6450-01-P

DEPARTMENT OF ENERGY

[Case Number 2018-003; EERE-2018-BT-WAV-0006]

Energy Conservation Program: Decision and Order Granting a Waiver to LG Electronics USA, Inc. from the Department of Energy Room Air Conditioner Test Procedure

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

ACTION: Notice of decision and order.

SUMMARY: The U.S. Department of Energy ("DOE") gives notice of a Decision and Order (Case Number 2018-003) that grants LG Electronics USA, Inc. ("LG") a waiver from specified portions of the DOE test procedure for determining the energy efficiency of specified room air conditioners. Under the Decision and Order, LG is required to test and rate the specified basic models of its room air conditioners in accordance with the alternate test procedure specified in the Decision and Order.

DATES: The Decision and Order is effective on **[INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. The Decision and Order will terminate upon the compliance date of any future amendment to the test procedure for room air conditioners located in 10 CFR part 430, subpart B, appendix F that addresses the issues presented in this waiver. At such time, LG must use the relevant test procedure for this product for any testing to demonstrate compliance with standards, and any other representations of energy use.

FOR FURTHER INFORMATION CONTACT: Ms. Lucy deButts, 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. E-mail: *AS_Waiver_Requests@ee.doe.gov*.

Ms. Sarah Butler, U.S. Department of Energy, Office of the General Counsel, Mail Stop GC-33, Forrestal Building, 1000 Independence Avenue SW., Washington, DC 20585-0103. Telephone: (202) 586-1777. Email: *Sarah.Butler@hq.doe.gov*.

SUPPLEMENTARY INFORMATION: In accordance with Title 10 of the Code of Federal Regulations (10 CFR 430.27(f)(2)), DOE gives notice of the issuance of its Decision and Order as set forth below. The Decision and Order grants LG a waiver from the applicable test procedure in 10 CFR part 430, subpart B, appendix F ("Appendix F") for specified basic models of room air conditioners, if LG tests and rates such products using the alternate test procedure specified in the Decision and Order. LG's representations concerning the energy efficiency of the specified basic models must be based on testing according to the provisions and restrictions in the alternate test procedure set forth in the Decision and Order, and the representations must fairly disclose the test results. Distributors, retailers, and private labelers are held to the same requirements when making representations regarding the energy efficiency of these products. (42 U.S.C. 6293(c))

Consistent with 10 CFR 430.27(j), not later than [**INSERT DATE 60 DAYS AFTER PUBLICATION IN THE *FEDERAL REGISTER***], any manufacturer currently distributing in commerce in the United States a product employing a technology or characteristic that results in the same need for a waiver from the applicable test procedure must submit a petition for waiver. Manufacturers not currently distributing such products in commerce in the United States must petition for and be granted a waiver prior to the distribution in commerce of those products in the

United States. Manufacturers may also submit a request for interim waiver pursuant to the requirements of 10 CFR 430.27.

Signed in Washington, DC, on May 1, 2019.

Steven Chalk,
Acting Deputy Assistant Secretary for Energy Efficiency,
Energy Efficiency and Renewable Energy.

Case # 2018-003
Decision and Order

I. Background and Authority

The Energy Policy and Conservation Act of 1975 ("EPCA"),[1] among other things, authorizes the U.S. Department of Energy ("DOE") to regulate the energy efficiency of a number of consumer products and 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 for certain types of consumer products. These products include room air conditioners, the focus of this document. (42 U.S.C. 6292(a)(2))

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

[1] All references to EPCA in this document refer to the statute as amended through the America's Water Infrastructure Act of 2018, Public Law 115-270 (October 23, 2018).
[2] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated as Part A.

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 that product (42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to determine whether the product complies with relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE is required to follow when prescribing or amending test procedures for covered products. EPCA requires that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which reflect energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle or period of use and requires that test procedures not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) The test procedure for room air conditioners is contained in the Code of Federal Regulations ("CFR") at 10 CFR part 430, subpart B, appendix F, *Uniform Test Method for Measuring the Energy Consumption of Room Air Conditioners* ("Appendix F").

Under 10 CFR 430.27, any interested person may submit a petition for waiver from DOE's test procedure requirements. DOE will grant a waiver from the test procedure requirements if DOE determines either that the basic model for which the waiver was requested contains a design characteristic that prevents testing of the basic model according to the prescribed test procedures, or that the prescribed test procedures evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics as to provide

materially inaccurate comparative data. 10 CFR 430.27(f)(2). DOE may grant the waiver subject to conditions, including adherence to alternate test procedures. *Id.*

II. LG's Petition for Waiver: Assertions and Determinations

By letter dated April 6, 2018, LG submitted a petition for waiver and application for an interim waiver from the applicable room air conditioner test procedure set forth in Appendix F. LG requested relief for the following room air conditioner basic models: LW2217IVSM, LW1817IVSM, and LW1517IVSM.[3] According to LG, Appendix F, which provides for testing at full-load performance only (*i.e.*, at a single indoor and high-temperature outdoor operating condition), does not take into account the benefits of variable-speed room air conditioners, with their part-load performance characteristics, and misrepresents their actual energy consumption. Appendix F requires room air conditioners be tested only with full-load performance as a result of DOE's having previously concluded that widespread use of part-load technology in room air conditioners was not likely to be stimulated by the development of a part-load metric, and insufficient information available at that time regarding the cost effectiveness of part-load technologies as compared to currently [at the time] available technologies. 76 FR 972, 1016 (January 6, 2011).

LG stated that variable-speed room air conditioners use frequency controls to constantly adjust the compressor rotation speed to maintain the desired temperature in the home without turning the motor on and off; that the compressor responds automatically to surrounding

[3] LG provided these basic model numbers in its April 6, 2018 petition. .

conditions to operate in the most efficient possible manner; and that this results in both significant energy savings and faster cooling compared to a typical room air conditioner, which does not have a variable-speed compressor. LG further stated that variable-speed room air conditioners also have a higher/lower operating range (10 Hz to 120 Hz) than room air conditioners without variable-speed compressors. LG asserted that because the DOE test procedure does not account for part-load performance, the results of the test procedure are not representative of the actual energy consumption of variable-speed room air conditioners. DOE agrees that the current test procedure produces test results that are unrepresentative of actual energy use, and accordingly energy efficiency, for variable-speed room air conditioners. The current test procedure's single full-load test condition does not account for such products automatically adjusting compressor or fan speed during performance under part-load conditions. As a result, the current test procedure does not capture the relative efficiency gains of variable-speed technology under part-load conditions, as would be experienced during a representative average use cycle or period of use. Also, an alternate test procedure, similar to LG's requested approach but with modifications, will appropriately reflect operation under part-load conditions and provide results that are representative of actual energy efficiency for variable-speed room air conditioners during a representative average use cycle or period of use, as discussed further below.

In its petition, LG requested an alternate test procedure, which would provide for testing the specified basic models according to Appendix F, except that the variable-speed room air

conditioners would be tested at four different outdoor temperature rating conditions[4] (95 degrees Fahrenheit ("°F") and 92 °F with maximum compressor speed, 87 °F with intermediate compressor speed, and 82 °F with minimum compressor speed) instead of the single outdoor temperature rating condition (95 °F) required by Appendix F. Under the suggested alternate test procedure, the variable-speed room air conditioner combined energy efficiency ratio ("CEER") would be calculated by multiplying the unit's measured CEER value at the 95 °F rating condition by a "performance adjustment factor." The performance adjustment factor would reflect the average performance improvement relative to a comparable single-speed unit resulting from the implementation of a variable-speed compressor across previously described multiple rating conditions. To determine the performance adjustment factor, individual CEER values would be measured at each of the four rating conditions, and the four CEER values would be averaged using weighting factors based on fractional temperature bin hours for each rating temperature.[5] This weighted-average value would be adjusted to normalize it against the expected weighted-average CEER under the same four rating conditions of a comparable single-speed room air conditioner that has the same performance as the variable-speed test unit at the 95 °F test condition. The performance adjustment factor would be calculated as the percent improvement of the weighted CEER value of the variable speed room air conditioner compared to the weighted CEER value of the comparable single-speed room air conditioner.

[4] Each rating condition is expressed as a set of indoor and outdoor dry-bulb temperatures, with corresponding wet-bulb temperatures to specify the sensible and latent heat conditions in both sides of the test chamber, as shown in Table 1 of the alternate test procedure in the Order. As a condensed notation when discussing the rating conditions in this Order, only the outdoor dry-bulb temperature is stated.

[5] The fractional temperature bin hours for each rating temperature are derived from those provided in Table 16 of AHRI 210/240-2017.

As discussed, the current test procedure relies on a single operating condition, defined by the dry-bulb and wet-bulb temperatures in the indoor and outdoor side test chambers. The suggested alternate approach for variable-speed room air conditioners involves measuring performance over a range of four operating conditions, including reduced outdoor temperature conditions at which variable-speed room air conditioners would perform more efficiently than single-speed room air conditioners, and that better reflect representative use. Although a single-speed air conditioner also would operate more efficiently at reduced outdoor temperatures, the marginal improvement of a variable-speed room air conditioner exceeds that of a single-speed room air conditioner. There are several reasons for this: unlike single-speed room air conditioners, variable-speed units match the load, avoid cycling losses, and use condition-specific control strategies. Because the current test procedure tests only under a single operating condition, comparing variable-speed room air conditioner performance based on testing at four operating conditions against a single-speed room air conditioner tested at the highest-temperature operating condition would not provide an appropriate comparison.

A performance adjustment factor allows a more appropriate comparison between a variable-speed room air conditioner tested according to the alternate test procedure and a single-speed room air conditioner tested according to the current test procedure. The performance adjustment factor represents the average relative benefit of variable-speed units over single-speed units across the range of operating conditions. It represents the benefit compared to a theoretical comparable single-speed room air conditioner. It is applied to the measured variable-speed room air conditioner performance only at the high-temperature operating condition (the same operating condition under which single-speed room air conditioners are tested) to provide a

more appropriate comparison to the existing CEER metric for single-speed room air conditioners .

On June 29, 2018, DOE published a notice that announced its receipt of the petition for waiver and granted LG an interim waiver. 83 FR 30717 ("June 2018 notice"). In the June 2018 notice, DOE presented LG's claim that the results of the test procedure in Appendix F are not representative of the actual energy consumption of the variable-speed room air conditioners specified in LG's petition for waiver and the requested alternate test procedure described above.

In the June 2018 notice, DOE specified an alternate test procedure as suggested by LG that must be followed for testing and certifying the specific basic models for which LG requested a waiver. For the reasons explained here and in the Notice of Petition for Waiver, without a waiver, the three room air conditioner basic models identified in the interim waiver, and included in this Order, contain a design characteristic, variable-speed compressors, that yields test results unrepresentative of their true energy efficiency.

By letter dated March 11, 2019, LG requested DOE extend the scope of the interim waiver to include an additional basic model, LW1019IVSM. LG stated that basic model LW1019IVSM employs the same technology as the basic models addressed by the interim waiver.

DOE has reviewed LG's waiver extension request and based on that review, determined that the room air conditioner basic model identified in LG's request incorporates the same design

characteristics as those basic models covered under the interim waiver in Case Number 2018-003 such that the test procedure evaluates that basic model in a manner that is unrepresentative of its actual energy use. DOE has also determined that the alternate test procedure will evaluate the additional basic model, LW1019IVSM, in a manner that is representative of its actual energy use. As such, DOE is including LG's basic model LW1019IVSM in this Decision and Order along with the three basic models that were listed in the interim waiver.

Thus, DOE is requiring LG to test and rate the four room air conditioner basic models identified in today's Order according to the alternate test procedure in today's Order. The alternate test procedure in this Order is a modified version of the procedure in the interim waiver.

In the June 2018 notice, DOE also solicited comments from interested parties on all aspects of the petition. *Id*. DOE received comments from various entities, all opposing LG's petition for various reasons. DOE received comments from the Appliance Standards Awareness Project ("ASAP"), Friedrich Air Conditioning ("Friedrich"), and a jointly submitted comment from Pacific Gas and Electric Company ("PG&E"), San Diego Gas and Electric ("SDG&E"), and Southern California Edison ("SCE") (hereinafter the "California IOUs"). On August 13, 2018, LG subsequently submitted a rebuttal statement (pursuant to 10 CFR 430.27(d)(3)) in response to these comments.[6]

[6] Comments submitted by ASAP, Friedrich, and the Joint Commenters, and the rebuttal statement submitted by LG can be accessed at: *https://www.regulations.gov/docket?D=EERE-2018-BT-WAV-0006*.

Although ASAP agreed with LG's assertion that the current test procedure for room air conditioners does not capture part-load performance and the potential benefits of variable-speed technology, they believe that a test procedure waiver is not the appropriate approach to address the concern. They stated that, instead of granting a waiver for an alternate test with fixed temperature, humidity, and compressor speeds, DOE should amend the current test procedure to use a load-based testing approach. ASAP contended that room air conditioners likely spend a significant amount of time during the cooling season operating under part-load conditions, which require less cooling. ASAP stated that the existing full-load test at an external temperature of 95 °F both does not reflect these actual operating conditions and does not capture inefficiencies and performance degradation due to a single-speed unit's cycling on and off under part-load operating conditions. ASAP suggested that a load-based test would better reflect how both single-speed and variable-speed room air conditioners perform in the field and would capture not only the benefits of variable-speed compressors, in that they are able to provide cooling that matches the load, but also other important factors that affect efficiency, including the avoidance of cycling losses and condition-specific control strategies. ASAP referenced recent work by the CSA Group in developing a load-based test for residential central air conditioners and heat pumps that it suggested could serve as a model for a load-based test for room air conditioners. ASAP further believes that a load-based approach would provide better information to consumers, encourage the adoption of new technologies that may improve efficiency, and, while also providing additional benefits to consumers and the electric grid (*e.g.*, quieter operation and

the ability to reduce power consumption during periods of peak demand). (ASAP, No. 5 at pp. 1−2)[7]

In response to ASAP's comments, LG noted that DOE's regulations specify that a granted waiver must be followed, as soon as practicable, by a test procedure rulemaking to amend DOE's regulations and eliminate any need for continuation of the waiver. LG asserted that a waiver is appropriate to address any misrepresentation of energy consumption immediately and expressed support for a subsequent rulemaking to establish such an approach in the DOE room air conditioner test procedure. LG also asserted that ASAP's preference for a dynamic load-based test would not be appropriate grounds for denying LG's petition for waiver, which it claimed has met all waiver criteria and is thereby warranted. (LG, No. 7 at pp. 2−3)

DOE agrees with the concept that a load-based test may be more representative of typical operation, where the conditions within a room vary and the room air conditioner operates based on the set point and monitored conditions. However, there are substantial issues with setting up and maintaining conditions in existing test chambers that are not designed for this type of test. These require significantly more technician involvement and time, thereby greatly increasing the test cost. In addition, because the specific equipment in the calorimeter chamber will affect the variation in chamber temperature as a function of the cooling load, ensuring the reproducibility of the test would substantially increase the test burden in relation to the potential improved

[7] A notation in the form "ASAP, No. 5 at pp. 1−2" identifies a written comment: (1) Made by the Appliance Standards Awareness Project; (2) recorded in document number 5 that is filed in the docket of this waiver (Docket No. EERE-2018- BT-WAV-0006) and available for review at *http://www.regulations.gov*; and (3) which appears on pages 1 and 2 of document number 5.

representativeness of the test. As a result, DOE has decided not to establish a load-based test. This understanding is based in part on investigative room air conditioner testing that DOE recently conducted.[8] The purposes of the testing were to determine the magnitude of changes to the existing test procedure that would be required under a load-based approach and to identify any issues arising from using calorimeter chambers (which would be necessary under a load-based approach) that were designed for fixed-temperature testing. DOE preliminarily found that calorimeter chambers typically used for room air conditioner testing are not designed to provide a fixed amount of cooling or heating to the chambers, but rather are designed to maintain a fixed temperature and relative humidity while the test unit operates continuously. DOE also is concerned that a load-based test for room air conditioners may not be as repeatable as the existing test procedure because room air conditioner set points and deadband thresholds[9] are typically not as accurate or precise as typical calorimeter chamber instrumentation, and therefore would also not be reproducible with existing test chambers whose varying designs and reconditioning equipment could result in different chamber sensible and latent heating during testing.

In addition to preferring a load-based test, ASAP expressed concern regarding the fixed compressor speeds in the LG-suggested alternate test procedure, stating that such test conditions do not reflect how variable-speed room air conditioners operate in the field. ASAP asserted that control strategies significantly impact efficiency and performance, and that by fixing the

[8] A summary of the results of the investigative room air conditioner testing can be accessed at: *https://www.regulations.gov/document?D=EERE-2018-BT-WAV-0006-0008*.
[9] The term "deadband" refers to the range of ambient air temperatures around the set point for which the compressor remains off, and above which cooling mode is triggered on.

compressor speeds, the alternate test procedure would not capture the impact of a unit's control strategy for adjusting the compressor (and potentially fan) speed(s) in response to varying conditions. (ASAP, No. 5 at p. 2)

DOE agrees that variable-speed room air conditioners in the field are likely to adjust their compressor speed in real-time in response to variations in the cooling load. However, EPCA requires developing a test procedure that is reasonably designed to produce results that measure performance during a representative average use cycle or period of use, without undue burden. Because of the large variation in cooling loads, both for rooms within a house, and among different housing types and geographical areas, identifying a single or multiple representative cooling loads would not be feasible at this time. Furthermore, load-based testing would impose undue cost and burden on manufacturers and test laboratories due to the unique construction and capabilities of existing calorimeter chambers and unit response variability during load-based testing. In contrast, DOE concludes that the approach suggested by LG to measure performance for the full range of variable-speed operation (*i.e.*, from low to full compressor speed under relevant operating conditions) would provide a sufficient performance determination of variable-speed room air conditioners.

Friedrich raised concerns about the suggested alternate test procedure. First, they questioned why the test conditions specified in the interim waiver were those suggested by LG instead of the full set of seasonal energy efficiency ratio ("SEER") test conditions in American National Standards Institute ("ANSI")/Air-Conditioning, Heating, and Refrigeration Institute "AHRI" 2017 Standard 210/240, "Performance Rating of Unitary Air-Conditioning & Air-

Source Heat Pump Equipment" ("AHRI 210/240-2017"). According to Friedrich, the bin hours and test methodology in AHRI 210/240-2017 have been thoroughly vetted. (Friedrich, No. 4 at p. 1)

In response to Friedrich's comments, LG noted that, where appropriate, the test conditions in the waiver test procedure are based on those in AHRI 210/240-2017 considering that AHRI 210/240-2017 applies to central air conditioners, whereas the petition for waiver is for room air conditioners. LG stated, for example, that the required test conditions in AHRI 210/240-2017 for central air conditioners having variable-speed compressors include a fifth condition, the F_1 test, which is at an outdoor temperature of 67 ºF, which LG stated is an unlikely temperature for room air conditioner operation. (LG, No. 7 at pp. 5–6)

DOE reviewed the full set of five required and two optional test conditions in AHRI 210/240-2017 and concludes that those four selected by LG apply to room air conditioners, but the three remaining conditions do not. Specifically, the outdoor test conditions for the required F_{Low} test[10] (and the optional G_{Low} and I_{Low} tests) in Tables 7 and 8 of AHRI 210/240-2017, while applicable to central air conditioners, are not compatible with the room air conditioner test procedure, as the dry-bulb temperature of 67 °F is below the indoor set point of 80 °F prescribed by the test procedure. DOE notes that LG suggested using the remaining required test conditions in Tables 7 and 8 of AHRI 210/240-2017 (*i.e.*, those designated as A_{Full}, B_{Full}, E_{Int}, and B_{Low}). In addition, DOE notes that the fractional temperature bin hours used in the waiver for each rating

[10] F_{Low} is the same test as the F_1 test referred to by LG above, as noted in Table 7 of AHRI 210/240-2017. AHRI 210/240-2017 changed the terminology used to refer to tests from the previous version of the standard.

condition were derived from the industry-accepted values provided in Table 16 of AHRI 210/240-2017.

Friedrich also questioned whether the capacity and power adjustment factors used to calculate the performance of a comparable single-speed room air conditioner are representative of the range of single-speed room air conditioners on the market. (Friedrich, No. 4 at p. 1) DOE conducted testing and modeling to estimate performance of room air conditioners at varying outdoor ambient conditions. DOE reviewed the capacity and power adjustment factors suggested by LG and notes that they largely align with the data from DOE's testing and modeling. Therefore, DOE is confident that the capacity and power adjustment factor values suggested by LG to estimate performance of a comparable single-speed room air conditioner at reduced ambient conditions are appropriate and representative of expected performance.

Friedrich also suggested that an alternate test for variable-speed room air conditioners should use a building load and operating hours at specific operating conditions, as is done for the SEER metric in AHRI 210/240-2017. Friedrich disagrees with LG's approach that instead assumes a room air conditioner operates for 750 hours in every condition. (Friedrich, No. 4 at p. 1) In response to Friedrich's comment, LG noted that DOE has previously determined that 750 operating hours is the representative average-use cycle per year for room air conditioners. (LG, No. 7 at pp. 6–7)

DOE reviewed Table 16 in AHRI 210/240-2017 and determined that the full set of conditions are likely not applicable to room air conditioner operation. Table 16 contains data

describing the fraction of the cooling season during which the temperature is within each of eight temperature bins, with representative temperatures for each bin ranging from 67 °F to 102 °F in increments of 5 °F. Specifically, DOE agrees that only bins 4 through 7 of Table 16 are appropriate for room air conditioner operation because these are the ranges of temperatures that span the current indoor and outdoor temperature conditions of 80 °F and 95 °F, respectively. DOE notes that normalizing those fractional bin hours results in the weighting factors suggested in LG's petition for waiver, with each weighting factor representing the fraction of 750 hours during the cooling season that would be associated with each outdoor temperature bin. Therefore, DOE concludes that the weighting factors suggested by LG are appropriate for variable-speed room air conditioners.

Friedrich also stated that the alternate test procedure compares the weighted variable-speed CEER to the weighted single-speed CEER, which is higher than the CEER value at which the comparable single-speed unit would currently be rated (*e.g.*, Friedrich commented that a non-weighted CEER of 12, as determined according to Appendix F, would correspond to a weighted CEER of 12.8 when calculated according to the alternate test procedure). Friedrich contends that a different metric should be used to rate variable-speed units, because if CEER is used, a variable-speed unit rated at 14.0 CEER would actually have a performance adjustment factor of 9.3 percent (as compared with the weighted single-speed CEER metric of 12.8), while the alternate test procedure would indicate that the performance adjustment factor would be 16.5 percent (as compared to a non-weighted 12.0 CEER). (Friedrich, No. 4 at p. 1) LG stated in response to Friedrich's comment that an alternate energy efficiency metric could be addressed by DOE in a subsequent test procedure rulemaking. (LG, No. 7 at p. 7)

DOE notes that only the final CEER metric calculated in section 5.4.9 of the waiver test procedure (*i.e.*, the non-weighted CEER value resulting from testing according to Appendix F, adjusted by the performance adjustment factor determined according to the waiver test procedure) would be used to compare efficiencies among different basic models of room air conditioners. The performance adjustment factor is defined as the percent difference between the weighted single-speed CEER metric adjusted for cycling losses and the weighted variable-speed CEER metric. This represents the relative difference between single-speed and variable-speed room air conditioner performance and efficiency. By comparison, the weighted CEER value is an interim value used to calculate the performance adjustment factor; it is not a reported performance metric. Therefore, it would not be appropriate to compare the variable-speed CEER metric resulting from the alternate test procedure to the interim weighted CEER value, as suggested by Friedrich. DOE concludes that the performance adjustment factor as implemented in this Decision and Order maintains a single metric for all room air conditioners (CEER), while capturing the efficiency improvements associated with variable-speed models.

The California IOUs recommended that DOE deny LG's waiver request and rescind the interim waiver because the CEER weighting scheme in the alternate test procedure represents too significant a change to the CEER performance metric and its calculation methodology. The California IOUs noted that under 10 CFR 430.27, a waiver shall not be granted if it will "change the energy use or efficiency metric that the manufacturer must use to certify compliance with the applicable energy conservation standard." They believe that the alternate testing procedure represents a change in the efficiency metric calculation because it incorporates a weighting

approach. Instead of a waiver, the California IOUs suggested that DOE conduct a test procedure rulemaking to allow opportunities for proper consideration, evaluation, and review before a manufacturer conducts testing and certification using an alternate test procedure. The California IOUs noted that the proposed testing conditions could then be evaluated to determine whether they accurately capture the energy consumption of the listed and comparable models. They asserted that because LG did not submit any data to justify the chosen testing conditions or weighting factors, the validity of these values cannot be verified. The California IOUs further asserted that if the alternate test procedure in this waiver is granted, the CEER metric for the identified LG models would no longer be comparable to those of room air conditioners from other manufacturers, resulting in an unfair marketplace and misleading information for consumers. (California IOUs, No. 6 at pp. 1−2)

In response to the comment from the CA IOUs, LG stated that its suggested alternate test procedure does not change the metric, but rather maintains the CEER metric and would not alter the minimum standard applicable to these products. LG further stated that it is preferable to provide better information to consumers as soon as possible, rather than waiting until a new test procedure rulemaking is completed. (LG, No. 7 at pp. 3–4)

DOE notes that the LG interim waiver approach assesses the performance improvements associated with variable-speed room air conditioners as compared to single-speed room air conditioners, on the basis of adjusted operation at varying, reduced-temperature operating conditions and accounting for savings associated with eliminating cycling losses. DOE recognizes that neither the intermediate individual CEER values nor the weighted CEER value

calculated for a variable-speed room air conditioner unit and comparable single-speed room air conditioner at the different operating conditions are comparable to the CEER determined using Appendix F. However, the alternate test procedure does not prescribe either of these values for determining compliance or for comparison with the CEER determined using Appendix F. Under the alternate test procedure, the intermediate CEER values are used to determine a performance adjustment factor that reflects the relative performance improvement associated with variable-speed operation. That performance adjustment factor is then applied to the Appendix F CEER metric. In that way, the efficiency metric for variable-speed room air conditioners remains comparable to the current CEER metric, which would continue to reflect performance of single-speed room air conditioners. Thus, consumers are informed of the relative efficiency improvements provided by variable-speed room air conditioners. As discussed above, the weighting factors and test conditions suggested by LG are based on the applicable values in Table 16 of AHRI 210/240-2017, which has been verified and validated and is an industry accepted standard.

Additionally, the California IOUs objected to DOE's assertion in the interim waiver that LG would suffer economic hardship and be at a competitive disadvantage if it were required to rate the identified models for which it requested a waiver according to the current room air conditioner test procedure. The California IOUs stated that following a review of product literature, they found that all three LG models listed in the interim waiver (LW2217IVSM, LW1817IVSM, and LW1517IVSM) currently exceed the minimum Federal standards for room air conditioners in their respective product classes, and would therefore not be precluded from entering the market. (California IOUs, No. 6 at p. 2)

LG stated that even though LG's products would not be barred from the market, it would suffer economic hardship and be at a competitive disadvantage without the waiver, because the DOE test procedure does not capture the relative efficiency improvements achieved by variable-speed room air conditioners over a range of operating conditions compared to single-speed room air conditioners. LG asserted that, without an alternate test procedure, the CEER values of variable-speed room air conditioners would be inaccurately low, despite the improved performance under part-load conditions. (LG, No. 7 at pp. 4–5)

For the reasons explained here and in the June 2018 notice, without a waiver, the basic models identified in the Order cannot be tested and rated for energy consumption on a basis representative of their true energy consumption characteristics. DOE has reviewed the recommended procedure suggested by LG and concludes that it will allow for generally accurate measurement of the energy use of the listed models, while alleviating the problems associated with testing these models following DOE's room air conditioner test procedure. LG must test and rate the four listed room air conditioner basic models according to the alternate test procedure specified in the Decision and Order. This alternate test procedure is substantively consistent with the interim waiver's alternate test procedure but makes some modifications.

Based on further review of the alternate test procedure required under the interim waiver order and subsequent investigative testing performed by DOE, the alternate test procedure required under today's Decision and Order: (1) does not permit use of a psychrometric chamber instead of a calorimeter chamber, (2) provides definitions for each fixed compressor speed, and

(3) specifies that compressor speeds will be set in accordance with instructions that LG will provide. DOE has determined that these changes are necessary to ensure better repeatability and reproducibility of the alternate test procedure, as well as representativeness of the results.

DOE is removing the option provided in the interim waiver order to test using the air-enthalpy method, which relies on use of a psychrometric chamber, as opposed to a calorimeter chamber. Use of a psychrometric chamber requires the installation of test ducts on the evaporator and condenser exhausts to measure the air-enthalpy and calculate cooling capacity, which may impact the air flow, particularly on the evaporator side where room air conditioners typically locate the inlet and outlet in close proximity. As such, the results from using a psychrometric chamber may not be representative of typical installations. Further, unlike the calorimeter method, the air-enthalpy method does not address heat loss through the chassis to the room, and may not capture possible heat transfer due to internal air leakage through the chassis between the indoor and outdoor test chambers. DOE's investigative testing of 9 room air conditioners suggested that the air-enthalpy and calorimeter methods are not interchangeable: DOE's results varied up to 11 percent in cooling capacity and efficiency between the two methods.

To capture the efficiency gains associated with variable-speed technology, the alternate test procedure requires testing variable-speed room air conditioners at different fixed compressor speeds under various reduced outdoor operating temperatures. To harmonize the alternate test procedure with industry standards and ensure the compressor speeds are representative of the expected load at each of the outdoor test conditions, DOE is providing definitions for the three

compressor speeds outlined in the Interim Waiver Order and revising the nomenclature for these speeds based on AHRI 210/240-2017. To ensure that the low and intermediate compressor speeds result in adequate cooling capacity under reduced loads, the low compressor speed definition requires that the test unit's measured cooling capacity at the low temperature (82 °F) rating condition must be within 47 percent to 57 percent of the measured cooling capacity when operating with the full compressor speed at the 95 °F rating condition. DOE developed this range based on the building load calculation, equation 11.6, in AHRI 210/240-2017, which relates the building load to the unit full-load cooling capacity and the outdoor temperature. DOE normalized this equation for room ACs so that full load operation occurs at a 95 °F outdoor temperature, rather than 98 °F under the existing equation, and then used the normalized equation to estimate the cooling load as a percentage of the full-load cooling capacity at the 82 °F outdoor temperature rating condition. Based on this analysis, DOE expects that, if a variable-speed room AC's cooling capacity at low compressor speed is higher than 57 percent of the unit's cooling capacity at the 95 °F rating condition, the cooling capacity would exceed the cooling load when the outdoor temperature is 82 °F. Thus, such a unit in the field would cycle the compressor under a cooling load corresponding to the rating condition because more cooling than necessary would be provided to the room, thereby incurring cycling losses and not providing the full performance benefits associated with variable-speed operation. Conversely, if a variable-speed room AC's cooling capacity at the low compressor speed is significantly lower than 57 percent of the unit's cooling capacity at the 95 °F rating condition, the unit would not provide sufficient cooling (based on the expected cooling load at the 82 °F rating condition) and would thereby impact consumer acceptance of the product. For this reason, and because variable-speed room ACs may use compressors that vary speed in discrete steps without the

capability to directly operate at a speed that meets the 57 percent requirement precisely, the low speed definition allows for a minimum cooling capacity at the low compressor speed of 47 percent of the cooling capacity at the 95 °F rating condition. This range ensures that the unit's cooling capacity at the representative low cooling load, as determined using the building load calculation in AHRI 210/240-2017, is achieved while maintaining the performance benefits of variable-speed compressors.

Setting and maintaining a specific room air conditioner compressor speed is not typically possible without specific control instructions from the manufacturer. Because fixed compressor speeds are critical to the repeatability of this alternate test procedure, DOE is requiring that the manufacturer provide DOE all necessary instructions to maintain the compressor speed required for each test condition.[11]

DOE also recognizes that corresponding changes are needed 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 will allow for an appropriate comparison of the annual energy consumption and operating costs between single-speed room air conditioners and the four variable-speed room air conditioner basic models listed in today's Order. As such, the alternate test procedure specifies two values of electrical power input. One

[11] Pursuant to 10 CFR 1004.11, if the manufacturer submits information that it believes to be confidential and exempt by law from public disclosure, the manufacturer 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. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

is used in calculating the average annual energy consumption in 10 CFR 430.23(f)(3), which in turn is used to calculate the combined annual energy consumption and estimated annual operating cost in 10 CFR 430.23(f)(4) and (f)(1), respectively. This value is the weighted average of the input power measured at each of the four test conditions plus the annual energy consumption in inactive mode or off mode. The second value is the value measured at the 95 °F rating condition and reported to DOE through certification reports, as required in 10 CFR 429.15(b)(2), and is used to calculate the unit's measured CEER value in 10 CFR 430.23(f)(5) before applying the performance adjustment factor. DOE concludes that, although a different value of electrical power input is appropriate for calculating the FTC EnergyGuide values, reporting of the electrical power input at the 95 °F rating condition ensures consistency with the cooling capacity measured under the same condition.

DOE further requires in today's Decision and Order testing of the specified basic models in accordance with the instructions submitted by LG on April 2, 2019, regarding the compressor frequencies and control settings used at each test condition for each basic model.[12]

The Decision and Order applies only to the four basic models listed in the Order and does not extend to any other basic models. LG may request that DOE extend the scope of this waiver to include additional basic models that employ the same technology as those listed in the Order. 10 CFR 430.27(g). LG may also submit another petition for waiver from the test procedure for

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

additional basic models that employ a different technology and meet the criteria for test procedure waivers. 10 CFR 430.27(a)(1).

DOE notes that it may rescind or modify the waiver at any time upon a determination that the factual basis underlying the petition for waiver is incorrect, or that the results from the alternate test procedure are unrepresentative of the basic models' true energy consumption characteristics. 10 CFR 430.27(k)(1). Likewise, LG may request that DOE rescind or modify the waiver if the company discovers an error in the information provided to DOE as part of its petition, determines that the waiver is no longer needed, or for other appropriate reasons. 10 CFR 430.27(k)(2).

III. Consultations with Other Agencies

In accordance with 10 CFR 430.27(f)(2), DOE consulted with the Federal Trade Commission ("FTC") staff concerning the LG petition for waiver. The FTC staff did not have any objections to DOE's granting a waiver to LG for the four specified basic models**.**

IV. Order

After careful consideration of all the material that was submitted by LG and commenters in this matter, public facing materials, and the testing conducted by DOE, it is **ORDERED** that:

(1) LG must, as of the date of publication of this Order in the *Federal Register,* test the following room air conditioner basic models with the alternate test procedure as set forth in paragraph (2):

Brand	Basic Model No.
LG	LW2217IVSM
LG	LW1817IVSM
LG	LW1517IVSM
LG	LW1019IVSM

(2) The alternate test procedure for the LG basic models referenced in paragraph (1) of this Order is the test procedure for room air conditioners prescribed by DOE at appendix F to subpart B of 10 CFR part 430 ("Appendix F") and 10 CFR 430.23(f), except: (i) determine the combined energy efficiency ratio ("CEER") as detailed below, and (ii) calculate the average annual energy consumption referenced in 10 CFR 430.23(f)(3) as detailed below. In addition, for each basic model listed in paragraph (1), maintain compressor speeds at each test condition and set control settings for the variable components, according to the instructions submitted to DOE by LG. All other requirements of Appendix F and DOE's regulations remain applicable.

In 10 CFR 430.23, in paragraph (f) revise paragraph (3)(i) to read as follows:

The electrical power input in kilowatts as calculated in section 5.2.1 of appendix F to this subpart, and

In 10 CFR 430.23, in paragraph (f) revise paragraph (5) to read as follows:

(5) Calculate the combined energy efficiency ratio for room air conditioners, expressed in Btu's per watt-hour, as follows:

(i) Calculate the quotient of:

(A) The cooling capacity as determined at the 95 °F outdoor test condition, $Capacity_{95}$, in Btus per hour, as determined in accordance with section 5.1 of appendix F to this subpart multiplied by the representative average-use cycle of 750 hours of compressor operation per year, divided by

(B) The combined annual energy consumption, in watt hours, which is the sum of the annual energy consumption for cooling mode, calculated in section 5.4.2 of appendix F to this subpart for test condition 1 in Table 1 of appendix F to this subpart, and the standby mode and off mode energy consumption, as determined in accordance with section 5.3 of appendix F to this subpart. The sum of the annual energy consumption in cooling mode and standby mode and off mode energy consumption is then multiplied by a conversion factor of 1,000 to convert kilowatt-hours to watt-hours.

(ii) Multiply the quotient calculated in paragraph (f)(5)(i) of this section by (1 + Fp), where Fp is the variable-speed room air conditioner performance adjustment factor as determined in section 5.4.8 of appendix F to this subpart.

(iii) Round the resulting value from paragraph (f)(5)(ii) of this section to the nearest 0.1 Btu per watt-hour.

In Appendix F:

Add in Section 1, *Definitions*:

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

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

1.10 "Full compressor speed (full)" means the compressor speed specified by the manufacturer at which the unit operates at full load testing conditions.

1.11 "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 compressor speed stages) or the next highest inverter frequency step (designs with discrete compressor speed steps).

1.12 "Low compressor speed (low)" means the compressor speed specified by the manufacturer at which the unit operates at low load test conditions, such that the measured cooling capacity at Temperature Condition 4 in Table 1 of this appendix, $Capacity_4$, is not less than 47 percent and not greater than 57 percent of the measured cooling capacity with the full compressor speed at Temperature Condition 1 in Table 1 of this appendix, $Capacity_1$.

Add to the end of Section 2.1 *Cooling*:

For the purposes of this waiver, all units must conduct the cooling mode test a total of four times: one test at each of the test conditions listed in Table 1, consistent with section 3.1 of this appendix.

Revise Section 3.1, *Cooling mode*, to read as follows:

Cooling mode. Establish the test conditions described in sections 4 and 5 of ANSI/AHAM RAC-1 (incorporated by reference; see 10 CFR 430.3) and in accordance with ANSI/ASHRAE 16 (incorporated by reference; see 10 CFR 430.3), with the following exceptions: Conduct the set of four cooling mode tests with the test conditions in Table 1. Set the compressor speed required for each test condition in accordance with instructions 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

Replace Section 5.1 to read as follows:

Calculate the condition-specific cooling capacity (expressed in Btu/hr), $Capacity_{tc}$, for each of the four cooling mode rating test conditions (tc), as required in section 6.1 of ANSI/AHAM RAC-1 (incorporated by reference; see 10 CFR 430.3) and in accordance with ANSI/ASHRAE 16 (incorporated by reference; see 10 CFR 430.3). Notwithstanding the requirements of 10 CFR 430.23(f), when reporting cooling capacity pursuant to 10 CFR 429.15(b)(2) and calculating energy consumption and costs pursuant to 10 CFR 430.23(f), use the cooling capacity determined for test condition 1 in Table 1 of this appendix.

Replace Section 5.2 to read as follows:

Determine the condition-specific electrical power input (expressed in watts), P_{tc}, for each of the four cooling mode rating test conditions, as required by section 6.5 of ANSI/AHAM RAC-1 (incorporated by reference; see 10 CFR 430.3) and in accordance with ANSI/ASHRAE 16 (incorporated by reference; see 10 CFR 430.3). Notwithstanding the requirements of 10 CFR 430.23(f), when reporting electrical power input pursuant to 10 CFR 429.15(b)(2) and calculating energy consumption and costs pursuant to 10 CFR 430.23(f)(5), use the electrical power input value measured for test condition 1 in Table 1 of this appendix. Notwithstanding the requirements of 10 CFR 430.23(f), when calculating energy consumption and costs pursuant to 10 CFR 430.23(f)(3), use the weighted electrical power input, P_{wt}, calculated in section 5.2.1 of this appendix, as the electrical power input.

Insert a new Section 5.2.1:

5.2.1 *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.

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).

Add a new Section 5.4, following Section 5.3, *Standby mode and off mode annual energy consumption*:

5.4 *Variable-speed room air conditioner performance adjustment factor*. Calculate the performance adjustment factor (Fp) as follows:

5.4.1 *Theoretical comparable single-speed room air conditioner*. Calculate the cooling capacity, expressed in British thermal units per hour (Btu/h), and electrical power input, expressed in watts, for a theoretical comparable single-speed room air conditioner at all cooling mode test conditions. A theoretical comparable single-speed room air conditioner has the same cooling capacity and electrical power input, with no cycling losses, as the variable-speed room air conditioner under test at test condition 1 in Table 1.

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

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

Where:

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

$Capacity_1$ = variable-speed room air conditioner cooling capacity, in Btu/h, determined in section 5.1 of this appendix for test condition 1 in Table 1.

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

P_1 = variable-speed room air conditioner electrical power input, in watts, determined in section 5.2 of this appendix for test condition 1 in Table 1.

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

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

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

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

tc as defined in section 5.2.1 of this appendix.

5.4.2 *Variable-speed 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 annual energy consumption, in kWh/year, in cooling mode for each test condition in Table 1.

P_{tc} and tc are as defined in section 5.2.1 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

5.4.3 *Theoretical comparable single-speed room air conditioner annual energy consumption for cooling mode at each cooling mode test condition.* Calculate the annual energy consumption 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.

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, determined in section 5.4.1 of this appendix.

tc as explained in section 5.2.1 of this appendix.

0.75 as defined in section 5.4.2 of this appendix.

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

$$CEER_{tc} = \frac{Capacity_{tc}}{\left(\frac{AEC_{tc} + E_{TSO}}{0.75}\right)}$$

Where:

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

$Capacity_{tc}$ = variable-speed room air conditioner cooling capacity, in Btu/h, for each test condition in Table 1, determined in section 5.1 of this appendix.

AEC_{tc} = variable-speed room air conditioner annual energy consumption, in kWh/yr, in cooling mode for each test condition in Table 1, determined in section 5.4.2 of this appendix.

E_{TSO} = standby mode and off mode annual energy consumption for room air conditioners, in kWh/year, determined in section 5.3 of this appendix.

tc as explained in section 5.2.1 of this appendix.

0.75 as defined in section 5.4.2 of this appendix.

5.4.5 *Theoretical comparable single-speed room air conditioner combined energy efficiency ratio at each cooling mode test condition.* 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.

$$CEER_{ss\_tc} = \frac{Capacity_{ss\_tc}}{\left(\frac{AEC_{ss\_tc} + E_{TSO}}{0.75}\right)}$$

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.

$Capacity_{ss\_tc}$ = theoretical comparable single-speed room air conditioner cooling capacity, in Btu/h, for each test condition in Table 1, in Btu/h, determined in section 5.4.1 of this appendix.

AEC_{ss_tc} = theoretical comparable single-speed room air conditioner annual energy consumption for each test condition in Table 1, in kWh/year, determined in section 5.4.3 of this appendix.

E_{TSO} = standby mode and off mode annual energy consumption for room air conditioners, in kWh/year, determined in section 5.3 of this appendix.

tc as explained in section 5.2.1 of this appendix.

0.75 as defined in section 5.4.2 of this appendix.

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

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

Where:

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

$CEER_{ss\_tc}$ = comparable single-speed room air conditioner adjusted combined energy efficiency ratio, in Btu/Wh, for each test condition in Table 1, determined in section 5.4.5 of this appendix.

CLF_{tc} = cycling loss factor for each cooling mode 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 defined in section 5.2.1 of this appendix.

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

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

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

Where:

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

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

$CEER_{tc}$ = variable-speed room air conditioner combined energy efficiency ratio, in Btu/Wh, at each test condition in Table 1, determined in section 5.4.4 of this appendix.

$CEER_{ss\_tc\_adj}$ = comparable single-speed room air conditioner adjusted combined energy efficiency ratio, in Btu/Wh, at each test condition in Table 1, determined in section 5.4.6 of this appendix.

W_{tc} and tc as explained in section 5.2.1 of this appendix.

5.4.8 *Variable-speed room air conditioner performance adjustment factor.* Calculate the variable-speed room air conditioner 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 performance adjustment factor.

$CEER_{wt}$ = variable-speed room air conditioner weighted combined energy efficiency ratio, in Btu/Wh, determined in section 5.4.7 of this appendix.

$CEER_{ss\_wt}$ = comparable single-speed room air conditioner weighted combined energy efficiency ratio, in Btu/Wh, determined in section 5.4.7 of this appendix.

(3) *Representations*. LG may not make representations about the efficiency of any basic model in paragraph (1) of this Order for compliance, marketing, or other purposes unless the basic model has been tested in accordance with the provisions set forth above and such representations fairly disclose the results of such testing in accordance with 10 CFR part 430, subpart B, appendix F and 10 CFR 429.15, as specified in this Order.

(4) This waiver shall remain in effect according to the provisions of 10 CFR 430.27.

(5) This waiver is issued on the condition that the statements, representations, and documents provided by LG are valid. Any modifications to the controls or configurations of a basic model subject to this waiver will render the waiver invalid with respect to that basic model, and LG will either be required to use the current Federal test procedure or submit a new application for a test procedure waiver. DOE may revoke or modify this waiver at any time if it determines the factual basis underlying the petition for waiver is incorrect, or the results from the alternate test procedure are unrepresentative of the basic model's true energy consumption characteristics. 10 CFR 430.27(k)(1). Likewise, LG may request that DOE rescind or modify the waiver if LG discovers an error in the information provided to DOE as part of its petition, determines that the waiver is no longer needed, or for other appropriate reasons. 10 CFR 430.27(k)(2).

(6) LG remains obligated to fulfill the certification requirements set forth at 10 CFR part 429.

Signed in Washington, DC, on May 1, 2019.

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Steven Chalk
Acting Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

[FR Doc. 2019-09438 Filed: 5/7/2019 8:45 am; Publication Date: 5/8/2019]