which relates the building load to an AC's full-load cooling capacity and outdoor temperature. DOE adapted this calculation for the room AC test procedure by normalizing Equation 11.60 so that full-load operation is assumed to occur at a 95 °F outdoor temperature, consistent with the outdoor test condition defined in the current room AC test procedure, rather than 98 °F as assumed by Equation 11.60. DOE used the normalized equation to determine the representative cooling load at an outdoor temperature of 82 °F as a percentage of the full-load cooling capacity at an outdoor temperature of 95 °F. Based on this analysis, an outdoor temperature of 82 °F would result in a cooling load of 57 percent of full-load cooling capacity. Therefore, DOE proposes that the representative cooling load at the low compressor speed and outdoor temperature of 82 °F (*i.e.* the temperature represented by Test Condition 4 in Table III–5), is 57 percent of the unit's cooling capacity when operating at 95 °F (*i.e.,* Test Condition 1 in Table III–5).

DOE recognizes that variable-speed room ACs may use compressors that vary their speed in discrete steps and may not be able to directly operate at a speed that provides 57 percent cooling capacity precisely; therefore, the defined cooling capacity associated with the low compressor speed is best presented as a range rather than a single value. DOE proposes that a 10-percent range would accommodate compressors that vary their speed in discrete steps.

DOE further proposes using 57 percent cooling load as the upper bound of the 10-percent range to define the cooling capacity associated with the lower compressor speed (*i.e.,* the range would be defined as 47 to 57 percent). The justification for using 57 percent as an upper bound, rather than as a midpoint in the 10-percent range, is as follows. Defining the upper bound of the 10-percent cooling load range as 57 percent would ensure that a variable-speed room AC is capable of matching the representative cooling load (57 percent of the maximum) at the 82 °F outdoor test condition, while providing the performance benefits associated with variable-speed operation. In contrast, if the 10-percent range were to be defined as, for example, 52 to 62 percent (with 57 percent as the midpoint), a variable-speed room AC could be tested at 60 percent, for example, without demonstrating the capability to maintain variable-speed performance down to 57 percent.

In summary, DOE proposes in newly added section 2.16 of appendix F to define ''low compressor speed (low)'' as the compressor speed specified by the manufacturer at which the unit operates at low load test conditions, such that the measured cooling capacity at the 82 °F outdoor test condition shall be no less than 47 percent and no greater than 57 percent of the unit's cooling capacity when operating at the 95 °F test condition.

DOE requests comment on the proposal to add new definitions for cooling mode, cooling capacity, combined energy efficiency ratio, single-speed room air conditioner, variable-speed room air conditioner, variable-speed compressor, full compressor speed (full), intermediate compressor speed (intermediate), and low compressor speed (low) in appendix F.

E. Active Mode Testing

The following sections describe proposed amendments and other considerations regarding the active mode testing provisions of appendix F.

1. Cooling Mode

a. General Test Approach

The current DOE room AC test procedure uses a calorimeter test method to determine the cooling capacity and associated electrical power input of a room AC. Under this approach, the test unit is installed between two chambers, one representing the indoor side and the other representing the outdoor side, which are both maintained at constant conditions by reconditioning equipment. The room AC operates in cooling mode, transferring heat from the indoor side to the outdoor side, while the reconditioning equipment counteracts the effects of the room AC to maintain constant test chamber conditions. The room AC cooling capacity is determined by measuring the required energy inputs to the reconditioning equipment.

In response to the June 2015 RFI, AHAM noted that it planned to conduct a round-robin test to identify sources of potential variation in the room AC test procedure. AHAM stated that because it believes that the current room AC standards are stringent, and that slight variation in the test procedure would have a significant impact in meeting standards, any DOE test procedure amendments should address potential sources of variation. (AHAM, June 2015 RFI, No. 5 at p. 5) In this NOPR, DOE is proposing various test procedure modifications intended to improve repeatability and reproducibility and mitigate potential areas of variation. While DOE has not quantified the cost impacts of these proposed changes, based on its analysis described in section III.L.1 of this document, DOE believes that they would serve to reduce test burden by reducing the potential need for tests to be re-run due to variation. DOE welcomes AHAM's round-robin test data to identify areas of variation in the room AC test procedure and encourages other interested parties to provide comment and feedback on this issue.

b. Test Setup and Air Sampling

In the August 2017 RFI, DOE noted that Section 4.2.7 of ANSI/ASHRAE 16–2009, which is incorporated by reference in the DOE test procedure, requires the calorimeter chamber conditions to be verified by air sampled from a location that is representative of the temperatures surrounding the unit and that simulate the conditions in which the unit operates in the field. As DOE stated, there is no procedure to verify whether the measured chamber temperature reading is representative of conditions at the test unit condenser and evaporator inlet, which may be affected by recirculation from the condenser and evaporator exhaust, respectively, thereby potentially reducing test repeatability and reproducibility. 82 FR 36349, 36353. In the August 2017 RFI, DOE requested data on more specific requirements for air sampling devices within the calorimeter test chambers to improve test repeatability. *Id.*

Friedrich asserted that the positioning of the air samplers impacts test repeatability, especially for through-the-wall units which intake and exhaust condenser air on the same plane. Friedrich recommended that the air sampler measurements be verified using a thermocouple grid at the evaporator and condenser air inlets. (Friedrich, No. 2 at p. 5)

AHAM stated that it does not currently have information that the thermocouple placement as prescribed in ANSI/ASHRAE Standard 16–2009 affects test repeatability and suggested that a balanced temperature is achieved throughout the calorimeter chamber. AHAM further noted that, unlike in a psychrometric test approach, the current calorimeter test approach takes into account any recirculation that would occur in the field. (AHAM, No. 3 at p. 6)

DOE is aware that the size, capability, and orientation of components within calorimeter test chambers may vary significantly, and that third-party laboratories extensively analyze their chambers and testing apparatus to maintain consistent and accurate air sampling measurements. DOE also understands that temperature gradients and unique airflow patterns can result from the interaction of a chamber reconditioning apparatus and the room AC under test, and that these interactions are particular to and dependent upon factors such as chamber size and shape, chamber equipment arrangement, size of reconditioning apparatus, and others, as noted in ANSI/ASHRAE Standard 16–2016 Section 8.2.7. Therefore, DOE contends that universal requirements for air sampling instrumentation and thermocouple placement could potentially reduce test accuracy and reproducibility. As discussed in section III.B.2 of this document, DOE is proposing to update the reference to ANSI/ASHRAE Standard 16 to the most current 2016 version, which includes additional clarification on best practices for air sampler and thermocouple placement.

c. Air-Enthalpy Test

As discussed in section III.B.2 of this document, DOE is proposing to use the calorimeter test method specified in ANSI/ASHRAE Standard 16–2016 for determining the cooling mode performance in appendix F. ANSI/ASHRAE Standard 16–2016 additionally contains an air-enthalpy test method (also referred to as a psychrometric test method), in which a technician places instruments in or near the evaporator air stream to measure the rate of cooled air added to the conditioned space. In the June 2015 RFI and the August 2017 RFI, DOE discussed the potential differences in accuracy and test burden associated with the two test methods and requested comment on the air-enthalpy method, specifically its applicability, accuracy, and associated test burden. 80 FR 34843, 34847 (July 18, 2015) and 82 FR 36349, 36353 (Aug. 4, 2017).

AHAM opposed the use of the air-enthalpy method as an alternative to the calorimeter method, stating that the calorimeter method is supported by historical data and is repeatable, while the repeatability of the air-enthalpy method for room ACs had not yet been assessed. According to AHAM, implementing this alternative test method would likely increase variation in testing and cause challenges for third-party verification and enforcement testing. (AHAM, June 2015 RFI, No. 5 at p. 3; AHAM, No. 3 at p. 7)

Friedrich also opposed the use of the air-enthalpy method for room ACs, based on internal testing that it stated showed a 2 to 3-percent variation in test results for the calorimeter method. Friedrich suggested that the variability of a psychrometric method for room ACs would be greater than the current variability associated with the calorimeter method. Friedrich added that psychrometric testing: (1) would not represent actual installation conditions, (2) would add uncertainty to the exhaust air wet-bulb temperature measurements, and (3) would fail to capture cooling from the portion of the room AC chassis installed in the room. Friedrich supported not updating the reference of ANSI/ASHRAE Standard 16–2009 in the DOE test procedure until further round-robin investigation is completed. (Friedrich, No. 2 at pp. 6–7)

DOE recognizes that installing test ducts on the evaporator and condenser exhausts to measure the air-enthalpy and calculate cooling capacity may impact the air flow, particularly on the evaporator side where room ACs typically locate the inlet and outlet in close proximity, and thus produce results that may not be representative of typical installations. The calorimeter method requires no test ducts or instrumentation that might impede or redirect airflow. DOE also agrees with Friedrich that, unlike the calorimeter method, the air-enthalpy method does not capture heat loss through the chassis to the room and further notes that the air-enthalpy method also may not capture possible heat transfer due to internal air leakage through the chassis between the indoor and outdoor test chambers.

As discussed in section III.C.8 of this document, DOE conducted testing to investigate any differences in test results between the air-enthalpy and calorimeter approaches. That testing showed a wide range of discrepancies between the air-enthalpy method and the calorimeter method, for both cooling capacity and efficiency. The largest differences were observed for units with evaporator airflows below 200 CFM, suggesting that the air-enthalpy test method as typically conducted with existing instrumentation does not produce results representative of actual room AC performance or comparable to measured performance in a calorimeter chamber. DOE expects that obtaining more accurate results would require specialized test equipment that is limited in availability and costly to design, develop, and produce.

Finally, DOE notes that the results of AHAM's round-robin testing results are not yet available to further evaluate the repeatability and reproducibility of the air-enthalpy method.

For these reasons, DOE is not proposing to allow the use of the air-enthalpy method for determining room AC cooling mode performance at this time.[26]

DOE seeks comment on the proposal not to include an air-enthalpy test approach for determine cooling mode performance of room ACs.

d. Side Curtain Heat Leakage and Infiltration Air

DOE considered the installation requirements for room ACs during testing and the impact of installation on efficiency performance, as described in the following sections.

Room ACs are designed to be installed in a window opening or through a wall, with the compressor and condenser outside the conditioned space and the evaporator inside the conditioned space, as shown in Figure III–2.

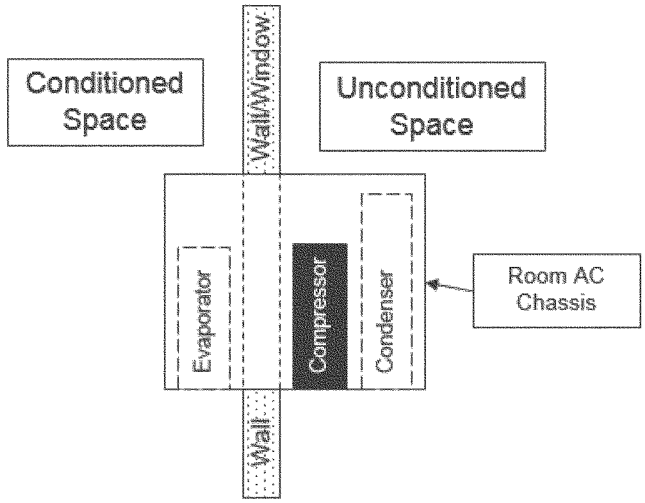

Figure III-2 Typical Room Air Conditioner Installation – Side View

The unit's outer case (*i.e.,* ''chassis'') provides a boundary between the outdoor and indoor sides, leading to potential air leakage (and therefore, heat leakage) into or out of the conditioned space. This leakage can occur within the room AC chassis (*i.e.,* internal heat leakage) or around the chassis (*i.e.,* external heat leakage), and may negatively impact the performance of the room AC. External heat leakage consists of two main forms: (1) Infiltration of outdoor air into the conditioned space; and (2) heat leakage through and around non-chassis installation components, designed to secure the room AC and prevent air leakage.

Section 4.2.2 of ANSI/ASHRAE Standard 16–2009, referenced by the current DOE room AC test procedure, directs that the test unit be installed with no efforts made to seal the internal construction of the unit.[27] Consequently, any internal heat leakage through the room AC that would occur in a typical consumer installation is accounted for in the current room AC test procedure.

Regarding the external sealing to avoid heat leakage, section 4.2.2 of ANSI/ASHRAE Standard 16–2009 requires that the test unit be installed in a way that is similar to its normal installation. DOE is aware that common industry practice for testing louvered room ACs is to install the room AC using a sealed setup, *i.e.,* the area around the test unit is sealed. This sealing prevents any inclusion of air leakage around the unit chassis. Any remaining gaps are typically insulated with tape to ensure a complete seal around the test unit. Consequently, any external heat leakage around the unit that may occur in a typical consumer installation is not typically accounted for by laboratories when conducting the room AC test procedure. DOE considered whether to clarify the installation instructions for room ACs to account for external heat leakage. In the following subsections, DOE describes the proposed additional direction intended to further account for the external heat leakage in a typical consumer installation.

Non-Louvered (Through-The-Wall) Room ACs

Non-louvered room ACs, (*i.e.,* those intended for through-the-wall installations) are installed inside a wall sleeve. Although the wall sleeve is designed to fit snugly within the wall, there is usually a small gap between the wall sleeve and the room AC, leading to potential air leakage into the conditioned space. Also, the room AC and wall sleeve represent a break in the building envelope through which thermal bridging[28] may occur, thereby transferring unwanted heat into the conditioned space. The air and heat leakage mechanisms for through-the-wall installations are shown in Figure III–3.

[26] Although DOE is proposing to reference ANSI/ASHRAE Standard 16–2016, which includes an optional air-enthalpy method, DOE proposes to only reference those sections in ANSI/ASHRAE Standard 16–2016 that apply to the calorimeter method.

[27] Note that the same requirements are retained in Section 6.1.1.4 of ANSI/ASHRAE Standard 16–2016.

[28] Thermal bridging refers to the conductive heat transfer that can occur through the room AC chassis and wall sleeve, which are usually made of metal. The metal acts as an ''easy'' path for heat transfer between the indoor side and the outdoor side of the building, reducing the effective insulation of the building and leading to heat gain, which is undesirable when a consumer seeks to cool an indoor space.

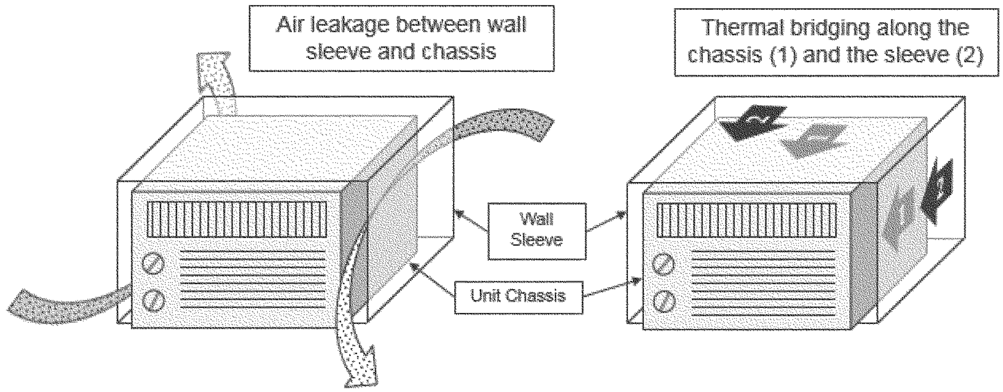

Figure III-3 Air and Heat Leakage Pathways, Non-Louvered Room Air Conditioners

DOE is aware that many manufacturers currently test non-louvered room ACs with compatible wall sleeves, in accordance with the existing requirement in the DOE test procedure that no effort be made to seal the unit internally before cooling mode testing. Regarding external sealing to avoid heat leakage, DOE is also aware that manufacturers typically test non-louvered room ACs with the included trim frame and other manufacturer-provided installation materials. As the non-louvered room ACs are installed in accordance with the manufacturer instructions provided to consumers, this setup would be similar to its normal installation.[29]

Some test laboratories have requested additional direction regarding the general setup—specifically, whether a wall sleeve is required when testing non-louvered room ACs, and if so, which wall sleeve must be used. Therefore, DOE proposes to specify in a new section 3.1.1 of appendix F that room ACs designed for through-the-wall installation (*i.e.,* non-louvered room ACs) must be installed inside a compatible wall sleeve (in accordance with the installation instructions provided to consumers), with the trim frame and other manufacturer-provided installation materials that are included in the retail package when purchasing the unit, where applicable. DOE believes that this proposed instruction would improve the representativeness and the reproducibility of test results. Because these supplemental instructions are consistent with the current requirement to install the test unit in a way that is similar to its normal installation and with DOE's understanding of current testing practice, these proposed amendments are not expected to increase test burden or change the test conduct from appendix F.

DOE requests comment on the proposal to specify in appendix F that non-louvered room ACs, which are designed for through-the-wall installation, must be installed using a compatible wall sleeve (per manufacturer instructions), with the provided or manufacturer-required rear grille, and with the included trim frame and other manufacturer-provided installation materials.

Louvered (Window) Room ACs

Louvered room ACs, designed for window installation, are typically installed using manufacturer-provided side curtains to cover the area of the window opening that is not covered by the unit itself. Side curtains reduce, but generally do not eliminate, air leakage between the conditioned and unconditioned space. Some heat leakage is also possible through the side curtains themselves and surrounding installation materials.

For hung-sash windows,[30] the top sash can be positioned in direct contact with the top side of the chassis. Two side curtains extend horizontally from the sides of the chassis. For this type of installation, the air leakage pathways are: (1) Through the gap between the surface of the chassis and the edges of the window opening, which are usually covered with side curtains (described below); and (2) through the gap between the two sashes. Manufacturers typically provide weather stripping to reduce air leakage between the window sashes.

For sliding windows,[31] the sash can be positioned in direct contact with the left or right side of the chassis. One curtain is typically provided that extends upward from the chassis to the top edge of the window opening. With this type of installation, the air leakage pathways are: (1) Through the gap between the surface of the chassis and top edge of the window opening, which is usually covered with a curtain; and (2) through the gap between the two sashes.

For casement windows, which have no sliding sashes, the window panels are attached to hinges and rotate to open or close the window. Consequently, the width and height of the window opening cannot be adjusted to match the size of the room AC chassis. Because of this, casement-type room ACs are usually designed for a narrow range of window widths. With this type of installation, the gaps between the surface of the chassis and the edges of the window opening represent significant leakage pathways.

Figure III–4 and Figure III–5 show the various air infiltration and heat leakage pathways for louvered room ACs.

[29] Note that Section 6.1.1.4 of ANSI/ASHRAE Standard 16–2016 requires the air conditioner be installed per the manufacturer instructions, which DOE contends is consistent with the normal installation requirements in ANSI/ASHRAE Standard 16–2009.

[30] A sash is a window panel that usually holds one or more panes of glass. In hung-sash windows, the sashes can be moved vertically along a rail in order to open or close the window.

[31] In sliding windows, the sashes can be moved horizontally along a rail.

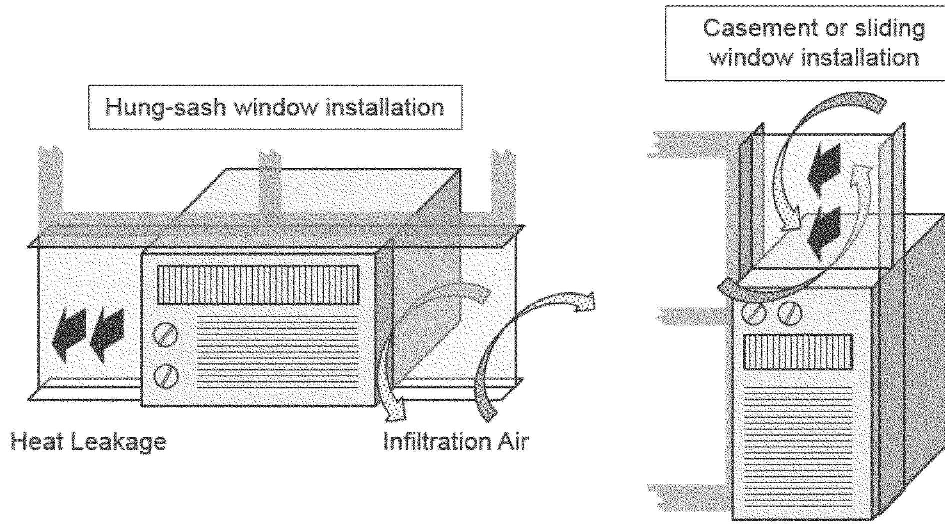

Figure III-4 Air and Heat Leakage Pathways, Louvered Room Air Conditioners in Hung-Sash and Casement/Slider Window Installations

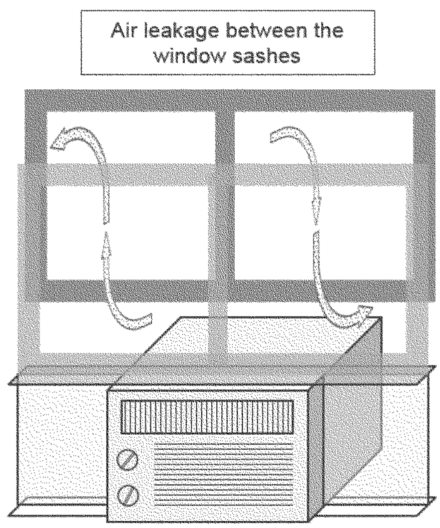

Figure III-5 Air Leakage Between Sashes, Louvered Room Air Conditioners in a Hung-Sash Window Installation

As described previously, Section 4.2.2 of ANSI/ASHRAE Standard 16–2009 requires that the test unit be installed in a way that is similar to its normal installation. No further direction is provided as to what constitutes normal installation. DOE is aware that common industry practice is to set up a louvered room AC for testing so that all air leakage around the unit chassis is precluded. DOE understands that current industry practice is to snugly install the room AC in the test chamber partition wall using insulating material to approximate the insulating properties of the fixed part of the separating partition, as shown in Figure III–6. Any remaining gaps are typically insulated with tape to ensure a complete seal around the test unit. Under those conditions, the test measures energy needed to compensate for internal heat leakage through the unit and the thermal bridging, but any external leakage (*i.e.,* infiltration air leakage around the unit chassis or heat leakage through the manufacturer-provided installation materials) is eliminated, neglecting any effect external air leakage may have on energy efficiency.

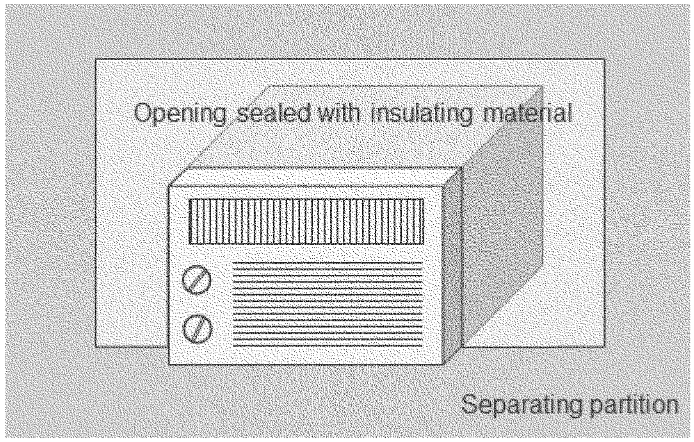

Figure III-6 Typical Louvered Room Air Conditioner Installation for Testing

The current U.S. Environmental Protection Agency (EPA) ENERGY STAR Product Specification for Room Air Conditioners Version 4.1 (ENERGY STAR V4.1), [32] requires that window units be provided with weather stripping and/or gasket materials appropriate for all window size(s) for which the unit is designed. Furthermore, the criteria require that the side curtains be tight fitting to minimize air leaks and contain insulation in the panel with a minimum insulation value of R1.[33] ENERGY STAR-qualified room ACs, with R1 side curtains, comprised 26 percent of basic models on the market as of September 2018.

Discussion of Comments

In the August 2017 RFI, DOE noted that, when conducting the calorimeter test prescribed in ANSI/ASHRAE Standard 16–2009 and referenced by appendix F, the test unit is installed so that all air and heat leakage around the unit that would normally be present in a typical installation is precluded by means of sealing. DOE requested comment on testing room ACs in accordance with the manufacturer-provided installation materials. 82 FR 36349, 36352 (Aug. 4, 2017).

Friedrich opposed the use of manufacturer-provided installation materials that are included in the retail package when purchasing the unit for room AC testing. Friedrich noted that DOE has not specified a required side curtain surface area for testing, which Friedrich stated could result in laboratories using varying side curtain surface areas, leading to significant test result variability and potential consumer confusion. Friedrich also suggested that laboratories may not be capable of testing with side curtains in place without significant test apparatus modifications. Friedrich further noted that, if the psychrometric method specified in ANSI/ASHRAE Standard 16–2016 were adopted, the heat loss between rooms would not be captured even when using manufacturer-provided side curtains. Friedrich also suggested that manufacturer-provided installation materials are not necessary because the existing test requirement of no more than 0.005 inches of water column pressure difference between the indoor and outdoor test chambers limits the effects of heat and air loss between the test chambers. (Friedrich, No. 2 at pp. 3–4) DOE agrees that requiring the use of side curtains may introduce additional variability in the test procedure, specifically regarding the size of the test chamber partition wall openings used by labs, leading to differing side curtain extensions and thus different air and heat leakage impacts. DOE further recognizes the additional test burden associated with modifying the partition wall and installing side curtains and believes that this burden outweighs the benefit of measuring the potentially minimal air and heat leakage due to the small pressure differential limit between the two test chambers.

AHAM noted that heat loss through the installation materials is already accounted for in Section 4.2.2 of ANSI/ASHRAE Standard 16–2009, referenced in appendix F, which requires that the room AC be installed in a manner similar to its normal installation with no effort to seal the internal construction of the unit to prevent air leakage, other than specifically provided by the manufacturer's consumer installation instructions. AHAM asserted that any modification to the instructions in ANSI/ASHRAE Standard 16–2009 would provide little additional value and is not necessary to ensure the test procedure is representative of an average use cycle. According to AHAM, doing so would increase test variation due to varying test lab window sizes and would require laboratories to stock different sizes of insulated partitions.

AHAM noted that window kits are not used in the portable AC test procedure, and that the portable AC test procedure only measures duct heat loss and infiltration air heat transfer because portable ACs draw condenser air from the conditioned space, which AHAM believes is not applicable to room ACs. AHAM claimed that the test burden increase from requiring the use of installation materials would not be justified by the minimal benefit to consumers. (AHAM, No. 3 at p. 5) As discussed above, DOE is aware that common laboratory practice is to forgo the use of manufacturer-provided installation materials included in the retail package and instead to seal to prevent air and heat leakage around the unit. DOE is also aware that laboratories typically modify the chamber partition wall to fit each test unit by adding or removing partition wall insulating materials. DOE also notes that, as discussed later in this section, Sections 6.1.1.4 and Section 8.4.2 of ANSI/ASHRAE Standard 16–2016 require that the perimeter of the AC under test must be sealed to the separating partition, which is consistent with common practice when testing room ACs and ensures repeatability and reproducibility. Therefore, DOE recognizes that an alteration to the common practice by requiring the use of all manufacturer-provided installation materials, including side curtains, may present additional test burden.

[32] The ENERGY STAR Certification Criteria V4.1 is available at *https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%204.0%20Room%20Air%20Conditioners%20Program%20Requirements.pdf*

[33] The insulation value is determined by the Federal Trade Commission's (FTC) Labeling and Advertising of Home Insulation regulations, 16 CFR part 460.

The California IOUs and Joint Advocates commented that room ACs should be installed with manufacturer-provided installation materials. (California IOUs, No. 4 at p. 4; Joint Advocates, No. 6 at p. 3) The California IOUs believe that the current test setup does not reflect real-world room AC operation and thus is contrary to EPCA's representative use requirements. According to the California IOUs, room ACs are typically installed in windows and secured with side curtains, wall sleeves, and other manufacturer-provided materials that are included in the retail package when purchasing the unit and are usually poorly insulated and allow for air infiltration, unlike the insulated wall in a calorimeter chamber. The California IOUs, therefore, encouraged DOE to capture the efficiency impacts of air infiltration, heat leakage, and pressure differentials in the room AC test procedure by requiring the use of all manufacturer-provided installation materials. (California IOUs, No. 4 at p. 4) The Joint Advocates asserted that the current DOE test procedure for room ACs does not represent actual unit efficiency for consumers, and therefore the Joint Advocates believe that testing room ACs with manufacturer-provided installation materials would incentivize improvements for installation materials to reduce infiltration air leakage. The Joint Advocates stated that reducing infiltration air would save energy and improve consumer comfort by reducing hot air entering from outdoors. (Joint Advocates, No. 6 at p. 3)

As discussed previously, DOE recognizes that the common practice for installing room ACs for testing does not necessarily utilize all manufacturer-provided installation materials. However, DOE recognizes the potentially significant variability and additional test burden associated with the use of side curtains and other manufacturer-provided installation materials that are not currently used. Further, DOE notes that Sections 6.1.1.4 and Section 8.4.2 of ANSI/ASHRAE Standard 16–2016 require that the perimeter of the AC under test must be sealed to the separating partition, which is consistent with common practice when testing room ACs. This requirement represents a change from the instructions in ANSI/ASHRAE Standard 16–2009, which in Section 4.2.2, as discussed, requires that the room AC be installed in a manner similar to its normal installation.

DOE conducted testing to investigate the inherent air infiltration and conductive heat transfer effects associated with manufacturer-provided installation materials included in the retail package when purchasing the unit. DOE tested 13 room ACs both with and without manufacturer-provided installation materials, otherwise following the appendix F test procedure and conditions. DOE installed each room AC in accordance with both ANSI/ASHRAE Standard 16–2009 and manufacturer instructions in a 34-inch wide window opening of the calorimeter test chamber partition wall. Because room AC chassis vary in width and height, the area filled by side curtains varied from unit to unit in the 34-inch wide window opening, and the height of the window opening was adjusted to match the height of each unit. Table III–7 displays the results of testing with and without manufacturer-provided installation materials under appendix F conditions.

TABLE III–7—IMPACT OF MANUFACTURER-PROVIDED INSTALLATION MATERIALS ON ROOM AIR CONDITIONER COOLING CAPACITY

Unit No.	Energy star rated	Measured cooling capacity		Measured cooling capacity change with installation materials	
		Without installation materials (*Btu/h*)	With installation materials (*Btu/h*)	(*Btu/h*)	(%)
1	Yes	5720	5450	−270	−4.7
2	No	10600	10530	−70	−0.7
3	Yes	11750	11950	+210	+1.8
4	Yes	20630	20470	−150	−0.7
8	No	5210	5260	+50	+1.0
9	Yes	5590	5580	−10	−0.2
10	No	5280	5420	+130	+2.5
11	Yes	5240	5270	+30	+0.6
12	No	6160	6050	−110	−1.8
13	Yes	7910	7940	+30	+0.4
14	Yes	8580	8340	−230	−2.7
15	Yes	21230	21200	−40	−0.2

DOE expected that the measured cooling capacity with installation materials would be consistently lower (worse) than the measured cooling capacity without installation materials (for which the unit is tightly sealed during testing to prevent air and heat leakage). However, as shown in Table III–7, DOE observed no consistent change in cooling capacity when using manufacturer-provided installation materials included in the retail package when purchasing the unit, with capacity impacts ranging from a reduction of 4.7 percent to an increase of 2.5 percent relative to the measured capacity without installation materials. Additionally, DOE found that the magnitude and direction (positive or negative) of the measured capacity impacts did not correlate with the presence of insulated side-curtains (*i.e.,* units that ship with minimum R1 side curtains were measured as having both higher and lower cooling capacity when tested with the side curtains installed). Nor did the magnitude and direction of the measured cooling capacity change correlate with the rated cooling capacity. Instead, the unexpected presence of positive cooling capacity changes suggests that the observed variations are driven more by measurement uncertainty than heat transfer losses.

Regardless of the source of the variation, however, all capacities measured while using manufacturer-provided installation materials were within 5 percent of those measured without installation materials. Because the variation in test results was minimal, DOE expects that any potential benefits of more representative cooling capacity measurements by testing with manufacturer-provided installation materials included in the retail package when purchasing the unit would be small and would be outweighed by the burden associated with such a testing configuration. Therefore, DOE is not proposing to require the use of manufacturer-provided installation materials in appendix F for louvered room ACs at this time.

DOE requests comment on the proposal, consistent with ANSI/ASHRAE Standard 16–2016, Sections 6.1.1.4 and Section 8.4.2, not to require installing louvered room ACs with the manufacturer-provided installation materials, including side curtains, and instead to require testing with the partition wall sealed to the unit.

e. Test Conditions

In the June 2015 RFI, DOE noted that the current room AC test procedure measures performance only under full-cooling-load outdoor test conditions of 95 °F dry-bulb and 75 °F wet-bulb, and therefore, technologies that improve performance under less extreme part-load conditions, such as variable-speed compressors and variable-opening expansion devices, would not improve rated performance under the current test procedure. DOE noted that for central ACs and heat pumps, the seasonal energy efficiency ratio (SEER) accounts for various annual conditions by testing at multiple rating conditions. DOE therefore requested comment on the merits of revising the current room AC test procedure to account for the benefit of technologies that improve performance under multiple cooling mode temperature conditions. 80 FR 34843, 34848 (June 18, 2015).

The Natural Resources Defense Council, Appliance Standards Awareness Project, Alliance to Save Energy, National Consumer Law Center, and Northwest Energy Efficiency Alliance (hereafter the ''Joint Commenters'') stated that measuring part-load performance in the DOE room AC test procedure would encourage manufacturers to develop products with variable-speed capabilities and other part-load technologies not available as of 2015 in room ACs available on the market. The Joint Commenters suggested that a metric that captures part-load performance could result in additional energy savings because room ACs are often used as the primary air conditioning source, either for a single room or an entire house, and thus are used more frequently than just for supplemental air conditioning on the hottest days and would likely benefit from part-load efficiency improvements. (Joint Commenters, June 2015 RFI, No. 7 at pp. 1–2)

The California IOUs commented that the effective and efficient use of part-load operation can be useful in maintaining a more constant room temperature while reducing overall energy consumption. However, they noted that the impact of part-load efficiency would depend on the number of operating hours associated with part-load operation in the overall performance metric. Therefore, the California IOUs suggested that DOE assess the potential efficiency benefits of part-load technologies and the number of operating hours under part-load conditions per year, claiming that including part-load efficiency in the regulated metric would only be effective if part-load operation represents a significant part of the annual operating hours. The California IOUs suggested that the part-load operating hours should not include hours during the summer, when room ACs typically operate at full-load conditions, nor should the inclusion of part-load operation result in a reduction of overall room AC operating efficiencies or an increase in peak demand. If DOE finds that part-load efficiency has a minimal impact on overall performance, the California IOUs expressed continued support for the current test condition. (California IOUs, June 2015 RFI, No. 8 at p. 3)

AHAM opposed part-load performance measurements, based on DOE's conclusion in the January 2011 Final Rule that such measurements would result in significant effort and additional test burden with minimal energy savings. (AHAM, June 2015 RFI, No. 5 at p. 4) In the January 2011 Final Rule, DOE stated that sufficient information was not available at the time to assess whether technologies that improve part-load efficiency would be cost effective, and that many of the technology options that could improve full-load efficiency would also improve part-load efficiency, so the current test conditions were indicative of the efficiency at a range of conditions. Thus, DOE decided to not amend the test procedure to measure part-load performance at that time. Nevertheless, DOE noted in the January 2011 Final Rule that it could consider amendments if additional information on this subject were to become available for future rulemakings. 76 FR 971, 1016 (Jan. 6, 2011). DOE notes that the market has developed since the January 2011 Final Rule, and that at least three variable-speed room ACs are now on the market. DOE expects that manufacturers will continue to introduce variable-speed room ACs to the market in the near term, because, on December 28, 2017, EPA released its ENERGY STAR 2018 Emerging Technology Award Criteria for Room ACs with Efficient Variable Output, which recognizes room ACs with variable-speed compressors that are more than 25 percent more efficient than a similar room AC with a single-speed compressor.[34] DOE expects that the introduction of these ENERGY STAR award criteria will incentivize manufacturers to further adopt variable-speed compressors in room ACs.

Multiple Test Conditions

On June 1, 2016, DOE established a test procedure for portable ACs that assesses cooling performance under two cooling mode test conditions, representative of typical conditions and extreme conditions (hereafter the ''June 2016 Portable AC Final Rule''). 81 FR 35241, 35249–35250. As discussed, room ACs are currently tested at a single outdoor test condition, 95 °F dry-bulb and 75 °F wet-bulb temperature, which aligns with only one of the two cooling mode test conditions for portable ACs. Considering the many similarities between the two products (*i.e.,* consumer utility, usage patterns, internal components), DOE requested comment in the August 2017 RFI on whether it would be appropriate to harmonize the two test procedures by including an additional test condition for room AC cooling mode testing (specifically, 83 °F dry-bulb and 67.5 °F wet-bulb outdoor temperature). 82 FR 36349, 36351–36352 (Aug. 4, 2017).

Friedrich opposed an additional cooling mode test condition for room ACs, stating that room ACs are optimized for the current 95 °F test condition and any changes to the test procedure would require system and component design changes. For example, Friedrich asserted that less expensive and more reliable capillary tube expansion devices would likely need to be replaced with more expensive and complex thermostatic expansion valves or variable orifice metering devices. Friedrich stated that just one component change could increase manufacturing cost by more than 15 percent as well as increase repair and installation complexity, and that the current room AC chassis may not have sufficient space to accommodate such devices. (Friedrich, No. 2 at pp. 1–2) DOE recognizes that

[34] Additional information on the ENERGY STAR Emerging Award for Industry Stakeholders is available at *https://www.energystar.gov/about/awards/energy-star-emerging-technology-award/energy-star-emerging-technology-award-industry.*

optimizing performance at any test condition likely would require design and component modifications, which may include adjusting the expansion device, blower motor, compressor, and other performance-related modification. DOE understands that any time a design change is initiated, significant engineering and manufacturing costs are incurred, for example, to fit larger and more complex components into size-restricted chassis. However, although an amended test procedure requiring testing room ACs at additional cooling mode test conditions would necessitate a corresponding amendment to the energy conservation standards for room ACs, the design and manufacturing costs incurred to redesign units to perform optimally at these conditions are outside of the scope of a test procedure rulemaking analysis. DOE notes that it would analyze in an energy conservation standards rulemaking any design and manufacturing costs potentially incurred to improve the efficiency of products.

AHAM and Friedrich opposed the proposed additional cooling mode test condition, saying that it would add significant test burden by effectively doubling the number of tests needed to certify a room AC, lengthening test time, and resulting in less laboratory availability, which could significantly slow time to market and disrupt production schedule. (AHAM, No. 3 at p. 4; Friedrich, No. 2 at p. 2) DOE agrees that an additional cooling mode test condition would increase test burden, though it would not require an adjustment in test unit installation and would instead necessitate adjusting only the outdoor test chamber conditions, since the indoor conditions remain the same for both cooling mode test conditions. DOE expects the total additional burden associated with testing a reduced operating test would be 4 to 5 hours. This reflects the time required to adjust the outdoor test chamber test conditions (about 2 hours for the chamber to reach a lower outdoor temperature test condition), and the additional test time, which is estimated to be 2 to 3 hours (approximately 1 to 2 hours for chamber and unit stabilization and 1 hour for the rating test period, as specified by ANSI/ASHRAE Standard 16–2009).

AHAM further stated that if DOE did consider an additional cooling mode test condition it would be inappropriate to consider an additional cooling mode test condition comparable to that which is established for dual-duct portable ACs (*i.e.,* the most similar portable AC configuration to room ACs). AHAM cited a September 2016 AHAM Home Comfort Survey that indicated the vast majority of portable ACs on the market are a single-duct configuration. As a result, most portable ACs would be tested with a single outdoor cooling mode test condition. AHAM therefore suggested it would be inappropriate to select test conditions for room ACs that align with the type of portable AC that a minority of consumers own and would not result in a comparable rating between all portable ACs and room ACs. (AHAM, No. 3 at p. 4) DOE notes that the additional cooling mode test condition that was adopted for dual-duct portable ACs was developed using room AC ownership data and a climate analysis; and, because the supporting data were derived from room ACs, DOE asserts that the previous analysis conducted in support of the portable AC test procedure applies to room ACs.

AHAM and Friedrich also contended that including a second test condition could confuse consumers, suggesting that adding a cooler test condition would result in a larger Seasonally Adjusted Cooling Capacity (SACC) compared to the cooling capacity as measured under the current conditions, which could result in consumers purchasing units that have too little capacity and are unable to meet cooling needs during peak periods. Friedrich further commented that if DOE were to proceed with these changes to the test procedure, it should coordinate with EPA and the Federal Trade Commission (FTC) to harmonize metrics across efficiency programs. (AHAM, No. 3 at p. 4; Friedrich, No. 2 at p. 2) DOE agrees that introducing a second cooling mode test condition for all room ACs would result in a general increase in the reported cooling capacities for all units, which may cause confusion for consumers who have become familiar with the typical capacity values in this well-established market.[35] Under the Memorandum of Understanding that EPA and DOE signed on September 30, 2009, DOE is responsible for the test methods and metrics to be used in the ENERGY STAR program when qualifying products. Therefore, if DOE were to modify the energy efficiency metric for room ACs in appendix F, EPA would accordingly consider revised ENERGY STAR qualification criteria based upon the amended DOE test procedure. Additionally, EPCA requires that any revisions to the labels for room ACs, for which the FTC is responsible, include disclosure of the estimated annual operating cost (determined in accordance with DOE's test procedures prescribed under section 6293 of EPCA), unless the Secretary determines that disclosure of estimated annual operating cost is not technologically feasible, or the FTC determines that such disclosure is not likely to assist consumers in making purchasing decisions or is not economically feasible. (42 U.S.C. 6294(c)(1)) Were DOE to amend the room AC test procedure to include an additional test condition, DOE understands that the FTC would develop any revised labeling requirements to disclose a revised annual energy cost calculation based on any modified energy efficiency metric.

The California IOUs opposed an additional cooling mode test condition, suggesting it would not be representative of actual usage conditions in California, where room ACs operate at peak capacity or close to it (*i.e.,* at conditions represented by the 95 °F dry-bulb test condition) for longer than 750 hours per year and are typically purchased in reaction to heatwaves, when peak cooling is required. The California IOUs cautioned that allocating less weight to the 95 °F dry-bulb cooling mode test condition may devalue the cooling mode operating performance that is most valued by consumers and is the basis for their purchase decisions. (California IOUs, No. 5 at p. 2) AHAM added that the current room AC test procedure tests the ''worst case'' energy use scenario and there is no reason to test room ACs under new test conditions that would result in less energy use. (AHAM, No. 3 at p. 4) Friedrich stated that room ACs optimized for a new reduced-temperature test condition would not have enough capacity to meet the cooling load at the existing higher-temperature condition. (Friedrich, No. 2 at p. 2) The California IOUs also claimed that an additional cooling mode test condition would interfere with calculating a room AC's peak demand power draw, which can have a large impact on peak load operation and is often the basis for future program development, rate structure, and overall power needs. (California IOUs, No. 5 at pp. 2–3)

The California IOUs and Joint Advocates commented that if DOE were to include an additional part-load cooling mode test condition, the test procedure would likely capture the benefits of technologies, such as variable-speed compressors, that enable

[35] DOE notes that consumer confusion about the number of temperature conditions was not a concern for portable ACs because DOE only recently established a test procedure for portable ACs that requires multiple cooling mode test conditions. Before that there was no DOE test procedure; the DOE test procedure for portable ACs has always required multiple cooling mode temperature conditions.

improved part-load performance. These commenters further stated that, in addition to improving part-load performance and efficiency by reducing compressor cycling and improving heat exchanger effectiveness, variable-speed compressors would provide more consistent room temperature and humidity control, improved dehumidification, and reduced noise levels. They suggested that adding variable-speed compressors would enable utilities to create incentives for consumers to use more intelligently controlled and connected room ACs with little impact on consumer comfort and would enable more flexible demand side resources to integrate increasing amounts of intermittent renewable energy sources into the grid. (California IOUs, No. 5 at p. 3; Joint Advocates, No. 6 at p. 2) However, the California IOUs suggested that further data are necessary prior to modifying the room AC test procedure to measure room AC performance and efficiency at part-load test conditions and to identify an appropriate alternative test condition and operating hours that would effectively capture part-load operation. (California IOUs, No. 5 at p. 4) Friedrich suggested that variable-speed compressors would not be feasible for room ACs due to increased installation and controls costs, as well as chassis space constraints. (Friedrich, No. 2 at p. 2) AHAM urged DOE to wait until variable-speed compressors are available in a number of products that would be sufficient to evaluate the impacts of a test procedure change before considering a test procedure change to account for them. (AHAM, No. 3 at p. 5)

DOE agrees with some, but not all, of these comments. The inclusion of additional cooling mode test conditions would better reflect operation under multiple temperature conditions, and product information based on testing using such conditions may create an incentive to increase the proportion of variable-speed room ACs on the market. Use of variable-speed compressors, in turn, may be beneficial to both consumers and utilities, because room ACs would operate more effectively and efficiently under multiple indoor and outdoor temperature conditions. However, DOE also recognizes that a test procedure that measures performance at both peak temperature conditions and a less extreme temperature condition would require a new overall weighted metric that would combine the performance under both temperature conditions because it would change measured energy consumption. DOE further recognizes that room AC performance has historically been based on peak performance under elevated outdoor temperature test conditions, which is the condition under which consumers most expect their room ACs to perform, and that peak performance would no longer be clearly portrayed by a weighted metric.[36] Furthermore, DOE notes information about variable-speed room ACs is limited: There are few variable-speed products on the market, and data about them is limited. DOE does not believe that the benefits of measuring performance at reduced outdoor temperature test conditions for all room ACs would outweigh the expected substantial increase in test burden, utility impacts, and consumer confusion that would result. Therefore, DOE is proposing to continue using a single test condition for testing single-speed room ACs, with no changes to the current CEER metric. However, as discussed in section III.C.2 of this document, DOE is proposing to require testing multiple test conditions for variable-speed room ACs, in order to capture the relative efficiency improvements associated with variable-speed operation. The test procedure would represent the performance of variable-speed room ACs using adjustments to the CEER calculations to obtain the same metric, which is based on performance at the maximum 95 °F outdoor rating condition.

DOE requests comment on the proposal not to include additional cooling mode test conditions for single-speed room ACs.

Cooling Test Alternatives

The current DOE test procedures for room ACs and packaged terminal air conditioners (PTACs) involve fixed temperature and humidity tests in a calorimeter at full-load or part-load conditions, during which specific dry-bulb and wet-bulb temperatures are maintained throughout the cooling mode test period. The DOE test procedure for central ACs requires testing at multiple cooling mode test conditions, with fixed temperature and humidity at each condition, similar to the current room AC test procedure, which has one test condition with a fixed temperature and humidity.

The Joint Advocates stated that the lower-temperature test condition discussed in the August 2017 RFI is a fixed temperature and humidity test and would not capture single-speed compressor cycling losses that would occur in typical temperature conditions. By comparison, a dynamic-cooling-load test, such as that being developed by the Canadian Standards Association, during which the compressor would cycle off when the setpoint is reached, may capture such cycling losses. The Joint Advocates suggested that the most representative room AC test procedure (*i.e.,* a dynamic-cooling-load test that measures part-load performance) would spur adoption of variable-speed compressors and adjustable fan speeds because it would capture cycling losses in single-speed units and increased efficiency from these technologies. (Joint Advocates, No. 6 at pp. 2–3)

DOE is aware of two approaches to measure part-load performance of a room AC, constant-cooling-load testing and dynamic-cooling-load testing. In a constant-cooling load test, a cooling load is applied to the indoor room using reconditioning equipment, and this cooling load does not change throughout the test. In a dynamic-cooling-load test, the cooling load applied to the indoor room follows a load profile which approximates how the cooling load on a typical unit would change throughout the day. In both the dynamic-cooling-load test suggested by the Joint Advocates and a constant-cooling-load test explored in DOE investigative testing, the chamber indoor cooling load is provided at a specified rate or value throughout testing instead of maintaining specific temperature conditions within the test chamber. In theory, this approach would be most representative of actual usage, where cooling loads are constant or variable due to external factors (*e.g.,* weather, door/window openings) and internal factors (*e.g.,* room occupants, appliance operation). Under a constant-cooling-load or dynamic-cooling-load test, a room AC with a single-speed compressor would cycle the compressor as the setpoint is reached, thereby introducing efficiency losses, whereas a variable-speed compressor could maintain constant operation at reduced speeds to match the cooling load with no cycling losses. As explained below, DOE explored this approach but is not proposing it because an increased test burden and reduced repeatability and reproducibility outweigh potential benefits.

DOE investigated the status of test data and uniform procedures to test with a specified constant or dynamic cooling load but found no widely adopted and industry-accepted test procedure for room ACs or other AC

[36] This understanding is based on discussion in the June 2010 Room AC Test Procedure Supplemental Notice of Proposed Rulemaking and comments from the California IOUs discussed above. 75 FR 37633–37634 (June 29, 2010). (California IOUs, No. 5 at p. 2)

products that uses a constant-cooling-load or dynamic-cooling-load test. DOE is aware of investigative efforts to test central ACs under varying cooling load conditions, but those have yielded only preliminary results which did not involve room ACs and did not provide sufficient evidence to show that a constant or dynamic load test would be repeatable and reproducible and not overly burdensome to conduct.[37] [38]

Due to the limited data available regarding constant-cooling-load testing, DOE conducted investigative testing to better understand the benefits and potential challenges associated with a constant-cooling-load test for room ACs. These tests were conducted using a variable-speed room AC rated at 18,000 Btu/h and a conventional single-speed room AC rated at 12,100 Btu/h. The single-speed room AC was selected because it was the louvered unit in the test sample closest in capacity to the variable-speed unit. DOE installed each room AC in a calorimeter test chamber, set the unit thermostat to 80 °F to match the indoor temperature specified in the appendix F test procedures, and then applied a fixed cooling load to the indoor room that was below the nominal rated cooling capacity of the test unit. The calorimeter chamber was configured to permit the indoor chamber temperature to vary, thereby allowing the test unit to eventually reach its thermostat set point and to adjust its cooling in response to the cooling load demands on the indoor room, as opposed to the constant-temperature test, which results in unvarying cooling operation. Table III–8 shows the results of these tests. All percentages are displayed are relative to full-cooling-load values measured during constant-temperature tests.

TABLE III–8—FIXED COOLING-LOAD-BASED TEST SINGLE-SPEED ROOM AIR CONDITIONER

Outdoor test condition (°F dry-bulb)	Chamber-imposed cooling load (%)	Compressor on time (%)	Percent of full-load power (%)	EER (Btu/Wh)	Percent of full-load EER (%)
95	49	53	62	9.2	79
	76	80	84	10.6	91
	78	82	86	10.6	91
	79	82	86	10.7	91
	80	84	88	10.6	91
82	46	48	58	11.8	79
	48	50	60	12.0	80
	67	69	77	13.1	88
	70	72	78	13.3	89

As discussed previously in section III.C of this document, and shown in Figure III–1, when tested under these same test conditions, the variable-speed room AC adjusted its compressor speed to match the applied cooling load, resulting in increased efficiency of between 9 percent and 25 percent at decreased cooling loads of 85 percent and 45 percent of the full-load cooling capacity, respectively, compared to the tested cooling capacity of the variable-speed room AC under the appendix F test procedure.

When tested according to the same constant-cooling-load test, the single-speed unit operated continuously until the unit thermostat setpoint was satisfied, at which time the unit cycled off the compressor. When the chamber temperature rose above the thermostat setpoint, the single-speed room AC activated the compressor. This off-and-on compressor cycling process continued throughout the rating test period. As shown in Table III–8, the fractional time the compressor was on (''compressor on time'') for a single compressor cycle during the test ranged from 84 percent to 48 percent as the cooling load decreased from 80 percent to 46 percent, respectively, of the tested cooling capacity. DOE also observed during testing that the total compressor cycle time (*i.e.,* the sum of a single period of compressor on time and compressor off time) decreased as cooling loads reduced, resulting in more frequent cycling and subsequent increased cycling losses.

As shown in Table III–8, DOE observed that the single-speed room AC was able to provide cooling that closely matched the chamber-imposed cooling load by cycling the compressor (*i.e.,* the percentage of compressor on time approximated the cooling load percentage). However, the single-speed room AC average input power during those same tests did not decrease at the same rate as the cooling capacity, which was indicative of the fan or blower remaining on when the compressor cycled off, as well as the significant additional power necessary to start up the compressor at the beginning of each compressor on cycle (*i.e.,* the percent of full-load power consumption during the same test was consistently higher than the cooling load percentage, as shown in Table III–8). As a result of the disproportionate cooling capacity and power decreases at reduced cooling loads, the overall efficiency of a single-speed room AC in terms of EER at reduced cooling loads decreased by up to 20 percent at a reduced load of about 50 percent of the full-load cooling capacity, as shown in Table III–8.[39] The overall efficiency of the variable-speed room AC in terms of EER increased by about 24 percent under similar reduced load conditions, as shown in Figure III–1.

Constant-cooling load tests have initially confirmed behavior that would be expected of room ACs in the field under conditions associated with partial loads (*i.e.,* lower outdoor temperatures at which the cooling load is typically smaller). During the constant-cooling-load test, single-speed room ACs cycle in proportion to the cooling load, and variable-speed room ACs adjust the compressor speed to match the measured cooling load in the room. Therefore, DOE would expect that

[37] The Canadian Standards Association has conducted dynamic-load testing for heat pumps. A summary is available at *http://neep.org/sites/default/files/NEEPCSAHarley2017-06-28.pdf.*

[38] Researchers at the University of Tokyo investigated the operation of split-type ACs under constant-load conditions in 2012. *https://docs.lib.purdue.edu/cgi/viewcontent.cgi?referer=&httpsredir=1article=2335context=iracc.*

[39] EER, is defined as the ratio of cooling capacity to unit power, in contrast to CEER, which additionally includes inactive mode or off mode power. Because the investigative testing did not include inactive mode or off mode testing, the investigative testing results are reported in EER.

cycling losses decrease the efficiency of single-speed room ACs at lower outdoor temperature conditions, an effect which variable-speed room ACs avoid. However, DOE contends that load-based tests, for reasons presented below, are currently not feasible for room ACs.

DOE is concerned that the constant-cooling-load test would reduce repeatability and reproducibility. Based on investigative testing, DOE found that conducting a constant-cooling-load test in an ANSI/ASHRAE Standard 16–2009-compliant calorimeter test chamber would impact repeatability and reproducibility. Table III–9 shows the results of indoor wet-bulb temperatures for the cooling-load-based tests conducted by DOE.

TABLE III–9—INDOOR WET-BULB TEMPERATURES FOR COOLING-LOAD-BASED TESTS

Tested unit	Outdoor test condition (°F dry-bulb)	Cooling load (%)	Average indoor temperature (°F wet-bulb)	Difference from rating condition (°F wet-bulb)
Single-Speed	95	49	67.6	0.6
		76	67.2	0.2
		78	67.0	0.0
		79	67.1	0.1
		80	67.1	−0.1
	82	46	67.5	0.1
		48	66.5	0.5
		67	66.8	−0.5
		70	67.1	−0.2
	Average		*67.1*	*0.1*
Variable-Speed	95	49	67.9	0.9
		73	68.0	1.0
		74	67.0	0.0
		85	67.0	0.0
		86	67.0	0.0
	87	45	67.0	0.0
		46	67.0	0.0
		63	67.0	0.0
		64	67.0	0.0
		85	67.0	0.0
	Average		*67.2*	*0.2*

As shown in Table III–9, at cooling loads less than 75 percent of the tested unit cooling capacity, the indoor wet-bulb temperature variation sometimes exceeded the 0.3 °F arithmetic average tolerance required by ANSI/ASHRAE Standard 16–2009. DOE believes this is because the test chamber lacks a dehumidifier and instead relies on the test unit to remove moisture from the indoor chamber and assist in maintaining the wet-bulb temperature. The single-speed and variable-speed room ACs were unable to remove sufficient water vapor from the indoor-side chamber while cycling on and off or while operating at reduced compressor speed, respectively, causing the indoor chamber wet-bulb temperature to vary from 67 °F up to 0.6 °F for the single-speed unit, and up to 1.0 °F for the variable-speed unit.

Also, because the chamber used for testing was not designed to accommodate constant-cooling-load testing, the chamber controls were not capable of automatically achieving a specific cooling load condition. Instead, an iterative process was necessary to manually program and adjust the heating, cooling, and humidification inputs to the room to achieve the desired cooling load. This difficulty in automatically achieving specific loading conditions contributed significant increased testing time and test burden arising from the need to ensure uniform test chamber dimensions. In addition, the chamber size and particular conditioning equipment may affect the rate at which the indoor chamber temperature and relative humidity decrease in response to the room AC operation, or increase after a single-speed unit cycles off, thus affecting cycle time and frequency, which in turn impact cycling losses and measured performance.

DOE notes that constant-cooling-load tests may not be reproducible because ANSI/ASHRAE Standard 16 does not specify chamber dimensions and reconditioning equipment characteristics which affect heat transfer capabilities within the chamber, and thus they likely are not uniform across the industry. DOE expects that cooling-load-based test reproducibility could increase with test chamber modifications to improve cooling load-setting controls, standardizing or normalizing for test chamber size, and adding a dehumidifier to the indoor chamber, although these would place some additional test burden on manufacturers. Furthermore, because existing calorimeter chambers rely on steady-state operation to ensure accuracy and precision, dynamic-cooling-load testing in a calorimeter test chamber would require extraordinarily slow cooling load changes, which DOE estimates would be on the order of about one percent of the tested unit cooling capacity every two hours to maintain chamber stability, requiring an impractically long test to measure a full range of cooling load conditions (*e.g.,* it would require an estimated 86 hours to reduce the cooling load from 100 percent to 57 percent of full load to reach the expected cooling load at an outdoor test condition of 82 °F, as discussed in section III.D of this document, compared to the 2 hours typically required to conduct the current test procedure). Because of the current lack of industry consensus on a constant-cooling-load or dynamic-cooling-load test procedure and the uncertainty regarding the repeatability of such tests, DOE judges that the potential benefits of constant-cooling-load or dynamic-cooling-load tests do not justify the increase in test burden in the form of test time and changes to test equipment. For these reasons, DOE is not proposing a constant-cooling-load or dynamic-cooling-load test for room ACs at this time.

f. Power Factor

In response to the June 2015 RFI, the California IOUs suggested that DOE should identify the power factor [40] at each operating voltage, provided that the market size for multiple-voltage units warrants that kind of coverage. (California IOUs, June 2015 RFI, No. 8 at p. 4) DOE measured power factor for a sample of 23 room ACs of varying product classes, capacities, and efficiencies and found that power factor results ranged from 0.93 to 0.99, with an average power factor of 0.97. Because the range of power factors was small and all measurements were close to a value of 1, DOE's testing suggests that there is no significant difference between the actual power drawn by a room AC and the apparent power supplied to the unit. Based on this, DOE expects that the metrics proposed in this document accurately described the power consumption of a room AC and therefore, the additional burden of measuring and reporting the power factor would outweigh any benefits this information would provide. Therefore, DOE does not propose to establish requirements for measuring and reporting the power factor for room ACs.

DOE seeks comment on the proposal to not establish requirements for measuring and reporting the power factor for room ACs.

2. Heating Mode

In the June 2015 RFI, DOE requested comment on appropriate test methods, industry test standards, and temperature conditions for measuring room AC reverse-cycle heating performance. DOE also requested information on the burdens associated with testing heating performance and whether they would disproportionately impact certain businesses. 80 FR 34843, 34847–34848.

The California IOUs supported measuring room AC heating mode performance in the DOE test procedure, but noted that with a combined performance metric, consumers would be unable to determine performance in individual active modes. According to the California IOUs, consumers could thus be confused when comparing units with and without heating, and might incorrectly assume that a high CEER necessarily represents efficient performance in both cooling and heating modes. The California IOUs also suggested that a combined efficiency metric could allow manufacturers to improve efficiency in heating mode while maintaining or even reducing cooling mode efficiency. Therefore, the California IOUs suggested that DOE implement separate cooling mode and heating mode metrics. (California IOUs, June 2015 RFI, No. 8 at pp. 2–3)

AHAM asserted that a heating mode test method is not necessary for room ACs, and that DOE should not adopt any metric for heating, whether separate or combined with cooling mode performance. AHAM stated that there is a trade-off between cooling and heating performance, so it would be difficult to optimize performance for both modes. Therefore, AHAM believes that including heating performance in the efficiency metric could increase prices while reducing product availability and consumer utility. AHAM also commented that a CEER metric that combines cooling and heating would confuse consumers, limit comparisons between room ACs with only cooling and those with both heating and cooling, and would diverge from the approach adopted for similar products. (AHAM, June 2015 RFI, No. 5 at pp. 3–4; AHAM, No. 3 at p. 7)

DOE agrees that combining cooling mode and heating mode performance into a single metric may limit a consumer's ability to recognize the mode-specific performance and compare performance with room ACs that only provide cooling. DOE also recognizes that a combined metric may lead to a reduction in cooling mode efficiency, if heating mode efficiency increases but the overall metric remains the same. DOE considered the approach taken for similar products and notes that PTACs and central ACs have separate metrics for heating and cooling performance while the test procedure for portable ACs does not consider heating performance. Further, DOE is not aware of data suggesting that heating mode is a significant operating mode for room ACs. Based on the lack of data of room ACs used for heating, and given the potential concerns raised by commenters, DOE is not proposing a test procedure to measure room AC heating mode in the room AC test procedure at this time.

DOE requests comment on the proposal not to establish a heating mode test procedure for room ACs at this time.

3. Off-Cycle Mode

Single-speed room ACs typically operate with a compressor on-off control strategy, where the compressor runs until the room temperature drops below a consumer-determined setpoint, then ceases to operate (*i.e.,* the unit operates in off-cycle mode [41]) until the room temperature rises above the setpoint, at which time the compressor starts again. The points at which the compressor stops and restarts depend on the setpoint temperature defined by the user and the deadband [42] programmed by the manufacturer. During the period in which the compressor remains off (*i.e.,* off-cycle mode), the fan may operate in different ways depending on manufacturer implementation: (1) The fan ceases operation entirely; (2) the fan continues to operate for a short period of time after the setpoint is reached and then stops until the compressor is reactivated; (3) the fan continues to operate continuously for a short period of time, after which it cycles on and off periodically until the compressor is reactivated; or (4) the fan continues to operate continuously until the compressor is reactivated.[43]

In the June 2015 RFI, DOE requested comment on the merits and limitations of including a requirement to measure off-cycle mode in the room AC test procedure. 80 FR 34843, 34846 (June 18, 2015). AHAM commented that DOE had previously concluded in a test procedure supplemental notice of proposed rulemaking (SNOPR) published for room ACs on June 29, 2010 (hereafter the "June 2010 SNOPR"), that the benefit of incorporating the energy use of the off-cycle mode into the overall energy efficiency metric is outweighed by the additional test burden for manufacturers. 75 FR 37954, 37604. AHAM asserted that nothing has changed since those determinations that

[40] The power factor of an alternating current electrical power system is defined as the ratio of the real power flowing to the load to the apparent power in the circuit. A load with a low power factor draws more electrical current than a load with a high power factor for the same amount of useful power transferred. The higher currents associated with low power factor increase the amount of energy lost in the electricity distribution system.

[41] "Off-cycle mode" is distinct from "off mode," in which a room AC not only ceases compressor and fan operation but also and may remain in that state for an indefinite time, not subject to restart by thermostat or temperature sensor signal.

[42] The term "deadband" refers to the range of ambient air temperatures around the setpoint for which the compressor remains off, and above which cooling mode is triggered on.

[43] Unlike air circulation mode, off-cycle mode is not user-initiated and only occurs when the ambient temperature has satisfied the setpoint.

would justify changing them. (AHAM, June 2015 RFI, No. 5 at pp. 2–3)

In the June 2010 SNOPR, DOE considered a definition for off-cycle mode that it proposed in a NOPR published in the **Federal Register** on December 9, 2008 (73 FR 74639), namely that off-cycle mode is a standby mode in which a room AC: (1) Has cycled off its main function by thermostat or temperature sensor, (2) does not have its fan or blower operating, and (3) will reactivate the main function according to the thermostat or temperature sensor signal. DOE notes that the 2010 off-cycle mode definition proposal only addressed a low-power state, excluding the possibility of fan or blower operation. By excluding the periods of fan operation from off-cycle mode, the definition for off-cycle mode considered in the June 2010 SNOPR would not have accounted for potentially significant room AC energy consumption. Unlike that definition, off-cycle mode as considered in this NOPR could include periods of potentially significant fan or blower energy use.

AHAM also noted DOE's conclusion in the January 2011 Final Rule that off-cycle mode does not persist for an indefinite time and therefore would not be considered a standby mode. (AHAM, June 2015 RFI, No. 5 at pp. 2–3; AHAM, No. 3 at p. 6) DOE agrees that, because off-cycle mode is terminated when the compressor reactivates, it would not be classified as a standby mode even if no fan or blower operation occurs. Regardless, such classification would not preclude any determination as to whether off-cycle mode should be incorporated in the energy efficiency metric.

In response to the August 2017 RFI, AHAM stated that the room AC industry recently adjusted to the CEER metric that was implemented in June 1, 2014, and that the metric has yet to be included on the EnergyGuide label. Therefore, AHAM suggested that including off-cycle mode in the room AC test procedure would prematurely adjust the performance metric, resulting in another burdensome redesign and testing process and potentially causing confusion with the test procedure. (AHAM, No. 3 at p. 6)

Friedrich also opposed including off-cycle mode testing for room ACs, stating that the portable AC off-cycle mode test requires an additional 2 hours in the test chamber after the cooling mode test, which is not an efficient use of test chamber time and which delays the manufacturer test and development timeline. (Friedrich, No. 2 at p. 4) DOE agrees that including an off-cycle mode test for room ACs would likely increase testing by 2 hours, in addition to a short period to adjust the test unit control settings.

The California IOUs noted that, in a previous test procedure rulemaking for room ACs, DOE discussed, but did not describe, a test procedure to measure fan-only energy use, and requested clarification regarding how off-cycle mode would address fan energy consumption. The California IOUs cited a Lawrence Berkeley National Laboratory study, which found that portable ACs consume 102 W when only operating the fan,[44] and suggested that room AC fan-only operation may similarly consume a significant amount of power and thus should be captured in the room AC test procedure. (California IOUs, No. 5 at p. 1) The Joint Advocates supported measuring off-cycle mode power consumption in the room AC test procedure, stating that it would provide better representation of actual use and efficiency, more information to consumers, and encourage manufactures to introduce more efficient fans and fan motors. The Joint Advocates commented that capturing fan operation outside of cooling mode would be consistent with the test procedures for portable ACs, dehumidifiers, and dishwashers. (Joint Advocates, No. 6 at pp. 3–4)

To investigate the merits of including off-cycle mode in the DOE test procedure, DOE conducted investigative testing of off-cycle mode for a sample of 27 room ACs.[45] The results of the testing are presented in Table III–10.

TABLE III–10—ROOM AC OFF-CYCLE MODE TESTING

Unit No.	Fan operation scheme in off-cycle mode	Off-cycle average power (W)	Average power for fan operating scheme (W)
OC–1	Continuous	253.3	270.1
OC–2	Continuous	286.9	
OC–3	Cyclical—Indefinite	17.0	10.7
OC–4	Cyclical—Indefinite	2.2	
OC–5	Cyclical—Indefinite	15.9	
OC–6	Cyclical—Indefinite	15.3	
OC–7	Cyclical—Indefinite	22.3	
OC–8	Cyclical—Indefinite	20.2	
OC–9	Cyclical—Indefinite	5.3	
OC–10	Cyclical—Indefinite	8.6	
OC–11	Cyclical—Indefinite	7.8	
OC–12	Cyclical—Indefinite	9.9	
OC–13	Cyclical—Indefinite	4.8	
OC–14	Cyclical—Indefinite	5.3	
OC–15	Cyclical—Indefinite	6.7	
OC–16	Cyclical—Indefinite	7.0	
OC–17	Cyclical—Indefinite	22.6	
OC–18	Cyclical—Indefinite	4.8	
OC–19	Cyclical—Indefinite	11.7	
OC–20	Cyclical—Indefinite	7.0	
OC–21	Cyclical—Indefinite	3.8	
OC–22	Cyclical—Indefinite	15.3	

[44] Burke, Thomas et al. ''Using Field-Metered Data to Quantify Annual Energy Use of Portable Air Conditioners'' Environmental Energy Technologies Division Lawrence Berkeley National Laboratory. December 2014.

[45] Room AC off-cycle mode investigative testing was consistent with the portable AC off-cycle mode test methodology.

TABLE III–10—ROOM AC OFF-CYCLE MODE TESTING—Continued

Unit No.	Fan operation scheme in off-cycle mode	Off-cycle average power (W)	Average power for fan operating scheme (W)
OC–23	Cyclical—Limited	3.5	2.7
OC–24	Cyclical—Limited	2.6	
OC–25	Cyclical—Limited	2.5	
OC–26	Cyclical—Limited	2.2	
OC–27	No Fan Operation	1.8	1.8

As shown in Table III–10, two of the units operated the fan continuously in off-cycle mode and consumed 270.1 W on average. Of the remaining 25, one did not operate the fan at all during off-cycle mode and consumed 1.8 W; four disabled the fan after a few fan cycles (shown as ''cyclical–limited'') and consumed 2.7 W on average; and the remaining 20 units continued cycling the fan throughout the test period (shown as '''cyclical–indefinite''), 10.7 W on average. The cyclical fan behavior that DOE observed was generally consistent with the ENERGY STAR V4.1 specification, which as discussed in section III.C.3 of this document, requires that all ENERGY STAR-certified room ACs ship with an energy saver mode enabled by default that minimizes energy consumption by limiting fan operation to: (1) While the compressor is operating (*i.e.,* cooling mode); (2) a period not exceeding 5 minutes after the compressor is switched off (*i.e.,* following cooling mode and prior to off-cycle mode); and (3) up to 17 percent of the total compressor off cycle time following the initial 5-minute period (*i.e.,* off-cycle mode), equivalent to 1 minute of fan-on time for every 5 minutes of fan-off time.

As discussed in a NOPR for the portable AC test procedure published on February 25, 2015, DOE tentatively determined that the benefits of measuring off-cycle mode power for portable ACs outweighed the additional test burden because all models tested from a market-representative sample operated the fan continuously in off-cycle mode with an average off-cycle mode power of 93 W. 80 FR 10211, 10231. However, based on the results described above, which indicate relatively low (*i.e.,* approximately 10 percent or less) average power use in off-cycle mode compared to the average power used in cooling mode, DOE has tentatively determined that the additional 2-hour test burden that would be required would outweigh the benefits of measuring off-cycle mode power for room ACs. Therefore, DOE is not proposing to define off-cycle mode or establish means for measuring off-cycle mode average power for room ACs in appendix F.

DOE requests comment on the proposal to not establish a definition or test procedure for off-cycle mode.

F. Standby Modes and Off Mode

Section 1.7 of appendix F defines standby mode as any mode where a room AC is connected to a mains power source and offers one or more of the following user-oriented or protective functions which may persist for an indefinite time: (a) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer; or (b) continuous functions, including information or status displays (including clocks) or sensor-based functions. Section 1.5 of appendix F defines inactive mode as a mode that facilitates the activation of active mode by remote switch (including by remote control) or internal sensor, or provides continuous status display. Section 1.6 of appendix F defines off mode as a mode distinct from inactive mode in which a room AC is connected to a mains power source and is not providing any active or standby mode function and where the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position is included within the classification of an off mode.

1. Referenced Standby Mode and Off Mode Test Standard

In the January 2011 Final Rule, DOE amended the room AC test procedure by incorporating provisions from IEC Standard 62301 First Edition for measuring standby mode and off mode power. 76 FR 971, 979–980 (Jan. 6, 2011). At that time, DOE reviewed the IEC Standard 62301 First Edition and concluded that it would generally apply to room ACs, with some clarifications, including allowance for testing standby mode and off mode in either the test chamber used for cooling mode testing, or in a separate test room that meets the specified standby mode and off mode test conditions. 76 FR 971, 986.

On January 27, 2011, IEC published IEC Standard 62301 Second Edition, an internationally accepted test procedure for measuring standby power in residential appliances, which included various clarifications to IEC Standard 62301 First Edition. Provisions from IEC Standard 62301 Second Edition are currently referenced in DOE test procedures for multiple consumer products for which standby mode and off mode energy use are measured (*e.g.,* dehumidifiers, portable ACs, dishwashers, clothes washers, clothes dryers, conventional cooking products, microwave ovens).

Based on its previous determinations for similar consumer products, DOE expects that the use of IEC Standard 62301 Second Edition for measuring the standby mode and off mode energy use for room ACs would improve the accuracy and representativeness of the test measurements and would not be unduly burdensome, compared to IEC Standard 62301 First Edition. Accordingly, DOE proposes to incorporate by reference relevant paragraphs of IEC Standard 62301 Second Edition in appendix F in place of those from IEC Standard 62301 First Edition, as follows.

a. Power Measurement Uncertainty

Section 4.4 of IEC Standard 62301 Second Edition introduces a more comprehensive specification for power measurement accuracy, which depends on the crest factor[46] and power factor of the input power, and the resulting calculated maximum current ratio (MCR). DOE notes that the allowable uncertainty is the same or less stringent than the allowable uncertainty specified in the First Edition, depending on the value of MCR and the power level being measured. In a final rule published in the **Federal Register** on October 31,

[46] The crest factor is the measured peak current drawn by the product divided by the measured root mean square current drawn by the product.

2012 (hereafter the ''October 2012 Final Rule''), regarding test procedures for consumer dishwashers, dehumidifiers, and conventional cooking products, DOE determined that this change in the allowable uncertainty would maintain sufficient accuracy of measurements under a full range of possible measured power levels while minimizing test burden associated with high instrumentation accuracy. 77 FR 65942, 65948. Because DOE understands that the standby power characteristics of room ACs are similar to those of dishwashers, dehumidifiers, and conventional cooking products and were tested using the same standard until the publication of the October 2012 Final Rule, DOE relies on that analysis and adopts it for room ACs. Therefore, DOE proposes to reference the power equipment specifications from Section 4.4 of IEC Standard 62301 Second Edition for determining standby mode and off mode power in appendix F.

DOE requests comment on the proposal to reference the power equipment specifications from Section 4.4 of IEC Standard 62301 Second Edition for determining standby mode and off mode power in appendix F.

b. Power Consumption Measurement Procedure

Section 4.2 of appendix F requires measuring standby mode and off mode power according to Section 5, Paragraph 5.3 of IEC Standard 62301 First Edition, as modified by Appendix F.[47] Paragraph 5.3 specifies a direct meter reading method. If the power varies over a cycle, as described in Section 5, Paragraph 5.3.2 of IEC Standard 62301 First Edition, testing must follow the average power approach for power that varies over a cycle in Section 5, Paragraph 5.3.2(a). This approach requires a measurement period long enough to include one or more complete cycles, and then calculating the average power over the measurement period is calculated.

IEC Standard 62301 Second Edition defines three different mode stability types (stable, cyclic, and irregular) and provides three methods to measure power consumption of an appliance: (1) Sampling, (2) average reading, and (3) direct meter reading. The direct meter reading method and average reading method are similar to the options in IEC Standard 62301 First Edition for stable and non-stable (cyclic or irregular) standby modes, respectively, that are currently referenced in the room AC test procedure. The following paragraphs describe the three methods in IEC Standard 62301 Second Edition to determine power consumption.

(1) The sampling method requires different approaches for stable, cyclic, and irregular power consumption modes. For stable modes, it requires a test period of at least 15 minutes, with power data recorded at least once every second. The first third of the total period is discarded, and the other two-thirds of the period are used to determine stability. Stability is achieved when the slope of a linear regression of the data is within tolerances listed in Section 5.3.2 of IEC Standard 62301 Second Edition. Once the stability criteria are satisfied, the result is the average power consumed during the latter two thirds of the total test period. For cyclic modes, the method requires two test periods, each not less than 10 minutes, and not less than two cycles each. Stability for a cyclic mode is achieved when the power difference between the two test periods is within tolerance. The representative average power is the average power consumed over both comparison periods. For irregular modes, or cyclic modes where the cycles never meet stability criteria, IEC Standard 62301 Second Edition requires collecting data sufficient to characterize the power consumption of the mode and recommends measuring a minimum of ten cycles.

(2) The direct meter reading method may only be used for stable modes, and requires a 30-minute stabilization period, which is extended if stability cannot be achieved. Once stability has been achieved, two instantaneous measurements are taken not less than 10 minutes apart. The average of these two readings is the result, as long as the two measurements agree within the tolerances specified in Section 5.3.4 of IEC Standard 62301 Second Edition. If the measurements do not agree sufficiently or stability cannot be achieved, testing must follow a different method.

(3) The average reading method may only be used for stable modes. This is a change from the first edition of IEC Standard 62301, which also allowed use for non-stable modes. After a 30-minute stabilization period, average power measurements are taken over two equal comparison periods, each not less than 10 minutes in duration. If the two measurements agree within the tolerances specified in Section 5.3.3 of IEC Standard 62301 Second Edition, the result is determined by the average of readings from both comparison periods. If the measurements do not agree within the specified tolerances or stability cannot be achieved, testing must follow the sampling method.

According to IEC Standard 62301 Second Edition, the sampling method is preferred for all cases and is specified for all units in which the power varies over the mode, or the mode to be measured is of limited duration. Thus, IEC Standard 62301 Second Edition specifies the sampling method to be used for modes when the power is cyclic or irregular and suggests that it is the fastest test method for stable modes.

DOE expects that adopting a single test method from IEC Standard 62301 Second Edition would ensure that the standby power test procedure for room ACs is uniform and repeatable because allowing multiple test methods may affect reproducibility if systematic differences exist between the test methods. DOE does not expect that proposing the sampling method for all standby mode and off mode testing would increase test burden, because power meters that can measure, store, and output readings at the required proposed sampling rate and accuracy for the sampling method are already widely used by test laboratories. DOE also does not anticipate that the power consumption measured with the sampling method would substantively vary from that measured with the direct meter or average reading methods. DOE notes that other covered products, such as dehumidifiers and portable ACs, require using the sampling method to measure standby mode and off mode average power. For these reasons, DOE proposes to adopt the sampling method from Section 5.3.2 of IEC Standard 62301 Second Edition to determine standby mode and off mode average power in appendix F.

DOE requests comment on the proposal to adopt and reference the sampling method from Section 5.3.2 of IEC Standard 62301 Second Edition to determine standby mode and off mode average power in appendix F.

G. Network Functionality

Network functionality on room ACs may enable functions such as communicating with the network to provide real-time information on the temperature conditions in the room or receiving commands via a remote user interface such as a smartphone. DOE has observed that network features on room ACs are designed to operate in the background while the room AC performs other functions. These network functions may operate continuously during all operating modes, and therefore may impact the

[47] Appendix F provides additional direction requiring the product to stabilize for 5 to 10 minutes and using an energy use measurement period of 5 minutes.

power consumption in all operating modes.

In the June 2010 SNOPR, DOE considered whether it should adopt amendments to the room AC test procedure to measure energy consumption when network functionality is enabled. DOE noted that a draft version of IEC Standard 62301 Second Edition described network mode as a mode where the energy using product is connected to a main power source and at least one network function is activated (such as reactivation via network command or network integrity communication) but where the primary function is not active. 75 FR 37594, 37605 (June 29, 2010). Due to the lack of information about room ACs with network functionality, in the January 2011 Final Rule, DOE did not adopt provisions to account for energy consumption associated with network functionality. 76 FR 971, 983–984 (Jan. 6, 2011).

DOE investigated the network-enabled units currently available in the market to assess whether an amendment to room AC test procedure to measure network functionality would be appropriate. DOE did not find network-capabilities to be common at this time and found that to the extent offered, in most cases, such units are sold network-ready or with the necessary hardware included. However, at least one manufacturer does not include the necessary hardware with the original purchase, instead selling a connectivity module separately. Based on these findings, and as discussed further in section III.H of this document, DOE is not proposing provisions to specifically measure and account for energy consumption associated with network functionality. However, to provide further direction and simplify the test setup and configuration settings, DOE proposes to specify in section 3.1.4 of appendix F that units with network capabilities must be tested with the network settings disabled, and that those network settings remain disabled for all tested operating modes (*i.e.,* cooling mode, standby mode, and off mode).

DOE also recently published an RFI on the emerging smart technology appliance and equipment market. 83 FR 46886 (Sept. 17, 2018). In that RFI, DOE sought information to better understand market trends and issues in the emerging market for appliances and commercial equipment that incorporate smart technology. DOE's intent in issuing the RFI was to ensure that DOE did not inadvertently impede such innovation in fulfilling its statutory obligations in setting efficiency standards for covered products and equipment. In this NOPR, DOE seeks comment on the same issues presented in the RFI as they may be applicable to room ACs.

DOE requests comment on the proposal to specify that all network or connectivity settings must be disabled during testing.

H. Connected Test Procedure

ENERGY STAR V4.1 specifies optional criteria for room ACs designed to provide additional functionality to consumers, such as alerts and messages, remote control and energy information, as well as demand response (DR) capabilities, which support the inclusion of room ACs in smart grid applications (hereafter ''connected room ACs''). These capabilities are all considered network functionality, as they require the room AC maintain communication continuously or intermittently with a server; however, DR functionality is a unique subset that enables smart grid communication and active modified operation in response to DR signals from an electric utility.

In the June 2015 RFI, DOE noted that the ENERGY STAR V4.0 criteria [48] may increase the market penetration of connected room ACs and that the operation of connected functions may require a significant amount of energy. Thus, DOE requested input on whether the test procedure should be amended to account for the energy consumed while the room AC performs connected functions. Specifically, DOE requested information on the connected features available in the market and the energy consumption of those features. Furthermore, DOE requested information on the current and anticipated market penetration of connected room ACs. 80 FR 34843, 34848 (June 18, 2015).

The Joint Advocates stated that there were already seven ''connected'' models in the ENERGY STAR list of certified room ACs as of August 29, 2017, and as more are introduced into the market, there may be significant and continuous additional energy consumption due to the connected functionality operating in an ''always on'' standby mode. The Joint Advocates suggested that the test procedure for room ACs should capture any power consumption associated with connected features to encourage manufacturers to provide connected functionality with low power consumption. (Joint Advocates, No. 6 at p. 4) DOE reiterates its request for comment on network connectivity issues in light of the September 17, 2018 RFI.

The Joint Commenters and California IOUs encouraged DOE to consider amending the existing room AC test procedure to include the energy consumption of connected features for connected room ACs. These commenters expect that connected room ACs, which can support smart grid interconnection, would become more common with the publication of the ENERGY STAR V4.0. The California IOUs noted that room ACs typically operate during peak hours, so the connected functionalities are particularly beneficial to both utilities and consumers by reducing the overall load and providing better-informed user control. The California IOUs also stated that as the market continues to grow for these features, it is important to understand how to measure, capture, and monitor the energy consumption and energy reduction that results from implementing the connected features. The California IOUs urged DOE to include the connected functions in the test procedure if the energy impacts are significant. (Joint Commenters, June 2015 RFI, No. 7 at p. 2; California IOUs, June 2015 RFI, No. 8 at p. 4; California IOUs, No. 5 at p. 1)

AHAM stated that an ENERGY STAR test method to evaluate DR capabilities had not yet been published, and therefore the market penetration for connected room ACs was still minimal. AHAM also stated that connected products offer consumers and utilities a unique energy savings opportunity by improving grid energy efficiency and allowing for peak-load shifting and implementation of renewable power sources). Therefore, AHAM suggested that DOE should not revise the room AC test procedure to account for the energy consumption associated with connected functionality because that would negate the potential benefits these products provide. (AHAM, June 2015 RFI, No. 5 at pp. 4–5)

On June 7, 2017, DOE and EPA published the final ENERGY STAR Program Requirements Product Specification for Room Air Conditioners: Test Method to Validate Demand Response (hereafter the ''June 2017 ENERGY STAR Test Method''). This test method validates that a unit complies with ENERGY STAR's DR requirements, which are designed to reduce energy consumption upon receipt of a DR signal. However, DOE notes that the June 2017 ENERGY STAR Test Method does not measure the total energy consumption or average power

[48] The optional criteria for connected room air conditioners contained in ENERGY STAR V4.0 are identical to those contained in the currently applicable V4.1 version.

while a unit responds to a DR signal. Further, DOE notes that no connected room ACs are currently available on the market that comply with the full set of ENERGY STAR V4.1 connected criteria, and therefore, the energy consumption cannot be determined for a range of products and manufacturers. There is also little available information indicating the frequency of received DR signals that are specified in the ENERGY STAR connected criteria. As a result, it is not possible to determine annual energy use attributed to DR signals. Therefore, given the issues raised in the September 17, 2018 RFI and the lack of available connected room ACs on the market and lack of energy consumption and usage data regarding the DR signals, DOE does not propose to amend its room AC test procedure in this rulemaking to measure energy consumption while a connected room AC is responding to a DR signal.

DOE requests comment on the proposal not to amend the DOE test procedure for room ACs to include energy consumption while a connected room AC responds to a DR signal.

I. Combined Energy Efficiency Ratio

The current room AC energy efficiency metric, CEER, accounts for the cooling provided by the room AC in cooling mode as a function of the total energy consumption in cooling mode and inactive mode or off mode. In the June 2015 RFI, DOE requested comment on the merits and limitations of revising the room AC test procedure and efficiency metric to account for energy consumption in various modes, such as cooling mode, heating mode, off-cycle mode, inactive mode, and off mode. 80 FR 34843, 34846 (June 18, 2015).

AHAM opposed adding additional energy metrics for room ACs, noting that the industry recently implemented product redesigns adding standby and off mode energy consumption in the overall efficiency metric, in response to the CEER established in the January 2011 Final Rule. As previously discussed in section III.E.3 of this document for off-cycle mode specifically, AHAM suggested that an additional metric would require another burdensome redesign and any new mode definitions and metrics would complicate the test procedure and increase the test burden. (AHAM, June 2015 RFI, No. 5 at p. 2) As discussed in section III.E.2 and section III.E.3 of this document, respectively, DOE is not proposing a heating mode or off-cycle mode test in appendix F. Further, although DOE is proposing a new test procedure for variable-speed room ACs that requires testing at additional outdoor test conditions, the new variable-speed room AC test procedure calculations produce a CEER value comparable to the existing CEER metric for single-speed units. The new calculations would not change the procedure for single-speed units.

DOE requests comment on the proposal to maintain the current CEER calculations for single-speed room ACs.

J. Certification and Verification Requirements

In a direct final rule published on April 22, 2011 (hereafter the ''April 2011 Direct Final Rule''), DOE published amended energy conservation standards for room ACs, with a compliance date of June 1, 2014. 76 FR 22454. The amended standards reflect performance in standby mode or off mode, based on a new performance metric, CEER, expressed in Btu/Wh. However, the sampling plan and certification reporting requirements in 10 CFR 429.15(a)(2)(ii) and (b)(2) were not updated in the April 2011 Direct Final Rule. DOE proposes in this NOPR to update those requirements to conform to the current metric by requiring the reporting of the CEER metric and to remove references to the previous performance metric, EER. For variable-speed room ACs, DOE proposes to require the additional reporting of cooling capacity and electrical input power for each of the three additional test conditions as part of a supplemental PDF that would be referenced within the manufacturer's certification report.

Friedrich urged DOE to examine the enforcement procedure for room AC standards, noting that CEER measurements can differ by 2 to 3 percent from laboratory to laboratory, especially for units rated below 12,000 Btu/h. Friedrich expressed the view that the current enforcement methodology fails to account for this variation. (Friedrich, No. 2 at p. 7)

DOE appreciates the comment by Friedrich, although it is outside the scope of this rulemaking. DOE may consider this information in the future if DOE conducts a rulemaking that would address certification and enforcement procedures and encourages Friedrich to submit its comment in any such rulemaking.

K. Reorganization of Calculations Currently in 10 CFR 430.23

Currently, 10 CFR 430.23(f) contains instructions for determining a room AC's estimated annual operating cost, with calculations described for the average annual energy consumption, combined annual energy consumption, EER, and CEER.

DOE proposes to move the formula for a unit's CEER from 10 CFR 430.23(f) to appendix F, to mitigate potential confusion, harmonize with the approach used for other products, and improve the readability of the calculations currently in 10 CFR 430.23(f) and appendix F. Similarly, DOE proposes to remove the formulas for average annual energy consumption in cooling mode and combined annual energy consumption from 10 CFR 430.23(f) and instead add formulas for annual energy consumption for each operating mode in appendix F.

Because the EER performance metric is does not apply to either current or future manufacturing, DOE proposes removing the EER formula from 10 CFR 430.23(f), and also proposes to remove the formulas for overall annual energy consumption in that section (*i.e.,* a combined annual energy consumption as well as an average annual energy consumption). Instead, DOE proposes to update the estimated annual operating cost calculation in 10 CFR 430.23(f) to reference energy consumption values calculated in appendix F.

Finally, DOE proposes to include in 10 CFR 429.15(a)(3) through (5) and (b)(3) and 10 CFR 430.23(f) instructions to round cooling capacity to the nearest 100 Btu/h, electrical input power to the nearest 10 W, and CEER to the nearest 0.1 Btu/Wh, to provide consistency in room AC capacity, electrical input power, and efficiency representations.

DOE requests comment on the proposed rounding instructions in appendix F for cooling capacity, electrical input power, and CEER and to revise the estimated annual operating cost calculation to now reference the annual energy consumption for each operating mode as calculated in appendix F, as opposed to the annual energy consumption calculation currently located in 10 CFR 430.23.

L. Test Procedure Costs, Harmonization, and Other Topics

1. Test Procedure Costs and Impact

EPCA requires that test procedures proposed by DOE not be unduly burdensome to conduct. In this NOPR, DOE proposes to amend the existing test procedure for room ACs by (1) updating industry standard references to the current versions; (2) adopting procedures for variable-speed room ACs that reflect the relative efficiency gains compared to single-speed room ACs; (3) adopting new definitions consistent with the proposed amendments; and (4) providing specifications and minor corrections to improve the test procedure repeatability, reproducibility, and overall readability. DOE has tentatively determined that these proposed amendments would not be unduly burdensome for manufacturers to conduct.

Based on review of the Compliance Certification Database in DOE's Compliance Certification Management System, DOE has identified 812 basic models of room ACs, representing 31 manufacturers.[49] However, this number likely is artificially high. DOE frequently finds that manufacturers fail to report a model as discontinued. DOE's analysis of this proposal indicates that, if finalized, the only cost savings or additional costs to manufacturers would be those already being incurred for variable-speed room ACs under the LG Waiver and Grant of Midea Interim Waiver.

a. Variable-Speed Test Impact

As discussed in section III.C.1 of this document, DOE proposes to add three additional cooling mode test conditions to the appendix F test procedure for variable-speed room ACs to better reflect the relative efficiency improvements of variable-speed ACs compared to single-speed room ACs. DOE estimates that the proposed amendments for variable-speed room AC would require a total of 14 hours of test chamber time, while the current test procedure requires approximately two hours of test chamber time. However, as discussed previously, all ten basic models (four from LG and six from Midea) currently on the market are subject to either the LG Waiver or the Grant of Midea Interim Waiver and are generally being tested consistent with the proposed amendments in this NOPR. 84 FR 20111 and 84 FR 68159. Therefore, the ten variable-speed room AC basic models identified by DOE would not need to be re-tested or re-certified if DOE adopts the amendments as proposed in this document. Although no other manufacturers are currently producing variable-speed room ACs that are sold in the United States, the additional testing time described above would be applicable to any entities that begin manufacturing a variable-speed room AC for introduction to the U.S. market.

DOE has tentatively concluded that the proposed test procedure in this NOPR would not add any industry test burden and that the minimal costs associated with the LG Waiver and Grant of Midea Interim Waiver test procedure are already being incurred.

DOE requests comment on the understanding of the estimated impact and associated costs to room AC manufacturers of the proposed amendment to test variable-speed room ACs.

b. Additional Amendments

DOE affirms that manufacturers of single-speed room ACs can rely on data generated under the current test procedure for single-speed room ACs should any of these additional proposed amendments be finalized. Therefore, the remainder of the amendments proposed in this NOPR for single-speed room ACs would not impact test costs.

2. Harmonization With Industry Standards

DOE is proposing that the test procedure for room ACs at appendix F incorporate by reference certain provisions of ANSI/AHAM RAC–1–2015 and ANSI/ASHRAE Standard 16–2016 for active mode testing conditions, methods, and calculations, and IEC Standard 62301 Second Edition for measuring standby and off mode power consumption.

DOE seeks comment on the degree to which the DOE test procedure should consider and be harmonized further with the most recent relevant industry standards for room ACs and whether any changes to the Federal test method would provide additional benefits to the public. DOE also requests comment on the benefits and burdens of, or any other comments regarding adopting any industry or voluntary consensus-based or other appropriate test procedure, without modification.

DOE notes that current industry test procedures, ANSI/AHAM RAC–1–2015 and ANSI/ASHRAE Standard 16–2016 do not include test procedures for variable-speed units, such as the multiple test conditions proposed in this NOPR. DOE requests comment on whether the industry is considering updating its standards for room AC testing to include provisions for testing variable-speed room ACs.

3. Other Test Procedure Topics

In addition to the issues identified earlier in this document, DOE welcomes comment on any other aspect of the existing test procedure for room ACs not already addressed by the specific areas identified in this document. DOE particularly seeks information that would improve the representativeness of the test procedure, as well as information that would help DOE create a procedure that would limit manufacturer test burden. Comments regarding repeatability and reproducibility are also welcome.

DOE also requests information that would help DOE create procedures that would limit manufacturer test burden through streamlining or simplifying testing requirements. In particular, DOE notes that under Executive Order 13771, ''Reducing Regulation and Controlling Regulatory Costs,'' Executive Branch agencies such as DOE must manage the costs associated with the imposition of expenditures required to comply with Federal regulations. See 82 FR 9339 (Feb. 3, 2017). Consistent with that Executive Order, DOE encourages the public to provide input on measures DOE could take to lower the cost of its regulations applicable to room ACs consistent with the requirements of EPCA.

M. Compliance Date and Waivers

EPCA prescribes that, if DOE amends a test procedure, all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with that amended test procedure, beginning 180 days after publication of such a test procedure final rule in the **Federal Register**. (42 U.S.C. 6293(c)(2)) If DOE were to publish an amended test procedure for room ACs, EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer would experience undue hardship in meeting the 180-day deadline. (42 U.S.C. 6293(c)(3)) To receive such an extension, a manufacturer must file a petition with DOE no later than 60 days before the end of the 180-day period and detail how the manufacturer will experience undue hardship. (*Id.*)

Upon the compliance date of an amended test procedure, if DOE issues such an amendment, any waivers that had been previously issued and are in effect that pertain to issues addressed by the amended test procedure terminate. 10 CFR 430.27(h)(2). Recipients of any such waivers would be required to test products subject to the waiver according to the amended test procedure as of the effective date of the amended test procedure. There is currently one waiver from the test procedure for room ACs for four variable-speed models manufactured by LG. In a decision and order published on May 8, 2019, DOE granted this waiver from DOE's room AC test procedure. 84 FR 20111. Additionally, there is one interim waiver from the room AC test procedure for six variable-speed models, manufactured by Midea, that DOE

[49] *https://www.regulations.doe.gov/certification-data/CCMS-4-Air_Conditioners_and_Heat_Pumps_-_Room_Air_Conditioners.html.* Accessed October 8th, 2018.

granted on December 13, 2019 (84 FR 68159) that would also terminate upon the compliance date of such an amended test procedure.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) has determined that the proposed regulatory action is a significant regulatory action under section (3)(f) of Executive Order 12866. Accordingly, this action was reviewed by OIRA in the Office of Management and Budget (OMB).

B. Review Under Executive Orders 13771 and 13777

On January 30, 2017, the President issued Executive Order (E.O.) 13771, ''Reducing Regulation and Controlling Regulatory Costs.'' See 82 FR 9339 (Feb. 3, 2017). E.O. 13771 stated the policy of the executive branch is to be prudent and financially responsible in the expenditure of funds, from both public and private sources. E.O. 13771 stated it is essential to manage the costs associated with the governmental imposition of private expenditures required to comply with Federal regulations.

Additionally, on February 24, 2017, the President issued E.O. 13777, ''Enforcing the Regulatory Reform Agenda.'' 82 FR 12285 (March 1, 2017). E.O. 13777 required the head of each agency designate an agency official as its Regulatory Reform Officer (RRO). Each RRO oversees the implementation of regulatory reform initiatives and policies to ensure that agencies effectively carry out regulatory reforms, consistent with applicable law. Further, E.O. 13777 requires the establishment of a regulatory task force at each agency. The regulatory task force is required to make recommendations to the agency head regarding the repeal, replacement, or modification of existing regulations, consistent with applicable law. At a minimum, each regulatory reform task force must attempt to identify regulations that:

(i) Eliminate jobs, or inhibit job creation;

(ii) Are outdated, unnecessary, or ineffective;

(iii) Impose costs that exceed benefits;

(iv) Create a serious inconsistency or otherwise interfere with regulatory reform initiatives and policies;

(v) Are inconsistent with the requirements of Information Quality Act, or the guidance issued pursuant to that Act, in particular those regulations that rely in whole or in part on data, information, or methods that are not publicly available or that are insufficiently transparent to meet the standard for reproducibility; or

(vi) Derive from or implement Executive Orders or other Presidential directives that have been subsequently rescinded or substantially modified.

DOE initially concludes that this rulemaking is consistent with the directives set forth in these executive orders. This proposed rule would not yield any cost savings or additional costs to manufacturers other than those already being incurred for variable-speed room ACs under the LG Waiver and the Grant of Midea Interim Waiver.

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IFRA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (Aug. 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: *http://energy.gov/gc/office-general-counsel.*

DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. The proposed rule prescribes amended test procedures to measure the energy consumption of room ACs in cooling mode, standby modes, and off mode. DOE tentatively concludes that this proposed rule would not have a significant impact on a substantial number of small entities, and the factual basis for this certification is set forth in the following paragraphs.

The Small Business Administration (SBA) considers a business entity to be small business, if, together with its affiliates, it employs less than a threshold number of workers specified in 13 CFR part 121. These size standards and codes are established by the North American Industry Classification System (NAICS) and are available at *https://www.sba.gov/document/support--table-size-standards.* Room AC manufacturing is classified under NAICS 333415, ''Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing.'' The SBA sets a threshold of 1,250 employees or fewer for an entity to be considered as a small business for this category.

DOE used DOE's Compliance Certification Database [50] to create a list of companies that sell room ACs covered by this rulemaking in the United States. Additionally, DOE surveyed the AHAM member directory to identify manufacturers of room ACs. DOE then consulted other publicly available data, purchased company reports from vendors such as Dun and Bradstreet, and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a ''small business manufacturing facility'' and have their manufacturing facilities located within the United States. Based on this analysis, DOE is unable to identify any small businesses that currently manufacture room ACs in the United States.

Because DOE identified no small businesses that manufacture room ACs in the United States, DOE tentatively concludes that the impacts of the test procedure amendments proposed in this NOPR would not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of an IRFA is not warranted. DOE will transmit the 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).

DOE seeks comment on the finding that there are no small businesses that manufacture room ACs.

D. Review Under the Paperwork Reduction Act of 1995

Manufacturers of room ACs 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 room ACs. (See generally 10 CFR part 429.) The collection-of-information requirement for the certification and recordkeeping is

[50] *https://www.regulations.doe.gov/certification-data.* Accessed October 5, 2018

subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 35 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

E. Review Under the National Environmental Policy Act of 1969

DOE is analyzing this proposed regulation in accordance with the National Environmental Policy Act of 1969 (NEPA) and DOE's NEPA implementing regulations (10 CFR part 1021). DOE's regulations include a categorical exclusion for rulemakings interpreting or amending an existing rule or regulation that does not change the environmental effect of the rule or regulation being amended. 10 CFR part 1021, subpart D, Appendix A5. DOE anticipates that this rulemaking qualifies for categorical exclusion A5 because it is an interpretive rulemaking that does not change the environmental effect of the rule and otherwise meets the requirements for application of a categorical exclusion. See 10 CFR 1021.410. DOE will complete its NEPA review before issuing the final rule.

F. Review Under Executive Order 13132

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

G. Review Under Executive Order 12988

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

H. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *http://energy.gov/gc/office-general-counsel.* DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

I. Review Under the Treasury and General Government Appropriations Act, 1999

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

J. 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 would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

K. 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). DOE has reviewed this proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

L. Review Under Executive Order 13211

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

The proposed regulatory action to amend the test procedure for measuring the energy efficiency of room ACs 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.

M. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Public Law 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 FTC concerning the impact of the commercial or industry standards on competition.

The proposed modifications to the test procedure for room ACs adopted in this final rule incorporates testing methods contained in certain sections of the following commercial standards: ''Room Air Conditioners,'' ANSI/AHAM RAC–1–2015, ''Method of Testing for Rating Room Air Conditioners, Packaged Terminal Air Conditioners, and Packaged Terminal Heat Pumps for Cooling and Heating Capacity,'' ANSI/ASHRAE Standard 16–2016, and ''Household electrical appliances—Measurement of standby power,'' IEC 62301 Edition 2.0, 2011–01. DOE has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA (*i.e.,* whether they were developed in a manner that fully provides for public participation, comment, and review.) DOE will consult with both the Attorney General and the Chairman of the FTC concerning the impact of these test procedures on competition, prior to prescribing a final rule.

N. Description of Materials Incorporated by Reference

In this NOPR, DOE proposes to incorporate by reference the test standard published by AHAM, titled ''Room Air Conditioners,'' ANSI/AHAM RAC–1–2015. ANSI/AHAM RAC–1–2015 is an industry-accepted test procedure that measures room AC performance in cooling mode, in addition to other modes. ANSI/AHAM RAC–1–2015 specifies testing conducted in accordance with other industry-accepted test procedures (already incorporated by reference) and determines energy efficiency metrics for various room AC operating modes. The proposed amendments in this NOPR include updating references to various sections in ANSI/AHAM RAC–1–2015 that address test setup, instrumentation, test conduct, calculations, and rounding. ANSI/AHAM RAC–1–2015 is reasonably available at *https://www.aham.org/ht/d/Store/.*

In this NOPR, DOE also proposes to incorporate by reference the test standard published by ASHRAE, titled ''Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners,'' ANSI/ASHRAE Standard 16–2016. ANSI/ASHRAE Standard 16–2016 is an industry-accepted test procedure that provides means for testing and determining the cooling and heating capacities of room ACs and packaged terminal air conditioners (PTACs), using either a calorimeter method or air-enthalpy method. The proposed amendments in this NOPR include updated general references to ANSI/ASHRAE Standard 16–2016, that address all areas of testing including installation, test setup, instrumentation, test conduct, data collection, and calculations. ANSI/ASHRAE Standard 16–2016 is reasonably available at *https://webstore.ansi.org/.*

In this NOPR, DOE also proposes to incorporate by reference several test standards published by ASHRAE: ''Standard Method for Temperature Measurement,'' ANSI/ASHRAE Standard 41.1–2013, ''Standard Methods for Air Velocity and Airflow Measurement,'' ANSI/ASHRAE Standard 41.2–1987 (RA 1992), ''Standard Methods for Pressure Measurement,'' ANSI/ASHRAE Standard 41.3–2014, ''Standard Methods for Humidity Measurement,'' ANSI/ASHRAE Standard 41.6–2014, and ''Standard Methods for Power Measurement,'' ANSI/ASHRAE Standard 41.11–2014. These standards are industry-accepted test procedures that prescribe methods and instruments for measuring temperature, air velocity, pressure, humidity, and power, respectively. These standards are cited by ANSI/ASHRAE Standard 16–2016, which this NOPR proposes to incorporate by reference. These standards are reasonably available at *https://webstore.ansi.org/.*

In this NOPR, DOE also proposes to incorporate by reference the test standard IEC 62301, titled ''Household electrical appliances—Measurement of standby power,'' (Edition 2.0, 2011–01) for appendix F. IEC 62301 is an industry-accepted test standard that sets a standardized method to measure the standby power of household and similar electrical appliances and is already incorporated by reference for a number of other DOE test procedures. IEC Standard 62301 Second Edition includes details regarding test set-up, test conditions, and stability requirements that are necessary to ensure consistent and repeatable standby and off-mode test results. IEC Standard 62301 Second Edition is reasonably available at *https://webstore.iec.ch/* and *http://www.webstore.ansi.org.* The proposed amendments in this NOPR include updating general references to IEC 62301 from the First Edition to the

Second Edition and adopting a new standby power test approach.

V. Public Participation

A. Participation in the Webinar

The time and date of the webinar are listed in the **DATES** section at the beginning of this document. If no participants register for the webinar, then it will be cancelled.

Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's website: *http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41.* Participants are responsible for ensuring their systems are compatible with the webinar software.

Additionally, you may request an in-person meeting to be held prior to the close of the request period provided in the **DATES** section of this document. Requests for an in-person meeting may be made by contacting Appliance and Equipment Standards Program staff at (202) 287–1445 or by email: *Appliance_Standards_Public_Meetings@ee.doe.gov.*

B. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this proposed rule.

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

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

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

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

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

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

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

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

Confidential Business Information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery two well-marked copies: One copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email to *RoomAC2017TP0012@ee.doe.gov* or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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

C. Issues on Which DOE Seeks Comment

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

(1) The proposed amendments to the room AC definition in 10 CFR 430.2. (See section III.A of this document)

(2) The proposed new beginning section to appendix F that would explicitly state the scope of coverage. (See section III.A of this document)

(3) The proposal to incorporate by reference ANSI/AHAM RAC–1–2015, and to adjust the section references in appendix F, to more narrowly refer to the cooling mode-specific sections and to update the section reference for measuring electrical power input. (See section III.B.1 of this document)

(4) The proposal to reference the relevant sections of ANSI/ASHRAE Standard 16–2016 in appendix F. (See section III.B.2 of this document)

(5) The proposal to incorporate the requirements of ANSI/ASHRAE Standard 16–2016 while

maintaining that an accuracy of ±0.5 percent of the quantity measured is applicable to all devices measuring electrical input for the room AC test procedure. (See section III.B.2 of this document)

(6) The proposal to incorporate ANSI/ASHRAE Standard 41.1–2013, ANSI/ASHRAE Standard 41.2–1987 (RA 1992), ANSI/ASHRAE Standard 41.3–2014, ANSI/ASHRAE Standard 41.6–2014, and ANSI/ASHRAE Standard 41.11–2014 in appendix F. (See section III.B.3 of this document)

(7) The proposal to adopt the additional test conditions from the LG Waiver test procedure for variable-speed room ACs. (See section III.C.2 of this document)

(8) The proposal to require fixing the compressor speed settings for variable-speed room ACs to full speed at the 95 °F and 92 °F test conditions, intermediate speed at the 87 °F test condition, and low speed at the 82 °F test condition. (See section III.C.3.a of this document)

(9) The proposal to require that manufacturers provide the third-party lab with the control settings required to achieve the fixed compressor speed for each test condition. (See section III.C.3.b of this document)

(10) The proposal to not address boost compressor speed performance and energy consumption in appendix F at this time. (See section III.C.3.c of this document)

(11) The proposal to use the capacity and electrical power adjustment factors of 0.0099 per °F and 0.0076 per °F, respectively. (See section III.C.4 of this document)

(12) The proposal to implement cycling loss factors consistent with AHRI Standard 210/240 to represent the expected performance of a theoretical comparable single-speed room AC at reduced outdoor temperature test conditions. (See section III.C.5 of this document)

(13) The proposed weighting factors associated with each of the outdoor test conditions. (See section III.C.6 of this document)

(14) The proposed calculations to determine a performance adjustment factor, which would credit the CEER of variable-speed room ACs to account for their efficiency improvements relative to a theoretical comparable single-speed room AC under varying test conditions. (See section III.C.7 of this document)

(15) The proposal not to allow for an optional alternative air-enthalpy test approach for room ACs. (See section III.C.8 and section III.E.1.c of this document)

(16) The proposal to include compressor frequencies and control settings as additional product-specific information for certifications involving variable-speed room ACs in 10 CFR 429.15. (See section III.C.9 and section III.J of this document)

(17) The proposal to calculate estimated annual operating cost for variable-speed room ACs using a weighted-average annual energy consumption based on the four cooling mode test conditions in newly added Table 1 of appendix F. (See section III.C.10 of this document)

(18) The proposal to report variable-speed room AC input power for certification purposes using the value measured at the 95 °F rating condition. (See section III.C.10 of this document)

(19) The proposal to add new definitions for cooling mode, cooling capacity, combined energy efficiency ratio, single-speed room air conditioner, variable-speed room air conditioner, variable-speed compressor, full compressor speed (full), intermediate compressor speed (intermediate), and low compressor speed (low) in appendix F. (See section III.D of this document)

(20) The proposal to specify in appendix F that room ACs designed for through-the-wall installation (*i.e.,* non-louvered room ACs) must be installed using a compatible wall sleeve (per manufacturer instructions), with the provided or manufacturer-required rear grille, and with the included trim frame and other manufacturer-provided installation materials. (See section III.E.1.d of this document)

(21) The proposal, consistent with ANSI/ASHRAE Standard 16–2016, Sections 6.1.1.4 and Section 8.4.2, to not require that room ACs designed for window installation (*i.e.,* louvered room ACs) be installed with the manufacturer-provided installation materials, including side curtains, and instead be tested with the partition wall sealed to the unit. (See section III.E.1.d of this document)

(22) The proposal to not include additional cooling mode test conditions for single-speed room ACs. (See section III.E.1.e of this document)

(23) The proposal to not establish requirements for measuring and reporting the power factors for room ACs. (See section III.E.1.f of this document)

(24) The proposal to not establish a heating mode test procedure for room ACs at this time. (See section III.E.2 of this document)

(25) The proposal to not establish a definition or test procedure for off-cycle mode. (See section III.E.3 of this document)

(26) The proposal to incorporate provisions from IEC Standard 62301 Second Edition for measuring standby mode and off mode power. (See section III.F of this document)

(27) The proposal to reference the power equipment specifications from Section 4.4 of IEC Standard 62301 Second Edition for determining standby mode and off mode power in appendix F. (See section III.F.1.a of this document)

(28) The proposal to adopt and reference the sampling method from Section 5.3.2 of IEC Standard 62301 Second Edition to determine standby mode and off mode average power in appendix F. (See section III.F.1.b of this document)

(29) The proposal to specify that all network or connectivity settings must be disabled during testing. (See section III.G of this document)

(30) The proposal to not amend the DOE test procedure for room ACs to consider energy consumption while a connected room AC responds to a DR signal. (See section III.H of this document)

(31) The proposal to maintain the current CEER calculations for single-speed room ACs at this time. (See section III.I of this document)

(32) The proposed rounding instructions in appendix F for cooling capacity, electrical input power, and CEER and to adjust the estimated annual operating cost calculation to reference the annual energy consumption for each operating mode as calculated in appendix F. (See section III.K of this document)

(33) The understanding of the estimated impact and associated costs to room AC manufacturers of the proposed amendment to test variable-speed room ACs. (See section III.L.1.a of this document)

(34) The degree to which the DOE test procedure should consider and be harmonized further with the most recent relevant industry standards for room ACs and whether any changes to the Federal test method would provide additional benefits

to the public. (See section III.L.2 of this document)

(35) The benefits and burdens of adopting any industry or voluntary consensus-based or other appropriate test procedure, without modification. (See section III.L.2 of this document)

(36) Whether the industry is considering updating its standards for room AC testing to include provisions for testing variable-speed room ACs. (See section III.L.2 of this document)

(37) Any other aspect of the existing test procedure for room ACs not already addressed by the specific areas identified in this document. (See section III.L.3 of this document)

(38) The finding that there are no small businesses that manufacture room ACs. (See section IV.C of this document)

VI. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

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

10 CFR Part 430

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

Signing Authority

This document of the Department of Energy was signed on April 30, 2020, by Alexander N. Fitzsimmons, Deputy Assistant Secretary for Energy Efficiency, 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 May 20, 2020.

Treena V. Garrett,

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

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

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

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

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

■ 2. Section 429.15 is amended by:

■ a. Removing the words ‘‘energy efficiency ratio’’ in paragraph (a)(2)(ii) and adding, in its place the words ‘‘combined energy efficiency ratio (CEER) (determined in § 430.23(f)(3) for each unit in the sample)’’;

■ b. Adding paragraphs (a)(3), (4) and (5);

■ c. Revising paragraph (b)(2); and

■ d. Adding paragraph (b)(3).

The revision and additions read as follows:

§ 429.15 Room air conditioners.

(a) * * *

(3) The cooling capacity of a basic model is the mean of the measured cooling capacities for each tested unit of the basic model, as determined in § 430.23(f)(1) of this chapter. Round the cooling capacity value to the nearest hundred.

(4) The electrical power input of a basic model is the mean of the measured electrical power inputs for each tested unit of the basic model, as determined in § 430.23(f)(2) of this chapter. Round the electrical power input to the nearest ten.

(5) Round the value of CEER for a basic model to one decimal place.

(b) * * *

(2) Pursuant to § 429.12(b)(13), a certification report shall include the following public product-specific information: The combined energy efficiency ratio in British thermal units per Watt-hour (Btu/Wh)), cooling capacity in British thermal units per hour (Btu/h), and the electrical power input in watts (W).

(3) Pursuant to § 429.12(b)(13), a certification report for a variable-speed room air conditioner basic model must include supplemental information and instructions in PDF format that include—

(i) The mean measured cooling capacity for the units tested at each additional test condition (*i.e.,* respectively, the mean of $Capacity_2$, $Capacity_3$, and $Capacity_4$, each expressed in Btu/h and rounded to the nearest 100 Btu/h, as determined in accordance with section 4.1.2 of appendix F of subpart B of part 430 of this chapter);

(ii) The mean electrical power input at each additional test condition (respectively, the mean of $Power_2$, $Power_3$, and $Power_4$, each expressed in W and rounded to the nearest 10 W, in accordance with section 4.1.2 of appendix F of subpart B of part 430 of this chapter, for test conditions 2, 3, and 4, in Table 1 of appendix F of subpart B of part 430 of this chapter); and

(iii) All additional testing and testing set up instructions (*e.g.,* specific operational or control codes or settings) necessary to operate the basic model under the required conditions specified by the relevant test procedure.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 4. Section 430.2 is amended by revising the definition of ‘‘Room air conditioner’’ to read as follows:

§ 430.2 Definitions.

* * * * *

Room air conditioner means a window-mounted or through-the-wall-mounted encased assembly, other than a ‘‘packaged terminal air conditioner,’’ that delivers cooled, conditioned air to an enclosed space, and is powered by single-phase electric current. It includes a source of refrigeration and may include additional means for ventilating and heating.

* * * * *

■ 5. Section 430.3 is amended by:

■ a. Revising paragraph (g)(1);

■ b. In paragraph (g)(6), removing, ‘‘appendix X1’’, and adding in its place, ‘‘appendices F and X1’’;

■ c. Redesignating paragraphs (g)(11) through (14) as (g)(15) through (18), respectively;

■ d. Redesignating paragraphs (g)(9) as (g)(12), and (g)(10) as (g)(13);

■ e. Redesignating paragraph (g)(8) as (g)(9);

■ f. Adding new paragraphs (g)(8), (10), (11), and (14);

■ g. Revising paragraph (i)(6);

■ g. In paragraph (p)(5), removing ‘‘appendix F and’’; and

■ h. In paragraph (p)(6), adding ''F,'' before ''G''.

The revisions and additions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(g) * * *

(1) ANSI/ASHRAE Standard 16–2016 (''ANSI/ASHRAE 16''), Method of Testing for Rating Room Air Conditioners, Packaged Terminal Air Conditioners, and Packaged Terminal Heat Pumps for Cooling and Heating Capacity, ASHRAE approved October 31, 2016, ANSI approved November 1, 2016, IBR approved for appendix F to subpart B.

* * * * *

(8) ANSI/ASHRAE Standard 41.2–1987 (RA 1992), (''ASHRAE 41.2–1987 (RA 1992)''), Standard Methods for Laboratory Airflow Measurement, ANSI reaffirmed April 20, 1992, IBR approved for appendix F to subpart B.

* * * * *

(10) ANSI/ASHRAE Standard 41.3–2014, (''ASHRAE 41.3–2014''), Standard Methods for Pressure Measurement, ANSI approved July 3, 2014, IBR approved for appendix F to subpart B.

(11) ANSI/ASHRAE Standard 41.6–2014, (''ASHRAE 41.6–2014''), Standard Method for Humidity Measurement, ANSI approved July 3, 2014, IBR approved for appendix F to subpart B.

* * * * *

(14) ANSI/ASHRAE Standard 41.11–2014, (''ASHRAE 41.11–2014''), Standard Methods for Power Measurement, ANSI approved July 3, 2014, IBR approved for appendix F to subpart B.

* * * * *

(i) * * *

(6) ANSI/AHAM RAC–1–2015 (''ANSI/AHAM RAC–1''), Room Air Conditioners, approved 2015, IBR approved for appendix F to subpart B of this part.

* * * * *

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

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

* * * * *

(f) *Room air conditioners.* (1) Determine cooling capacity, expressed in British thermal units per hour (Btu/h), with the results of the test rounded to the nearest 100 Btu/h, as follows:

(i) For a single-speed room air conditioner, determine the cooling capacity in accordance with section 4.1.2 of appendix F of this subpart.

(ii) For a variable-speed room air conditioner, determine the cooling capacity in accordance with section 4.1.2 of appendix F of this subpart for test condition 1 in Table 1 of appendix F of this subpart.

(2) Determine electrical power input, expressed in watts (W) and rounded to the nearest 10 W as follows:

(i) For a single-speed room air conditioner, determine the electrical power input in accordance with section 4.1.2 of appendix F of this subpart.

(ii) For a variable-speed room air conditioner, determine the electrical power input in accordance with section 4.1.2 of appendix F of this subpart, for test condition 1 in Table 1 of appendix F of this subpart.

(3) Determine the combined energy efficiency ratio (CEER), expressed in British thermal units per watt-hour (Btu/Wh) and rounded to the nearest 0.1 Btu/Wh as follows:

(i) For a single-speed room air conditioner, determine the CEER in accordance with section 5.2.2 of appendix F of this subpart.

(ii) For a variable-speed room air conditioner, determine the CEER in accordance with section 5.3.11 of appendix F of this subpart.

(4) Determine the estimated annual operating cost for a room air conditioner, expressed in dollars per year, by multiplying the following two factors and rounding as directed:

(i) For single-speed room air conditioners, the sum of AEC_{cool} and $AEC_{ia/om}$, determined in accordance with section 5.2.1 and section 5.1, respectively, of appendix F of this subpart. For variable-speed room air conditioners, the sum of AEC_{wt} and $AEC_{ia/om}$, determined in accordance with section 5.3.4 and section 5.1, respectively, of appendix F of this subpart; and

(ii) A representative average unit cost of electrical energy in dollars per kilowatt-hour as provided by the Secretary. Round the resulting product to the nearest dollar per year.

* * * * *

■ 7. Appendix F to subpart B of part 430 is revised to read as follows:

Appendix F to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Room Air Conditioners

Note: On or after [DATE 180 DAYS AFTER DATE OF PUBLICATION OF THE FINAL RULE IN THE **FEDERAL REGISTER**], any representations made with respect to the energy use or efficiency of room air conditioners must be made in accordance with the results of testing pursuant to this appendix.

Prior to [DATE 180 DAYS AFTER DATE OF PUBLICATION OF THE FINAL RULE IN THE **FEDERAL REGISTER**], manufacturers must either test room air conditioners in accordance with this appendix, or the previous version of this appendix as it appeared in the Code of Federal Regulations on January 1, 2020. DOE notes that, because representations made on or after [DATE 180 DAYS AFTER DATE OF PUBLICATION OF THE FINAL RULE IN THE **FEDERAL REGISTER**] must be made in accordance with this appendix, manufacturers may wish to begin using this test procedure immediately.

0. Incorporation by Reference

DOE incorporated by reference the entire standard for ANSI/AHAM RAC–1, ANSI/ASHRAE 16, ANSI/ASHRAE 41.1, ASHRAE 41.2–1987 (RA 1992), ASHRAE 41.3–2014, ASHRAE 41.6–2014, ASHRAE 41.11–2014, and IEC 62301 in § 430.3. However, only enumerated provisions of ANSI/AHAM RAC–1 and ANSI/ASHRAE 16 apply to this appendix, as follows:

(1) ANSI/AHAM RAC–1:

(i) Section 4—Testing Conditions, Section 4.1—General, using ANSI/ASHRAE 16–2016 in place of ANSI/ASHRAE 16–1983 (RA 2014)

(ii) Section 5—Standard Measurement Test, Section 5.2—Standard Test Conditions: 5.2.1.1

(iii) Section 6—Performance Tests—Cooling Units, Section 6.1—Cooling Capacity Test, using ANSI/ASHRAE 16–2016 in place of ANSI/ASHRAE 16–1983 (RA 2014)

(iv) Section 6—Performance Tests—Cooling Units, Section 6.2—Electrical Input Test, using ANSI/ASHRAE 16–2016 in place of ANSI/ASHRAE 16–1983 (RA 2014)

(2) ANSI/ASHRAE 16:

(i) Section 3—Definitions

(ii) Section 5—Instruments

(iii) Section 6—Apparatus, Section 6.1—Calorimeters, Sections 6.1.1–6.1.1., 6.1.1.3a, 6.1.1.4–6.1.4, including Table 1

(iv) Section 7—Methods of Testing, Section 7.1—Standard Test Methods, Section 7.1a, 7.1.1a

(v) Section 8—Test Procedures, Section 8.1—General

(vi) Section 8—Test Procedures, Section 8.2—Test Room Requirements

(viii) Section 8—Test Procedures, Section 8.3—Air Conditioner Break-In

(ix) Section 8—Test Procedures, Section 8.4—Air Conditioner Installation

(x) Section 8—Test Procedures, Section 8.5—Cooling Capacity Test

(xi) Section 9—Data To Be Recorded, Section 9.1

(xii) Section 10—Measurement Uncertainty

(xiii) Normative Appendix A Cooling Capacity Calculations—Calorimeter Test Indoor and Calorimeter Test Outdoor

If there is any conflict between any industry standard(s) and this appendix, follow the language of the test procedure in this appendix, disregarding the conflicting industry standard language.

1. Scope

This appendix contains the test requirements to measure the energy performance of a room air conditioner.

2. Definitions

2.1 ''Active mode'' means a mode in which the room air conditioner is connected to a mains power source, has been activated and is performing any of the following functions: Cooling or heating the conditioned space, or circulating air through activation of its fan or blower, with or without energizing active air-cleaning components or devices such as ultra-violet (UV) radiation, electrostatic filters, ozone generators, or other air-cleaning devices.

2.2 ''ANSI/AHAM RAC–1'' means the test standard published jointly by the American National Standards Institute and the Association of Home Appliance Manufacturers, titled ''Room Air Conditioners,'' Standard RAC–1–2015 (incorporated by reference; see § 430.3).

2.3 ''ANSI/ASHRAE 16'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners,'' Standard 16–2016 (incorporated by reference; see § 430.3).

2.4 ''ANSI/ASHRAE 41.1'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Standard Method for Temperature Measurement,'' Standard 41.1–2013 (incorporated by reference; see § 430.3).

2.5 ''ASHRAE 41.2–1987 (RA 1992)'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Standard Methods for Laboratory Airflow Measurement,'' Standard 41.2–1987 (RA 1992) (incorporated by reference; see § 430.3).

2.6 ''ASHRAE 41.3–2014'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Standard Methods for Pressure Measurement,'' Standard 41.3–2014 (incorporated by reference; see § 430.3).

2.7 ''ASHRAE 41.6–2014'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Standard Method for Humidity Measurement,'' Standard 41.6–2014 (incorporated by reference; see § 430.3).

2.8 ''ASHRAE 41.11–2014'' means the test standard published jointly by the American National Standards Institute and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled ''Standard Methods for Power Measurement,'' Standard 41.11–2014 (incorporated by reference; see § 430.3).

2.9 ''Combined energy efficiency ratio'' means the energy efficiency of a room air conditioner in British thermal units per watt-hour (Btu/Wh) and determined in section 5.2.2 of this appendix for single-speed room air conditioners and section 5.3.12 of this appendix for variable-speed room air conditioners.

2.10 ''Cooling capacity'' means the amount of cooling, in British thermal units per hour (Btu/h), provided to a conditioned space, measured under the specified conditions and determined in section 4.1 of this appendix.

2.11 ''Cooling mode'' means an active mode in which a room air conditioner has activated the main cooling function according to the thermostat or temperature sensor signal or switch (including remote control).

2.12 ''Full compressor speed (full)'' means the compressor speed at which the unit operates at full load testing conditions, achieved by following the instructions certified by the manufacturer.

2.13 ''IEC 62301'' means the test standard published by the International Electrotechnical Commission, titled ''Household electrical appliances—Measurement of standby power,'' Publication 62301 (Edition 2.0 2011–01), (incorporated by reference; see § 430.3).

2.14 ''Inactive mode'' means a standby mode that facilitates the activation of active mode by remote switch (including remote control) or internal sensor or which provides continuous status display.

2.15 ''Intermediate compressor speed (intermediate)'' means the compressor speed higher than the low compressor speed by one third of the difference between low compressor speed and full compressor speed with a tolerance of plus 5 percent (designs with non-discrete speed stages) or the next highest inverter frequency step (designs with discrete speed steps), achieved by following the instructions certified by the manufacturer.

2.16 ''Low compressor speed (low)'' means the compressor speed at which the unit operates at low load test conditions, achieved by following the instructions certified by the manufacturer, such that $Capacity_4$, the measured cooling capacity at test condition 4 in Table 1 of this appendix, is no less than 47 percent and no greater than 57 percent of $Capacity_1$, the measured cooling capacity with the full compressor speed at test condition 1 in Table 1 of this appendix.

2.17 ''Off mode'' means a mode in which a room air conditioner is connected to a mains power source and is not providing any active or standby mode function and where the mode may persist for an indefinite time, including an indicator that only shows the user that the product is in the off position.

2.18 ''Single-speed room air conditioner'' means a type of room air conditioner that cannot automatically adjust the compressor speed based on detected conditions.

2.19 ''Standby mode'' means any product mode where the unit is connected to a mains power source and offers one or more of the following user-oriented or protective functions which may persist for an indefinite time:

(a) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer. A timer is a continuous clock function (which may or may not be associated with a display) that provides regular scheduled tasks (*e.g.,* switching) and that operates on a continuous basis.

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

2.20 ''Theoretical comparable single-speed room air conditioner'' means a theoretical single-speed room air conditioner with the same cooling capacity and electrical power input as the variable-speed room air conditioner under test, with no cycling losses considered, at test condition 1 in Table 1 of this appendix.

2.21 ''Variable-speed compressor'' means a compressor that can vary its rotational speed in non-discrete stages or discrete steps from low to full.

2.22 ''Variable-speed room air conditioner'' means a type of room air conditioner that can automatically adjust compressor speed based on detected conditions.

3. Test Methods and General Instructions

3.1 *Cooling mode.* The test method for testing room air conditioners in cooling mode (''cooling mode test'') consists of applying the methods and conditions in ANSI/AHAM RAC–1 Section 4, Paragraph 4.1 and Section 5, Paragraph 5.2.1.1, except in accordance with ANSI/ASHRAE 16, including the references to ANSI/ASHRAE 41.1, ANSI/ASHRAE 41.2–1987 (RA 1992), ANSI/ASHRAE 41.3–2014, ANSI/ASHRAE 41.6–2014, and ANSI/ASHRAE 41.11–2014, all referenced therein, as defined in sections 2.3 through 2.8 of this appendix. Use the cooling capacity simultaneous indoor calorimeter and outdoor calorimeter test method in Section 7.1.a and Sections 8.1 through 8.5 of ANSI/ASHRAE 16, except as otherwise specified in this appendix. If a unit can operate on multiple operating voltages as distributed in commerce by the manufacturer, test it and rate the corresponding basic models at all nameplate operating voltages. For a variable-speed room air conditioner, test the unit following the cooling mode test a total of four times: One test at each of the test conditions listed in Table 1 of this appendix, consistent with section 4.1 of this appendix.

3.1.1 *Through-the-wall installation.* Install a non-louvered room air conditioner inside a compatible wall sleeve with the provided or manufacturer-required rear grille, and with the included trim frame and other manufacturer-provided installation materials, per manufacturer instructions provided to consumers.

3.1.2 *Power measurement accuracy.* All instruments used for measuring electrical inputs to the test unit, reconditioning equipment, and any other equipment that operates within the calorimeter walls must be accurate to ±0.5 percent of the quantity measured.

3.1.3 *Electrical supply.* For cooling mode testing, test at each nameplate operating voltage, and maintain the input standard voltage within ±1 percent. Test at the rated frequency, maintained within ±1 percent.

3.1.4 *Control settings.* If the room air conditioner has network capabilities, the network settings must be disabled throughout testing.

3.1.5 *Measurement resolution.* Record measurements at the resolution of the test instrumentation.

3.1.6 *Temperature tolerances.* Maintain each of the measured chamber dry-bulb and wet-bulb temperatures within a range of 1.0 °F.

3.2 *Standby and off modes.*

3.2.1 Install the room air conditioner in accordance with section 5, paragraph 5.2 of IEC 62301 and maintain the indoor test conditions (and outdoor test conditions where applicable) as required by section 4, paragraph 4.2 of IEC 62301. If testing is not conducted in a facility used for testing cooling mode performance, the test facility must comply with section 4, paragraph 4.2 of IEC 62301.

3.2.2 *Electrical supply.* For standby mode and off mode testing, test at each nameplate operating voltage, and maintain the input standard voltage within ±1 percent. Maintain the electrical supply at the rated frequency ±1 percent.

3.2.3 *Supply voltage waveform.* For the standby mode and off mode testing, maintain the electrical supply voltage waveform indicated in section 4, paragraph 4.3.2 of IEC 62301.

3.2.4 *Wattmeter.* The wattmeter used to measure standby mode and off mode power consumption must meet the resolution and accuracy requirements in Section 4, Paragraph 4.4 of IEC 62301.

3.2.5 *Air ventilation damper.* If the unit is equipped with an outdoor air ventilation damper, close this damper during standby mode and off mode testing.

4. Test Conditions and Measurements

4.1 *Cooling mode.*

4.1.1 *Temperature conditions.* Establish the test conditions described in sections 4 and 5 of ANSI/AHAM RAC–1 and in accordance with ANSI/ASHRAE 16, including the references to ANSI/ASHRAE 41.1 and ANSI/ASHRAE 41.6–2014, for cooling mode testing, with the following exceptions for variable-speed room air conditioners: Conduct the set of four cooling mode tests with the test conditions presented in Table 1 of this appendix. Set the compressor speed required for each test condition in accordance with instructions the manufacturer provided to DOE.

TABLE 1—INDOOR AND OUTDOOR INLET AIR TEST CONDITIONS—VARIABLE-SPEED ROOM AIR CONDITIONERS

Test condition	Evaporator inlet (indoor) air, °F		Condenser inlet (outdoor) air, °F		Compressor speed
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	
Test Condition 1	80	67	95	75	Full
Test Condition 2	80	67	92	72.5	Full
Test Condition 3	80	67	87	69	Intermediate
Test Condition 4	80	67	82	65	Low

4.1.2 *Cooling capacity and power measurements.* For single-speed units, measure the cooling mode cooling capacity (expressed in Btu/h), Capacity, and electrical power input (expressed in watts), P_{cool}, in accordance with section 6, paragraphs 6.1 and 6.2 of ANSI/AHAM RAC–1, respectively, and in accordance with ANSI/ASHRAE 16, including the references to ANSI/ASHRAE 41.2–1987 (RA 1992) and ANSI/ASHRAE 41.11–2014. For variable-speed room air conditioners, measure the condition-specific cooling capacity (expressed in Btu/h), $Capacity_{tc}$, and electrical power input (expressed in watts), P_{tc}, for each of the four cooling mode rating test conditions (tc), as required in section 6, paragraphs 6.1 and 6.2, respectively, of ANSI/AHAM RAC–1, respectively, and in accordance with ANSI/ASHRAE 16, including the references to ANSI/ASHRAE 41.2–1987 (RA 1992) and ANSI/ASHRAE 41.11–2014.

4.2 *Standby and off modes.* Establish the testing conditions set forth in section 3.2 of this appendix, ensuring the unit does not enter any active mode during the test. For a unit that drops from a higher power state to a lower power state as discussed in section 5, paragraph 5.1, Note 1 of IEC 62301, allow sufficient time for the room air conditioner to reach the lower power state before proceeding with the test measurement. Use the sampling method test procedure specified in section 5, paragraph 5.3.2 of IEC 62301 for testing all standby and off modes, with the following modifications: allow the product to stabilize for 5 to 10 minutes and use an energy use measurement period of 5 minutes.

4.2.1 If the unit has an inactive mode, as defined in section 2.14 of this appendix, as defined in section 2.17 of this appendix, measure and record the average inactive mode power, P_{ia}, in watts.

4.2.2 If the unit has an off mode, as defined in section 2.17 of this appendix, measure and record the average off mode power, P_{om}, in watts.

5. Calculations

5.1 *Annual energy consumption in inactive mode and off mode.* Calculate the annual energy consumption in inactive mode and off mode, $AEC_{ia/om}$, expressed in kilowatt-hours per year (kWh/year).

$$AEC_{iaom} = P_{ia} \times t_{ia} + P_{om} + t_{om}$$

Where:

$AEC_{ia/om}$ = annual energy consumption in inactive mode and off mode, in kWh/year.

P_{ia} = average power in inactive mode, in watts, determined in section 4.2 of this appendix.

P_{om} = average power in off mode, in watts, determined in section 4.2 of this appendix.

t_{ia} = annual operating hours in inactive mode and multiplied by a 0.001 kWh/Wh conversion factor from watt-hours to kilowatt-hours. This value is 5.115 kWh/W if the unit has inactive mode and no off mode, 2.5575 kWh/W if the unit has both inactive and off mode, and 0 kWh/W if the unit does not have inactive mode.

t_{om} = annual operating hours in off mode and multiplied by a 0.001 kWh/Wh conversion factor from watt-hours to kilowatt-hours. This value is 5.115 kWh/W if the unit has off mode and no inactive mode, 2.5575 kWh/W if the unit has both inactive and off mode, and 0 kWh/W if the unit does not have off mode.

5.2 *Combined energy efficiency ratio for single-speed room air conditioners.* Calculate the combined energy efficiency ratio for single-speed room air conditioners as follows:

5.2.1 *Single-speed room air conditioner annual energy consumption in cooling mode.* Calculate the annual energy consumption in cooling mode for a single-speed room air conditioner, AEC_{cool}, expressed in kWh/year.

$$AEC_{cool} = 0.75 \times P_{cool}$$

Where:

AEC_{cool} = single-speed room air conditioner annual energy consumption in cooling mode, in kWh/year.

P_{cool} = single-speed room air conditioner average power in cooling mode, in watts, determined in section 4.1.2 of this appendix.

0.75 is 750 annual operating hours in cooling mode multiplied by a 0.001 kWh/Wh conversion factor from watt-hours to kilowatt-hours.

5.2.2 *Single-speed room air conditioner combined energy efficiency ratio.* Calculate the combined energy efficiency ratio, CEER, expressed in Btu/Wh, as follows:

$$CEER = \left[\frac{Capacity}{\left(\frac{AEC_{cool} + AEC_{ia/om}}{0.75}\right)}\right]$$

Where:

CEER = combined energy efficiency ratio, in Btu/Wh.

Capacity = single-speed room air conditioner cooling capacity, in Btu/h, determined in section 4.1.2 of this appendix.

AEC_{cool} = single-speed room air conditioner annual energy consumption in cooling mode, in kWh/year, calculated in section 5.2.1 of this appendix.

$AEC_{ia/om}$ = annual energy consumption in inactive mode or off mode, in kWh/year, calculated in section 5.1 of this appendix.

0.75 as defined in section 5.2.1 of this appendix.

5.3 *Combined energy efficiency ratio for variable-speed room air conditioners.* Calculate the combined energy efficiency ratio for variable-speed room air conditioners as follows:

5.3.1 *Weighted electrical power input.* Calculate the weighted electrical power input in cooling mode, P_{wt}, expressed in watts, as follows:

$$P_{wt} = \sum_{tc} P_{tc} \times W_{tc}$$

Where:

P_{wt} = weighted electrical power input, in watts, in cooling mode.

P_{tc} = electrical power input, in watts, in cooling mode for each test condition in Table 1 of this appendix.

W_{tc} = weighting factors for each cooling mode test condition: 0.05 for test condition 1, 0.16 for test condition 2, 0.31 for test condition 3, and 0.48 for test condition 4.

tc represents the cooling mode test condition: ‘‘1’’ for test condition 1 (95 °F condenser inlet dry-bulb temperature), ‘‘2’’ for test condition 2 (92 °F), ‘‘3’’ for test condition 3 (87 °F), and ‘‘4’’ for test condition 4 (82 °F).

5.3.2 *Theoretical comparable single-speed room air conditioner.* Calculate the cooling capacity, expressed in Btu/h, and the electrical power input, expressed in watts, for a theoretical comparable single-speed room air conditioner at all cooling mode test conditions.

$Capacity_{ss\_tc} = Capacity_1 \times (1 + (M_c \times (95 - T_{tc})))$

$P_{ss\_tc} = P_1 \times (1 - (M_p \times (95 - T_{tc})))$

Where:

$Capacity_{ss\_tc}$ = theoretical comparable single-speed room air conditioner cooling capacity, in Btu/h, calculated for each of the cooling mode test conditions in Table 1 of this appendix.

$Capacity_1$ = variable-speed room air conditioner unit's cooling capacity, in Btu/h, determined in section 4.1.2 of this appendix for test condition 1 in Table 1 of this appendix.

P_{ss_tc} = theoretical comparable single-speed room air conditioner electrical power input, in watts, calculated for each of the cooling mode test conditions in Table 1 of this appendix.

P_1 = variable-speed room air conditioner unit's electrical power input, in watts, determined in section 4.1.2 of this appendix for test condition 1 in Table 1 of this appendix.

M_c = adjustment factor to determine the increased capacity at lower outdoor test conditions, 0.0099 per °F.

M_p = adjustment factor to determine the reduced electrical power input at lower outdoor test conditions, 0.0076 per °F.

95 is the condenser inlet dry-bulb temperature for test condition 1 in Table 1 of this appendix, 95 °F.

T_{tc} = condenser inlet dry-bulb temperature for each of the test conditions in Table 1 of this appendix (in °F).

tc as explained in section 5.3.1 of this appendix.

5.3.3 *Variable-speed room air conditioner unit's annual energy consumption for cooling mode at each cooling mode test condition.* Calculate the annual energy consumption for cooling mode under each test condition, AEC_{tc}, expressed in kilowatt-hours per year (kWh/year), as follows:

$AEC_{tc} = 0.75 \times P_{tc}$

Where:

AEC_{tc} = variable-speed room air conditioner unit's annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1 of this appendix.

P_{tc} = as defined in section 5.3.1 of this appendix.

0.75 as defined in section 5.2.1 of this appendix.

tc as explained in section 5.3.1 of this appendix.

5.3.4 *Variable-speed room air conditioner weighted annual energy consumption.* Calculate the weighted annual energy consumption in cooling mode for a variable-speed room air conditioner, AEC_{wt}, expressed in kWh/year.

$AEC_{wt} = \Sigma_{tc} AEC_{tc} \times W_{tc}$

Where:

AEC_{wt} = weighted annual energy consumption in cooling mode for a variable-speed room air conditioner, expressed in kWh/year.

AEC_{tc} = variable-speed room air conditioner unit's annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1 of this appendix, determined in section 5.3.3 of this appendix.

W_{tc} = weighting factors for each cooling mode test condition: 0.05 for test condition 1, 0.16 for test condition 2, 0.31 for test condition 3, and 0.48 for test condition 4.

tc as explained in section 5.3.1 of this appendix.

5.3.5 *Theoretical comparable single-speed room air conditioner annual energy consumption in cooling mode at each cooling mode test condition.* Calculate the annual energy consumption in cooling mode for a theoretical comparable single-speed room air conditioner for cooling mode under each test condition, AEC_{ss_tc}, expressed in kWh/year.

$AEC_{ss\_tc} = 0.75 \times P_{ss\_tc}$

Where:

AEC_{ss_tc} = theoretical comparable single-speed room air conditioner annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1 of this appendix.

P_{ss_tc} = theoretical comparable single-speed room air conditioner electrical power input, in watts, in cooling mode for each test condition in Table 1 of this appendix, determined in section 5.3.2 of this appendix.

0.75 as defined in section 5.2.1 of this appendix.

tc as explained in section 5.3.1 of this appendix.

5.3.6 *Variable-speed room air conditioner combined energy efficiency ratio at each cooling mode test condition.* Calculate the variable-speed room air conditioner unit's combined energy efficiency ratio, $CEER_{tc}$, for each test condition, expressed in Btu/Wh.

$$CEER_{tc} = \frac{Capacity_{tc}}{\left(\frac{AEC_{tc} + AEC_{ia/om}}{0.75}\right)}$$

Where:

$CEER_{tc}$ = variable-speed room air conditioner unit's combined energy efficiency ratio, in Btu/Wh, for each test condition in Table 1 of this appendix.

$Capacity_{tc}$ = variable-speed room air conditioner unit's cooling capacity, in Btu/h, for each test condition in Table 1 of this appendix, determined in section 4.1.2 of this appendix.

AEC_{tc} = variable-speed room air conditioner unit's annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1 of this appendix, determined in section 5.3.3 of this appendix.

$AEC_{ia/om}$ = annual energy consumption in inactive mode of off mode, in kWh/year, determined in section 5.1 of this appendix.

0.75 as defined in section 5.2.1 of this appendix.

tc as explained in section 5.3.1 of this appendix.

5.3.7 *Theoretical comparable single-speed room air conditioner combined energy efficiency ratio.* Calculate the combined energy efficiency ratio for a theoretical comparable single-speed room air conditioner, $CEER_{ss\_tc}$, for each test condition, expressed in Btu/Wh.

$$CEER_{ss\_tc} = \frac{Capacity_{ss\_tc}}{\left(\frac{AEC_{ss\_tc} + AEC_{ia/om}}{0.75}\right)}$$

Where:

$CEER_{ss\_tc}$ = theoretical comparable single-speed room air conditioner combined energy efficiency ratio, in Btu/Wh, for each test condition in Table 1 of this appendix.

$Capacity_{ss\_tc}$ = theoretical comparable single-speed room air conditioner cooling capacity, in Btu/h, for each test condition in Table 1 of this appendix, determined in section 5.3.2 of this appendix.

AEC_{ss_tc} = theoretical comparable single-speed room air conditioner annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1 of this appendix, determined in section 5.3.5 of this appendix.

$AEC_{ia/om}$ = annual energy consumption in inactive mode or off mode, in kWh/year, determined in section 5.1 of this appendix.

0.75 as defined in section 5.2.1 of this appendix.

tc as explained in section 5.3.1 of this appendix.

5.3.8 *Theoretical comparable single-speed room air conditioner adjusted combined energy efficiency ratio.* Calculate the adjusted combined energy efficiency ratio, for a theoretical comparable single-speed room air conditioner, $CEER_{ss\_tc\_adj}$, with cycling losses considered, for each test condition, expressed in Btu/Wh.

$CEER_{ss\_tc\_adj} = CEER_{ss\_tc}$ $\mathrm{CEER}_{tc} \times CLF_{tc}$

Where:

$CEER_{ss\_tc\_adj}$ = theoretical comparable single-speed room air conditioner adjusted combined energy efficiency ratio, in Btu/Wh, for each test condition in Table 1 of this appendix.

$CEER_{ss\_tc}$ = theoretical comparable single-speed room air conditioner combined energy efficiency ratio, in Btu/Wh, for each test condition in Table 1 of this appendix, determined in section 5.3.7 of this appendix.

CLF_{tc} = cycling loss factor for each test condition; 1 for test condition 1, 0.971 for test condition 2, 0.923 for test condition 3, and 0.875 for test condition 4.

tc as explained in section 5.3.1 of this appendix.

5.3.9 *Weighted combined energy efficiency ratio.* Calculate the weighted combined energy efficiency ratio for the variable-speed room air conditioner unit, $CEER_{wt}$, and theoretical comparable single-speed room air conditioner, $CEER_{ss\_wt}$, expressed in Btu/Wh.

$CEER_{wt} = \Sigma_{tc} CEER_{tc} \times W_{tc}$

$CEER_{ss\_wt} = \Sigma_{tc} CEER_{ss\_tc\_adj} \times W_{tc}$

Where:

$CEER_{wt}$ = variable-speed room air conditioner unit's weighted combined energy efficiency ratio, in Btu/Wh.

$CEER_{ss\_wt}$ = theoretical comparable single-speed room air conditioner weighted combined energy efficiency ratio, in Btu/Wh.

$CEER_{tc}$ = variable-speed room air conditioner unit's combined energy efficiency ratio, in Btu/Wh, at each test condition in Table 1 of this appendix, determined in section 5.3.6 of this appendix.

$CEER_{ss\_tc\_adj}$ = theoretical comparable single-speed room air conditioner adjusted combined energy efficiency ratio, in Btu/Wh, at each test condition in Table 1 of this appendix, determined in section 5.3.8 of this appendix.

W_{tc} as defined in section 5.3.4 of this appendix.

tc as explained in section 5.3.1 of this appendix.

5.3.10 *Variable-speed room air conditioner performance adjustment factor.* Calculate the variable-speed room air conditioner unit's performance adjustment factor, F_p.

$$F_p = \frac{\left(CEER_{wt} - CEER_{ss\_wt}\right)}{CEER_{ss\_wt}}$$

Where:

F_p = variable-speed room air conditioner unit's performance adjustment factor.

$CEER_{wt}$ = variable-speed room air conditioner unit's weighted combined energy efficiency ratio, in Btu/Wh, determined in section 5.3.9 of this appendix.

$CEER_{ss\_wt}$ = theoretical comparable single-speed room air conditioner weighted combined energy efficiency ratio, in Btu/Wh, determined in section 5.3.9 of this appendix.

5.3.11 *Variable-speed room air conditioner combined energy efficiency ratio.* Calculate the combined energy efficiency ratio, CEER, expressed in Btu/Wh, for variable-speed air conditioners.

$CEER = CEER_1 \times (1 + F_p)$

Where:

CEER = combined energy efficiency ratio, in Btu/Wh.

$CEER_1$ = variable-speed room air conditioner combined energy efficiency ratio for test condition 1 in Table 1 of this appendix, in Btu/Wh, determined in section 5.3.6 of this appendix.

F_p = variable-speed room air conditioner performance adjustment factor, determined in section 5.3.10 of this appendix.

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