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Part IV

## Department of Energy

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430
Energy Conservation Program: Test Procedures for Microwave Ovens (Active Mode); Proposed Rule

## DEPARTMENT OF ENERGY

### Office of Energy Efficiency and Renewable Energy

### 10 CFR Part 430

**[Docket No. EERE–2010–BT–TP–0023]**

**RIN 1904–AC26**

## Energy Conservation Program: Test Procedures for Microwave Ovens (Active Mode)

**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 revise its test procedures for microwave ovens established under the Energy Policy and Conservation Act. The proposed amendments would add provisions for measuring the active mode energy use for microwave ovens, including both microwave-only ovens and convection microwave ovens. Specifically, DOE is proposing provisions for measuring the energy use of the microwave-only cooking mode for both microwave-only ovens and convection microwave ovens based on the testing methods in the latest draft version of the International Electrotechnical Commission Standard 60705, ''Household microwave ovens—Methods for measuring performance.'' DOE is proposing provisions for measuring the energy use of the convection-only cooking mode for convection microwave ovens based on the DOE test procedure for conventional ovens in our regulations. DOE is also proposing to calculate the energy use of the convection-microwave cooking mode for convection microwave ovens by apportioning the microwave-only mode and convection-only mode energy consumption measurements based on typical consumer use.

**DATES:** DOE will hold a public meeting on Tuesday, March 5, 2013, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section V, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but submitted no later than April 22, 2013. See section V, ''Public Participation,'' for details.

**ADDRESSES:** The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section near the end of this notice.

Any comments submitted must identify the NOPR on Test Procedures for Microwave Ovens, and provide docket number EERE–2010–BT–TP–0023 and/or regulatory information number (RIN) 1904–AC26. Comments may be submitted using any of the following methods:

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

2. *Email: MWO-2010-TP-0023@ee.doe.gov.* Include docket number EERE–2010–BT–TP–0023 and/or RIN 1904–AC26 in the subject line of the message.

3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC 20585–0121. 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:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 6th Floor, 950 L'Enfant Plaza SW., Washington, DC 20024. *Telephone:* (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

For detailed instructions on submitting comments and additional information on the rulemaking process, see section V of this document (Public Participation).

*Docket:* The docket is available for review at *www.regulations.gov,* including **Federal Register** notices, framework documents, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the *www.regulations.gov* index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;dct=FR%252BPR%252BN%252BO%252BSR;rpp=10;po=0;D=EERE-2010-BT-TP-0023.* This Web page contains a link to the docket for this notice on the *www.regulations.gov* site. The *www.regulations.gov* Web page contains simple instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through *www.regulations.gov.*

For further information on how to submit a comment or review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or email: *Brenda.Edwards@ee.doe.gov.*

**FOR FURTHER INFORMATION CONTACT:**

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Mr. Ari Altman, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 287–6307. Email: *ari.altman@hq.doe.gov.*

**SUPPLEMENTARY INFORMATION:**

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## I. Authority and Background

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291, *et seq.;* ''EPCA'' or, ''the Act'') sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110–140 (Dec. 19, 2007)). Part B of title III, which for editorial reasons was redesignated as Part A upon incorporation into the U.S. Code (42 U.S.C. 6291–6309), establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.'' These include microwave ovens, the subject of today's notice. (42 U.S.C. 6291(1)–(2) and 6292(a)(10))

Under EPCA, this program consists essentially of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use (1) as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and (2) for making representations about the efficiency of those products. Similarly, DOE must use these test requirements to determine whether the products comply with any relevant standards promulgated under EPCA.

*General Test Procedure Rulemaking Process*

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 provides in relevant part that any test procedures prescribed or amended under this section shall be reasonably designed to produce test results that 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 shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

In addition, 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)) Finally, in any rulemaking to amend a test procedure, DOE must determine to what extent, if any, the proposed test procedure would alter the measured energy efficiency of any covered product as determined under the existing test procedure. (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

EISA 2007 amended EPCA to require DOE to amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already incorporates the standby mode and off mode energy consumption, or if such integration is technically infeasible. 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 a separate test is technically feasible. (42 U.S.C. 6295(gg)(2)(A))

*DOE Microwave Oven Test Procedure*

DOE's test procedure for microwave ovens is codified at appendix I to subpart B of Title 10 of the Code of Federal Regulations (CFR) (Appendix I). The test procedure was established in an October 3, 1997 final rule that addressed active mode energy use only. 62 FR 51976.

On July 22, 2010, DOE published in the **Federal Register** a final rule for the microwave oven test procedure rulemaking (July 2010 TP Repeal Final Rule), in which it repealed the regulatory provisions for establishing the cooking efficiency test procedure for microwave ovens under the Energy Policy and Conservation Act (EPCA). 75 FR 42579. In the July 2010 TP Repeal Final Rule, DOE determined that the existing microwave oven test procedure to measure the cooking efficiency, which was based on the IEC Standard 705—Second Edition 1998 and Amendment 2—1993, ''Methods for Measuring the Performance of Microwave Ovens for Households and Similar Purposes'' (IEC Standard 705), did not produce representative and repeatable test results. DOE stated that it was unaware of any test procedures that had been developed that addressed the concerns with the microwave oven cooking efficiency test procedure. DOE was also unaware of any research or data on consumer usage indicating what a representative food load would be, or any data showing the repeatability of test results. 75 FR 42579, 42581. In addition, in comments received in response to a separate test procedure notice of proposed rulemaking (NOPR) published in the **Federal Register** on October 17, 2008, which addressed provisions for measuring standby mode and off mode energy use for microwave ovens (73 FR 62134), interested parties commented that pure water has relatively low specific resistivity, and actual food items that might be cooked in a microwave oven would have more salts and thus absorb microwave energy more efficiently than pure water. Interested parties stated that, as a result, testing with a water load would likely result in lower efficiency measurements than would be expected from using actual food products.

On July 22, 2010, DOE also published in the **Federal Register** a notice of public meeting to initiate a separate rulemaking process to consider new provisions for measuring microwave oven energy efficiency in active (cooking) mode. 75 FR 42611. DOE held the public meeting on September 16, 2010. DOE received no data or comments at or in response to this public meeting suggesting potential methodologies for test procedures for microwave oven active mode.

On October 24, 2011, DOE published a Request for Information (RFI) notice to announce that it has initiated a test procedure rulemaking to develop active mode testing methodologies for microwave ovens (hereafter referred to as the October 2011 RFI). 76 FR 65631. DOE specifically sought information, data, and comments regarding representative and repeatable methods for measuring the energy use of microwave ovens, in particular for the microwave-only and convection-

microwave cooking (*i.e.,* microwave plus convection and any other means of cooking) modes. DOE sought comment on the following: (1) The characteristics of food loads representative of consumer use, (2) the repeatability of energy use measurements using different food loads, and (3) consumer usage data on the hours of operation in active mode, standby mode, and off mode for the development of an integrated energy use metric. In response to the October 2011 RFI, interested parties commented that testing microwave-only ovens and convection microwave ovens with real and artificial food loads do not produce acceptable levels of repeatability and reproducibility. Interested parties also commented that DOE should harmonize its test procedure for microwave-only ovens with IEC Standard 60705, ''Household microwave ovens—Methods for measuring performance'' (IEC Standard 60705).

Based on DOE's determination to initiate a microwave oven active mode test procedure rulemaking and comments received on the October 2011 RFI, DOE conducted testing to evaluate potential amendments to its microwave oven test procedure to establish new methods for measuring the active mode energy use for these products, including the microwave-only, convection-only, and convection-microwave cooking modes. On June 5, 2012, DOE published a Notice of Data Availability (NODA) to present test results and analytical approaches that DOE was considering for potential amendments to the microwave oven test procedure and to request additional comment and information on these results (hereafter referred to as the June 2012 NODA). 77 FR 33106. In the June 2012 NODA, DOE presented test results from microwave-only cooking mode testing of water loads and food simulation mixtures consisting of water and basic food ingredients (*i.e.,* fats, sugars, salt, fiber, proteins, etc.). DOE also presented test results from testing using the convection-microwave cooking mode on the following loads: (1) Crisco® All-Vegetable shortening, (2) Russet Burbank potatoes, (3) U.S. Department of Agriculture (USDA) grade A boneless chicken breasts, and (4) food simulation TX–151 gels. [1] Finally, DOE presented test results from testing of the convection-only cooking mode using the aluminum test block specified in the DOE conventional oven test procedure in 10 CFR part 430, subpart B, appendix I. In response to the June 2012 NODA, DOE received comments on the following issues:

- The Association of Home Appliance Manufacturers (AHAM) and Whirlpool Corporation (Whirlpool) commented that the draft revised IEC Standard 60705 produces repeatable and reproducible results and DOE should harmonize with the IEC Standard 60705 when the revised version is published. (AHAM, No. 18 at pp. 2–3; Whirlpool, No. 15 at pp. 1–2)
- AHAM and Whirlpool stated that DOE should not develop test procedures for convection microwave ovens because: (1) They represent only 4 percent of microwave oven shipments, (2) the potential for energy savings is trivial compared to the added test burden, and (3) there are currently no international test standards for these products. (AHAM, No. 18 at p. 3; Whirlpool, No. 15 at pp. 4–6)
- The Appliance Standards Awareness Project (ASAP), and National Resources Defense Council (NRDC) supported the development of test procedures for convection microwave ovens. (ASAP, NRDC, No. 17 at pp. 1–2)

On January 18, 2013, DOE published a final rule (hereafter referred to as the January 2013 Final Rule) amending the test procedure for microwave ovens to incorporate by reference certain provisions of IEC Standard 62301, ''Household electrical appliances—Measurement of standby power,'' Edition 2.0 2011–01 (IEC Standard 62301 (Second Edition)) for measuring standby mode and off mode energy use. 78 FR 4015.

## II. Summary of the Notice of Proposed Rulemaking

In today's NOPR, DOE proposes to amend the test procedures for microwave ovens in 10 CFR part 430 to include methods for measuring the active mode energy use. The proposed amendments would add test methods for microwave-only ovens based on the provisions in the draft revised IEC Standard 60705. The proposed test method would involve measuring the energy consumption required to heat water loads of 275 grams (g), 350 g, and 1000 g, in 600 milliliter (ml), 900 ml, and 2000 ml borosilicate glass test containers, respectively, by 45–50 degrees Celsius (°C) and 50–55 °C.[2] The results from the two different temperature rise tests would then be used to linearly interpolate the energy consumption required to heat each load by 50 °C, which is then weighted based on consumer usage to calculate the weighted per-cycle cooking energy consumption. In addition to the cooking cycle energy consumption, the proposed amendments would also require that if the microwave oven is capable of operating in fan-only mode while the microwave is cooling down after the completion of the microwave-only cooking cycle, such energy consumption shall be measured until the end of the fan-only mode. This energy consumption would then be added to the cooking energy consumption to calculate an overall weighted per-cycle energy consumption.

For convection microwave ovens (*i.e.,* microwave ovens that incorporate convection features and possibly other means of cooking), DOE is proposing in today's NOPR that the microwave-only cooking mode be measured according to the procedures described above for microwave-only ovens, which are based on the draft revised IEC Standard 60705. DOE is also proposing that the convection-only cooking mode for convection microwave ovens be measured according to the DOE conventional ovens test procedure in 10 CFR part 430, subpart B, appendix I, with added clarifications and changes. The proposed test method involves setting the temperature controls to 375 degrees Fahrenheit (°F) and heating an 8.5 ± 0.1 pound cylindrical aluminum test block from ambient room temperature until the test block temperature has increased 234 °F above its initial temperature. The proposed amendments would also require that if the microwave oven is capable of operating in fan-only mode after the completion of the convection-only cooking cycle, such energy consumption shall be measured until the end of the fan-only mode. DOE also proposes to calculate the per-cycle energy consumption for the convection-microwave cooking mode by apportioning the microwave-only mode and convection-only mode energy consumption measurements described above based on typical consumer use.

DOE is proposing to require that the microwave-only and convection-only test series each be repeated three times unless the total microwave-only and convection-only per-cycle energy consumption for the second measurement is within 1.5 percent of

[1] TX–151 is a solidifying powder that, when combined with water creates a gel. One consumer product review organization in the United Kingdom used the TX–151 gels to simulate a food load. 77 FR 33106, 33116.

[2] DOE notes that for the proposed microwave-only mode test procedure amendments, all numerical values are presented in metric units in today's notice to demonstrate harmonization with the November 2011 draft IEC Standard 60705. In the regulatory text, all values are presented in U.S. units with metric units in parenthesis.

the value obtained from the first measurement. DOE notes that the proposed requirement for multiple test runs would improve the accuracy of the test results by accounting for the variability from test to test.

DOE is proposing in today's NOPR to establish an integrated annual energy use metric that combines standby mode, off mode, and all available active modes for each product type (*i.e.,* microwave-only ovens and convection microwave ovens). The total annual energy use would be calculated as the sum of the product of the per-cycle energy consumption and the number of annual cooking cycles for each available active mode cooking mode, plus the sum of the product of the average standby mode and off mode power consumption and the annual standby mode and off mode hours.

As noted above, EPCA requires that DOE determine whether a proposed test procedure amendment would alter the measured efficiency of a product, thereby requiring adjustment of existing standards. (42 U.S.C. 6293(e)) Because there are currently no Federal energy conservation standards for microwaves, such requirement does not apply to this rulemaking.

## III. Discussion

### *A. Products Covered by This Test Procedure Rulemaking*

DOE defines ''microwave oven'' as a class of kitchen ranges and ovens which is a household cooking appliance consisting of a compartment designed to cook or heat food by means of microwave energy, including microwave ovens with or without thermal elements designed for surface browning of food and convection microwave ovens. 10 CFR 430.2 In the March 2011 Interim Final Rule, DOE determined that this regulatory definition includes all ovens equipped with microwave capability, including convection microwave ovens [3] (*i.e.,* microwave ovens that incorporate convection features and possibly other means of cooking) because they are capable of cooking or heating food by means of microwave energy. 76 FR 12825, 12828–30 (March 9, 2011). In the January 2013 Final Rule, DOE amended the microwave oven test procedure to add a definition of convection microwave oven in 10 CFR 430.2 as a microwave oven that incorporates convection features and any other cooking means in a single compartment. 78 FR 4015, 4018 (Jan. 18, 2013). For the purpose of this active mode test procedure rulemaking, DOE is not proposing to amend the definition of convection microwave oven in 10 CFR 430.2. In today's NOPR, DOE is proposing amendments to address test procedures for both microwave-only ovens and convection microwave ovens.

DOE notes that all products that combine a microwave oven with other appliance functionality would be considered covered products under a microwave oven regulatory requirement, including microwave/conventional ranges, microwave/conventional ovens, microwave/conventional cooking tops, and other combined products such as microwave/refrigerator-freezer/charging stations.[4] However, DOE proposes not to require such ''combined products'' be tested according to the proposed amendments in today's NOPR due to a lack of information regarding appropriate testing methods and proper apportionment of energy use between the different functional components of the combined products.

### *B. Effective Date for the Test Procedure and Date on Which Use of the Test Procedure Will Be Required*

The effective date of the active mode test procedures for microwave ovens would be 30 days after the date of publication of the final rule. DOE's amended test procedure regulations codified in the CFR would clarify, though, that the procedures and calculations adopted in the final rule need not be performed to determine compliance with energy conservation standards until compliance with any final rule establishing amended energy conservation standards for microwave ovens in active mode is required. However, as of 180 days after publication of the final rule, any representations as to the active mode energy consumption of the products that are the subject of this rulemaking would need to be based upon results generated under the applicable provisions of this test procedure. (42 U.S.C. 6293(c)(2))

### *C. Consumer Usage*

DOE notes that Lawrence Berkeley National Laboratories (LBNL) conducted a consumer usage survey to evaluate the consumer usage habits for microwave ovens.[5] The survey collected data from 2258 households on the typical cycle lengths, the annual number of cooking cycles, and the annual hours of use for microwave-only ovens. The survey also collected data from 653 households on the typical cycle lengths, the annual number of cooking cycles, and the annual hours of use for each available cooking mode for convection microwave ovens. The results from the study conducted by LBNL are presented in Table III.1 and Table III.2.

TABLE III.1—ESTIMATE OF CONSUMER USE FOR MICROWAVE-ONLY OVENS

| Mode | Cycle length (*min*) | Number of annual cycles | Annual hours (*hours*) |
|---|---|---|---|
| Microwave-Only Cooking | 2.62 | 1026 | 44.9 |

TABLE III.2—ESTIMATE OF CONSUMER USE FOR CONVECTION MICROWAVE OVENS

| Mode | Cycle length (*min*) | Number of annual cycles | Annual hours (*hours*) |
|---|---|---|---|
| Microwave-Only Cooking | 2.54 | 842 | 35.7 |
| Convection-Only Cooking | 18.70 | 101 | 31.7 |

[3] Note that in the March 2011 Interim Final Rule, DOE referred to such a product as a ''combination oven.''

[4] DOE proposed in the May 2012 TP SNOPR to add a definition of ''microwave/conventional cooking top'' in 10 CFR 430.2 to state that it is a class of kitchen ranges and ovens that is a household cooking appliance consisting of a microwave oven and a conventional cooking top. DOE also proposed to add a definition of a ''microwave/conventional oven'' as a class of kitchen ranges and ovens which consists of a microwave oven and a conventional oven in separate compartments. 77 FR 28805, 28809–10 (May 16, 2012).

[5] Alison Williams, Hung-Chia (Dominique) Yang, Bereket Beraki, Louis-Benoit Desroches, Scott J. Young, Chun Chun Ni, Henry Willem, and Camilla Dunham Whitehead: LBNL; Sally M. Donovan, Consultant, Melbourne, Australia. (2012) *Surveys of Microwave Ovens in U.S. Homes.* Lawrence Berkeley National Laboratory, LBNL–5947E. December.

TABLE III.2—ESTIMATE OF CONSUMER USE FOR CONVECTION MICROWAVE OVENS—Continued

| Mode | Cycle length (*min*) | Number of annual cycles | Annual hours (*hours*) |
|---|---|---|---|
| Convection-Microwave Cooking | 15.00 | 69 | 17.3 |

In response to the June 2012 NODA, Whirlpool commented that an informal poll of their employees suggested that for convection microwave oven owners, 90 percent of field use is microwave-only cooking, and the remaining 10 percent is a mix of convection-microwave cooking and convection-only cooking. (Whirlpool, No. 15 at p. 5) The field use data presented in Table III.2 shows that microwave-only cooking, convection-only cooking, and convection-microwave cooking account for 83.2 percent, 10.0 percent, and 6.8 percent, respectively, of the total annual cooking cycles. DOE notes that these values are in relative agreement with Whirlpool's informal employee survey. As discussed in section III.F, DOE is proposing to use the consumer usage data in Table III.1 and Table III.2 to calculate the total annual energy consumption for both microwave-only ovens and convection microwave ovens.

Korea commented on the June 2012 NODA that active mode energy use testing is unnecessary for microwave ovens because microwave ovens operate in active mode for only a very short period of time. Korea stated that the European Union and Korea only test microwave ovens in standby mode. Korea commented that if DOE proceeds with a test procedure for microwave oven active mode, DOE should provide scientific data concerning the annual active mode hours for microwave ovens and the percentage of energy consumed in active mode and standby mode. (Korea, No. 20 at p. 2) Based on the data presented in section III.F, DOE estimates for microwave-only ovens that active mode energy use contributes to 75.1 percent of the total annual energy use, whereas standby mode and off mode energy use accounts for the remaining 24.9 percent of the total annual energy use. Similarly for convection microwave ovens, the active mode energy use contributes to 83.9 percent of the total annual energy use, and standby mode and off mode accounts for the remaining 16.1 percent of the total annual energy use. Because the active mode energy use accounts for a significant portion of the total annual energy use, DOE is proposing amendments in today's NOPR for measuring the active mode energy use.

*D. Specifications for the Test Methods and Measurements for the Microwave-Only Ovens*

1. IEC Standard 60705/Water Test Loads

In today's NOPR, DOE is proposing to add test methods for measuring the energy consumption of the microwave-only cooking mode for microwave-only ovens based on the November 2011 draft IEC Standard 60705. As discussed in section I, before being repealed, DOE's previous active mode test procedure for microwave ovens incorporated by reference portions of IEC Standard 705 for measuring the energy consumption of the microwave-only cooking mode. These test methods measured the amount of energy required to raise the temperature of 1 kilogram (kg) of water by 10 °C under controlled conditions. The ratio of usable output power over input power described the energy factor (EF), a measure of the cooking efficiency.[6]

DOE notes that the IEC published a revised version of IEC Standard 705, which was renamed IEC Standard 60705—Edition 3.0 1999–04, ''Household microwave ovens—Methods for measuring performance'' (IEC Standard 60705 Third Edition). IEC subsequently published an updated version, IEC Standard 60705—Edition 4.0 2010–04 (IEC Standard 60705 Fourth Edition). Both of these test methods maintained the same basic testing methods as IEC Standard 705 for measuring the active mode energy use of microwave ovens.

In the June 2012 NODA, DOE noted that the IEC is in the process of revising its current test standard for microwave ovens, IEC Standard 60705 Fourth Edition. 77 FR 33106, 33108 (June 5, 2012). The latest draft version of the IEC Standard 60705 that DOE was aware of for the June 2012 NODA was dated August 8, 2010 (hereafter referred to as the August 2010 draft IEC Standard 60705.) However, after the June 2012 NODA, DOE was made aware of a more recent draft version of IEC Standard 60705, which is dated November 25, 2011 (hereafter referred to as the November 2011 draft IEC Standard 60705.) DOE will therefore be considering this newer draft version in this rulemaking.

The November 2011 draft IEC Standard 60705 includes a new test method that continues to use water as the cooking load. The draft revised test method involves measuring the energy consumption required to heat water loads of 275 g, 350 g, and 1000 g, in 600 ml, 900 ml, and 2000 ml borosilicate glass test containers,[7] respectively, by 45–50 °C and 50–55 °C. The results from the two different temperature rise tests at each load size are used to linearly interpolate the energy consumption required to heat the load by 50 °C. The cooking cycle energy consumption for each water load size is then weighted based on consumer usage to calculate an average weighted per-cycle cooking energy consumption. The weighting factors are as follows: 275 g = 3/11; 350 g = 6/11; 1000 g = 2/11. According to the November 2011 draft IEC Standard 60705, these weighting factors are related to average household use and represent typical loads.

In addition to the cooking cycle energy consumption, the November 2011 draft IEC Standard 60705 includes methods for measuring the cooling down energy consumption for a period of 15 minutes after the completion of a 50 °C water load temperature rise cooking cycle. Although this measurement method may be applied to all microwave ovens, including those that revert back to standby mode or off mode, the November 2011 draft IEC Standard 60705 notes that the cooling down energy consumption measurement is designed to measure the energy consumption associated with ventilating the microwave oven (*i.e.,* operation of a fan) to cool down the cavity. The November 2011 draft IEC Standard 60705 includes the cooling down energy consumption measurement in an informative annex that is not required to be conducted.

DOE recognizes that the IEC has made changes to the draft IEC Standard 60705

[6] The previous DOE microwave oven test procedure also provided for the calculation of several other measures of energy consumption, including cooking efficiency and annual energy consumption.

[7] The August 2010 draft IEC Standard 60705 evaluated for the June 2012 NODA used a smaller test container for the 275 g water load (400 ml capacity) than specified in the November 2011 draft IEC Standard 60705 (600 ml capacity.) Because the dimensions of both test containers are reasonably similar, however, DOE believes the repeatability and reproducibility of the two test containers will be relatively equivalent.

testing methods and that these testing methods may be subject to further changes during the IEC review process. However, DOE decided to consider the methodology from the November 2011 draft IEC Standard 60705 for potential amendments to the DOE test procedure. In the June 2012 NODA, DOE presented results from testing to evaluate the repeatability of the August 2010 draft IEC Standard 60705 test methods for measuring the cooking cycle energy consumption. 77 FR 33106, 33108–11 (June 5, 2012). The results, summarized in Table III.3, showed minimal test-to-test variation for each water load size. As noted above, DOE believes that the repeatability and reproducibility of test results using the November 2011 draft IEC Standard 60705 would be relatively equivalent to the August 2010 draft IEC Standard 60705.

TABLE III.3—JUNE 2012 NODA DRAFT REVISED IEC STANDARD 60705 COOKING CYCLE TEST RESULTS

| | | Draft Revised IEC Standard 60705 Cooking Cycle Test | | | |
|---|---|---|---|---|---|
| | | 275 g Water load | 350 g Water load | 1000 g Water Load | Overall weighted |
| Energy Consumption (*Wh*) | Average | 37.99 | 44.34 | 114.90 | 56.11 |
| | Min | 32.54 | 39.14 | 104.86 | 50.35 |
| | Max | 46.61 | 54.68 | 130.87 | 66.54 |
| Test-to-Test Variation—Standard Error (%) | Average | 1.08 | 1.06 | 0.44 | 0.58 |
| | Min | 0.05 | 0.10 | 0.09 | 0.03 |
| | Max | 2.31 | 2.59 | 0.78 | 1.25 |

DOE also conducted testing for the June 2012 NODA to evaluate the testing methods in the August 2010 draft IEC Standard 60705 for measuring the cooling down energy consumption after the completion of the microwave-only cooking cycle. The test results showed minimal variation in the measured cooling down energy consumption from test to test and also between the different load sizes. DOE also noted that for all of the units in its test sample, which included countertop and over-the-range microwave-only and convection microwave ovens, none contained a fan that operated at the end of the microwave-only cooking cycle. DOE noted that when the door was closed after the load was removed at the end of the cooking cycle, the microwave ovens reverted back to the standby mode. 77 FR 33106, 33111–12 (June 5, 2012).

DOE also noted in the June 2012 NODA that the European Committee for Electrotechnical Standardization (CENELEC) conducted a round-robin testing program to evaluate the repeatability and reproducibility of the August 2010 draft IEC Standard 60705. A total of 5 manufacturer test labs and 5 independent test labs in Europe conducted testing according to the August 2010 draft IEC Standard 60705 on 4 microwave oven models. For the measured weighted cooking cycle energy consumption, the results showed that the test-to-test variation expressed as standard error within each laboratory was on average 0.56 percent and the lab-to-lab variation was on average 2.30 percent. For the measured weighted cooling down energy consumption, the results showed that the test-to-test variation expressed as standard error within each laboratory was on average 0.24 percent and the lab-to-lab variation was on average 6.14 percent. CENELEC determined that the repeatability and reproducibility for both the measured weighted cooking cycle energy consumption and cooling down energy consumption to be acceptable. 77 FR 33106, 33111–12 (June 5, 2012).

DOE requested comments on the test methods and test results presented in the June 2012 NODA, and other issues related to measuring energy consumption of the microwave-only cooking mode.

AHAM and Whirlpool both stated that the levels of repeatability and reproducibility of the August 2010 draft IEC Standard 60705 were determined to be acceptable by the CENELEC round-robin test program. (AHAM, No. 18 at pp. 2–3; [8] Whirlpool, No. 15 at p. 1) AHAM and Whirlpool commented that if DOE proceeds with an active mode test procedure for microwave ovens, DOE should harmonize with IEC Standard 60705 when that revised test procedure is complete for the following reasons:

- Microwave ovens do not represent a large amount of energy consumption as compared to other products and DOE should therefore not direct its limited resources to duplicate what another group has adequately done;
- The August 2010 draft IEC Standard 60705 is based on extensive testing and considered both repeatability and reproducibility;
- International harmonization will provide clarity and consistency for interested parties and reduce testing burden; and
- Issues related to the test procedure are not unique to United States; unlike some other products, microwave ovens do not vary significantly across countries. (AHAM, No. 18 at pp. 2–3; Whirlpool, No. 15 at p. 1)

In the June 2012 NODA, DOE requested comment on whether multiple test runs using the draft revised IEC Standard 60705 should be required. ASAP and NRDC commented that IEC Standard 705 required that the test be conducted three times unless the power measurement variability from the first two tests is sufficiently small. ASAP and NRDC stated that although the draft revised IEC Standard 60705 does not require multiple tests, DOE should maintain the requirement that multiple tests be performed to maintain a high degree of quality among reported data. (ASAP, NRDC, No. 17 at p. 2). Whirlpool stated that based on the CENELEC test results, testing each product twice should be sufficient if the two results show a small variation. (Whirlpool, No. 15 at p. 2)

Whirlpool noted that the cooling fan used in countertop and built-in microwave ovens is typically rated at 20–50 W, whereas a hood fan used for cooling an over-the-range microwave oven is typically rated at 100–200 watts (W). Whirlpool commented that for a microwave oven with a 1000 W rated cooking output, the total energy consumption is typically 1800 W. As a result, the cooling fan for countertop and built-in microwave ovens represents 1 to 3 percent of the total active mode energy consumption, whereas the hood cooling fan for over-

[8] A notation in the form ''AHAM, No. 18 at pp. 2–3'' identifies a written comment: (1) Made by the Association of Home Appliance Manufacturers; (2) recorded in document number 18 that is filed in the docket of the microwave oven active mode test procedure rulemaking (Docket No. EERE–2010–BT–TP–0023) and available for review at *www.regulations.gov;* and (3) which appears on pages 2 through 3 of document number 18.

the-range microwave ovens represents 5 to 10 percent of the total active mode energy consumption. (Whirlpool, No. 15 at p. 3)

The Republic of Korea (Korea) commented that water is not an optimal means of assessing the real-world energy use of microwave ovens. (Korea, No. 20 at p. 2) DOE recognizes Korea's concerns of using water as the test load. However, as discussed later in this section, DOE is unaware of any real or simulation test loads that produce repeatable and reproducible test results.

Whirlpool commented that water hardness has become an issue for other DOE test procedures, but it has not been thoroughly evaluated for microwave ovens. Whirlpool noted that although the water hardness was not measured during the CENELEC round-robin testing, which included test laboratories in ten geographical locations, the normal variation in water hardness was captured lab-to-lab reproducibility of test results. (Whirlpool, No. 15 at p. 1) DOE agrees with Whirlpool that variations in water hardness were likely captured in the lab-to-lab testing. Based on the lab-to-lab variation of 2.30 percent from the CENELEC testing, DOE is not proposing amendments to the microwave oven test procedure to include requirements for the water hardness used for testing. DOE may consider such amendments if data is made available showing that the water hardness has a measurable effect on test results.

Based on DOE and CENELEC testing, DOE agrees with AHAM and Whirlpool that the test methods in August 2010 draft IEC Standard 60705, and equivalently the November 2011 draft IEC Standard 60705, produce repeatable and reproducible results. DOE is proposing in today's NOPR to amend the microwave oven test procedure to include provisions for measuring the microwave-only active mode energy use based on the November 2011 draft IEC Standard 60705, with the following additional language to clarify the application of these provisions.

DOE notes that the current microwave oven test procedure already includes definitions ''built-in'' and ''freestanding'' to describe certain installation configurations. DOE is proposing in today's NOPR to add a definition for ''over-the-range'' to describe the installation configuration for certain microwave ovens that are intended to be installed in the cabinetry above a conventional range or cooktop. DOE is proposing to include in the definition that such products are supported by surrounding cabinetry, walls, or other similar structures on the sides, top, and/or rear of the product.

DOE noted in the June 2012 NODA that for over-the-range microwave ovens, all products equipped with a fan designed to vent air out of the microwave oven cooking cavity offer two installation configurations: (1) Such that the vent fan exhausts air from the cooking cavity to the outdoors and (2) such that the vent fan recirculates air from the cooking cavity back into the room (''recirculation configuration''). For the majority of products in DOE's test sample, the default installation configuration for the venting fan was for air recirculation back into the room. DOE is proposing to amend section 2.1.3 in Appendix I to require that over-the-range microwave ovens be installed with the exhaust vent/recirculation fan installed in the recirculation configuration in accordance with manufacturer's instructions. Requiring over-the-range microwave ovens to have their vent fans installed in the recirculation configuration will reduce testing burden by not requiring specific outdoor venting pipes or requiring the test room be capable of outdoor venting that would be necessary if the vent fan was required to be installed in the outdoor exhaust configuration. DOE also notes that requiring a single configuration for the venting fan will provide a consistent measurement method for all products.

DOE notes that the November 2011 draft IEC Standard 60705 specifies that at the beginning of each test, the oven shall not have been operated for a period of at least 6 hours. The November 2011 draft IEC Standard 60705 also specifies that the temperatures of the magnetron and power supply shall be within 2 °C of the ambient temperature and that forced cooling may be used to assist in cooling the component temperatures to ambient conditions. DOE notes that sections 1.12 and 2.6 in Appendix I currently specify that all areas of the appliance shall attain the normal nonoperating temperature before any testing begins. The normal nonoperating temperature is defined as the temperature that the appliance would attain if it remained in the test room for 24 hours ± 2.8 °C. DOE recognizes that the range in allowable temperature specified in the current DOE test procedure is slightly larger than the range specified in the November 2011 draft IEC Standard 60705. However, DOE is unaware of any data indicating that allowable temperature range will measurably affect the repeatability of the test procedure. DOE believes that the provisions in the November 2011 draft IEC Standard 60705 and the current DOE test procedure in appendix I are effectively equivalent, requiring that the appliance be at the ambient room temperature prior to the start of testing. DOE also notes that methods such as forced air cooling to attain the normal nonoperating temperature would be allowed under appendix I. For these reasons, DOE is not proposing any amendments to the normal nonoperating temperature specified in sections 1.12 and 2.6 in appendix I.

DOE notes that the November 2011 draft IEC Standard 60705 specifies that the water test load should be placed on a thermally insulating pad when making temperature measurements. DOE is proposing in today's NOPR to require the use of an insulating pad with a heat capacity of 1.30 kiloJoule (kJ)/kg-K or less, which is the heat capacity of polystyrene. DOE notes that polystyrene is a low-cost and readily available material that will effectively insulate the water test load while making temperature measurements.

DOE is proposing to include test methods for measuring the energy consumption of the fan-only mode while the microwave is cooling down after the completion of the microwave-only cooking cycle. As noted above, none of the microwave ovens in DOE's test sample were equipped with a fan that operated at the end of the microwave-only cooking cycle to cool down the microwave oven, but instead reverted back to standby mode when the load was removed and the door was closed. However, DOE recognizes that there may be microwave ovens on the market or future microwave ovens that could potentially operate in fan-only mode at the end of the microwave-only cooking cycle. DOE is, therefore, proposing to include provisions for measuring the fan-only mode cooling down energy consumption only for microwave ovens equipped with a fan that operates automatically at the completion of the cooking cycle to cool down the microwave oven. As a result, DOE is proposing to define ''fan-only mode'' as a mode that is not user-selectable and in which a fan circulates air internally or externally to the microwave oven for a finite period of time after the end of the cooking cycle.

DOE is proposing that if the microwave oven is capable of operating in fan-only mode while the microwave is cooling down after the completion of the microwave-only cooking cycle, such energy consumption shall be measured based on the provisions in the November 2011 draft IEC Standard 60705 with the following modification. After the completion of the 50 °C

temperature rise cooking cycle, the test load would then be removed from the microwave oven and the door closed within 30 ± 2 seconds after the completion of the cooking cycle, at which point the fan-only mode energy consumption and duration would then be measured until the end of the fan-only mode. DOE recognizes that the duration of fan-only mode may vary from product to product. DOE is, therefore, proposing to measure energy use and duration of the fan-only mode rather than for a fixed period of 15 minutes as specified in the November 2011 draft IEC Standard 60705.

DOE is not aware of the typical duration of fan-only mode operation after the completion of the microwave-only cooking cycle because none of the microwave ovens in DOE's test sample operated in such a mode. DOE recognizes that for a shorter cycle time, the duration of the fan-only mode may only be a short period of time. As a result, DOE is seeking comment on whether the requirement that the microwave oven door be closed within 30 ± 2 seconds after the completion of the microwave-only cooking cycle is appropriate for all microwave ovens to accurately measure the fan-only mode energy use.

Although the November 2011 draft IEC Standard 60705 does not require multiple repeat test runs, DOE agrees with the comments discussed above that requiring multiple test runs will improve the accuracy of the test results. Based on the provisions in IEC Standard 705, DOE is proposing to require that the full microwave-only test series be repeated three times unless the total microwave-only per-cycle energy consumption for the second measurement is within 1.5 percent of the value obtained from the first measurement.

DOE notes that the proposed amendments would renumber sections currently in Appendix I. As a result, DOE is also proposing to correct the relevant section number references throughout appendix I.

2. Food Simulation Mixture Test Loads

In the June 2012 NODA, DOE conducted testing on a limited sample of microwave ovens using the microwave-only cooking mode to evaluate mixtures that would simulate food loads that may be reheated in a microwave. The mixtures were composed of water and basic food ingredients (*i.e.,* fats, sugars, salt, fiber, proteins, etc.) with a total combined mass of 350 g. DOE selected the 350 g load size (using the 900 ml borosilicate glass container) based on the draft revised IEC Standard 60705 weighting factors for the load size with the highest frequency of use. The ingredients composing each mixture were based on nutritional labels of commonly microwaved foods. DOE also tested mixtures with only one or two key ingredients to evaluate whether the repeatability could be improved by limiting the number of ingredients. The results from this testing showed a higher range and average test-to-test variation compared to the water-only load and compared to the results using the August 2010 draft IEC Standard 60705 test method. 77 FR 33106, 33113 (June 5, 2012).

In the June 2012 NODA, DOE requested comment on the suitability of using actual or simulated food loads for testing. AHAM and Whirlpool commented that, based on DOE's test results and the reasons outlined in their previous comments on the October 2011 RFI, real and simulation food loads do not produce repeatable or reproducible results. AHAM and Whirlpool also added that CENELEC previously sponsored a study that examined different food loads, including real food, artificial food, and salt water, and concluded that food loads cannot meet their requirements of repeatability and reproducibility. (AHAM, No. 18 at p. 2; Whirlpool, No. 15 at pp. 1, 3–4) R.F. Schiffmann Associates, Inc. (Schiffmann) commented that all natural food materials, whether chemically modified or not, are derived from a living material, which may change with time of year, growing location, weather conditions, and storage conditions, and thus cannot be standardized. Schiffmann also stated that food simulants may be a viable alternative, but at minimum, the following properties must be maintained from sample to sample to ensure statistically reproducible materials and conditions:

- Moisture level, pH, water activity, viscosity, and salinity from sample to sample;
- Shape, dimensions, weight, and phase;
- If the simulant is in the form of an emulsion or colloidal suspension, the particle size of the discontinuous phase or suspended particles;
- Ionic strength;
- Location within the microwave oven and heating time from test to test; and
- The amount of time between tests; (Schiffman, No. 19 at p. 1–2)

ASAP and NRDC commented that repeatability and reproducibility of the test procedure are critical, and achieving them may be at the expense of testing representative food loads. ASAP and NRDC stated that the active mode energy savings for microwave ovens may not justify the added test procedure development effort to determine the optimal simulated food load. (ASAP & NRDC, No. 17 at p. 1).

Korea stated that if real food is used for testing, the results need to be repeatable and reproducible by standardizing the composition of food samples used. Korea stated that DOE would also need to ensure that the standardized food samples are readily available at a reasonable cost. (Korea, No. 20 at p. 2)

Based on DOE's test results and the comments from interested parties in response to the June 2012 NODA, DOE is not proposing amendments in today's NOPR to require the use of real or simulated food loads. If data are made available for any real or simulated food loads showing repeatable and reproducible results, DOE may consider amendments to the DOE microwave oven test procedure at that time.

*E. Specifications for the Test Methods and Measurements for Convection Microwave Ovens*

In today's NOPR, DOE is proposing test methods for measuring the active mode energy consumption of convection microwave ovens. DOE is proposing to measure the energy consumption of the microwave-only cooking mode for convection microwave ovens using the test procedures described above in section III.D.1. DOE is proposing to measure the energy consumption of the convection-only cooking mode for convection microwave ovens based on the DOE conventional ovens test procedure in 10 CFR part 430, subpart B, Appendix I, with added clarifications and changes. Finally, DOE is proposing to calculate the energy consumption of the convection-microwave cooking cycle by apportioning the microwave-only mode and convection-only mode energy consumption measurements based on typical consumer use.

In the June 2012 NODA, DOE noted that convection microwave ovens typically can be operated using the microwave-only cooking mode, convection-only cooking mode, and convection-microwave cooking mode. DOE investigated whether testing procedures could be developed to evaluate the convection-microwave and convection-only cooking modes of convection microwave ovens. 77 FR 33106, 33114 (June 5, 2012).

In response to the June 2012 NODA, ASAP and NRDC commented in support of developing test methods for

measuring the energy consumption of convection microwave ovens to better differentiate products available on the market based on efficiency and design options. ASAP and NRDC also commented that all inherent assumptions should be justified with field usage data, surveys, or other data sources, and question the benefits of adopting a test procedure before such information has been collected. (ASAP & NRDC, No. 17 at pp. 1–2) AHAM and Whirlpool stated that because the convection microwave ovens represented 4.1 percent of total microwave oven shipments in 2010 and because the draft revised IEC Standard 60705 does not include test procedures for the convection-microwave cooking mode, DOE should not develop a test procedure for convection microwave ovens. (AHAM, No. 18 at p. 3; Whirlpool No. 15 at pp. 1, 5)

Based on the information from AHAM and Whirlpool that convection microwave ovens represent approximately 4.1 percent of U.S. microwave oven shipments and data from *Appliance Magazine* showing 9.552 million microwave oven shipments in 2011,[9] convection microwave ovens represent nearly 400,000 annual shipments. DOE believes that convection microwave ovens therefore represent a significant number of shipments and warrant separate test methods. The estimates of the annual energy use of the different cooking modes for a typical convection microwave oven, presented below in section III.F, show that the convection-only cooking mode and convection-microwave cooking mode energy consumption account for a significant portion of the total annual energy consumption for these products (28.2 percent and 16.9 percent, respectively). DOE also notes that, for the reasons discussed in section III.G, the test methods for measuring the convection-only and convection-microwave cooking energy use are not unduly burdensome to conduct. For these reasons, DOE is proposing amendments to measure the convection-only cooking and convection-microwave cooking energy use in convection microwave ovens.

1. Convection-Only Cooking Mode

DOE investigated whether a testing procedure could be developed to evaluate the convection-only cooking mode of a convection microwave oven. For the June 2012 NODA, DOE developed a testing method based on the DOE conventional cooking products test procedure for conventional ovens in 10 CFR part 430, subpart B, appendix I, to measure the energy consumption of the convection cooking mode for convection microwave ovens. The DOE conventional oven test procedure involves setting the temperature control for the convection cooking cycle such that the temperature inside the oven is 325 ± 5 °F higher than the room ambient air temperature (77 ± 9 °F). An 8.5 ± 0.1 pound cylindrical aluminum test block is then heated from ambient room air temperature ± 4 °F until the test block temperature has increased 234 °F above its initial temperature. The measured energy consumption is used to calculate the cooking efficiency and energy factor. 77 FR 33106, 33118 (June 5, 2012).

In the June 2012 NODA, DOE noted that the cavity temperature requirement of 325 ± 5 °F higher than the room ambient air temperature would result in a temperature setting close to 400 °F. Based on DOE's review of products currently available on the U.S. market, a number of convection microwave ovens do not have a 400 °F temperature setting, but all convection microwave ovens that DOE surveyed have a 375 °F temperature setting. As a result, DOE modified the test method to conduct this testing using a temperature control setting of 375 °F to heat the aluminum test block to 234 °F above its initial temperature. In addition, DOE also specified that the aluminum test block be placed on the metal cooking rack provided by the manufacturer. 77 FR 33106, 33118 (June 5, 2012). The results from this testing, summarized in Table III.4, showed minimal test-to-test variation for the convection-only cooking cycle.

TABLE III.4—JUNE 2012 NODA CONVECTION-ONLY COOKING CYCLE TEST RESULTS

| | | Convection-only cooking cycle |
|---|---|---|
| Cooking Efficiency (%) | Average | 9.06 |
| | Min | 6.51 |
| | Max | 12.42 |
| Test-to-Test Variation—Standard Error (%) | Average | 1.30 |
| | Min | 0.68 |
| | Max | 2.11 |

With regards to the 234 °F temperature rise used in the convection-only test method, Whirlpool commented in response to the June 2012 NODA that if the intent is to accommodate convection microwave ovens that fall 25 °F short of the temperature rise specified in the DOE conventional oven test procedure, an adjustment of 166 °F seems illogical. (Whirlpool, No. 15 at p. 6) DOE notes that it is not considering adjusting any temperatures by 166 °F. DOE clarifies that the temperature control would be set using the user interface controls to 375 °F, and that the temperature rise of the test block during the test cycle would be 234 °F above the initial block temperature.

In the June 2012 NODA, DOE requested comment on whether the cooling fan energy consumption should be included in the efficiency metric for convection microwave ovens. ASAP and NRDC commented that DOE should require the measurement of cooling fan energy use for both microwave-only, and convection microwave ovens. ASAP and NRDC questioned the logic of measuring the cooling fan energy consumption for a specific period of time (*i.e.,* 15 minutes) instead of measuring the energy consumption until the cooking cavity drops by a certain temperature difference. (ASAP & NRDC, No. 17 at p. 2) Whirlpool commented that requiring the measurement of the fan-only mode cooling down energy consumption would add considerable test burden to measure a very small amount of energy in a very small product segment and would not

[9] ''60th Annual Appliance Industry Forecast.'' *Appliance Market Research Report, Appliance Magazine,* May 2012.

contribute to goal of national energy savings. (Whirlpool, No. 15 at p. 6)

Based on the test results and analysis discussed above, DOE is proposing amendments to the microwave oven test procedure in Appendix I, to include test methods for measuring the active mode energy consumption for convection-only cooking mode for convection microwave ovens based on the test methods described above, with the following additional clarifications.

DOE notes that in the January 2013 Final Rule for the microwave oven standby and off mode test procedure, DOE amended the microwave oven test procedure to provide a definition of convection microwave oven in 10 CFR 430.2. The amendment defines convection microwave ovens as a microwave oven that incorporates convection features and any other means of cooking in a single compartment. 78 FR 4015, 4018 (Jan. 18, 2013). DOE believes that the definition for convection microwave ovens is also suitable for today's proposed amendments, and is not proposing to amend this definition.

DOE is proposing to require that if the convection microwave oven allows for the turntable to be turned on or off, the appliance shall be tested with the turntable turned on. DOE notes that the turntable is typically turned on by default, and as a result, is likely the most common configuration used by consumers. DOE believes this will provide a consistent and comparable test method from product to product.

DOE recognizes that different microwave ovens may have different fan-only mode durations. As a result, DOE is proposing in today's NOPR to require that the energy use and duration of the fan-only mode be measured at the end of the convection-only cooking cycle until the completion of the fan-only mode. Based on DOE's testing, the duration of the fan-only mode was between 0 and 7 minutes. DOE believes the added testing time to measure fan-only mode is minimal compared to the overall convection-only cooking test cycle length, which was, on average, approximately 73 minutes among the units in DOE's test sample. As a result, the proposed requirement to measure the fan-only mode would add little to the overall testing burden.

DOE is proposing to add new sections 4.4.7 and 4.4.7.1 in Appendix I to calculate the convection microwave oven convection-only cooking cycle energy consumption using the same basic calculations used for convection ovens specified in 10 CFR part 430, subpart B, appendix I, sections 4.1.1 and 4.1.1.1. DOE is proposing to add the calculated convection-only cooking cycle energy consumption and the measured fan-only mode energy consumption to calculate the total convection-only mode energy consumption. DOE is also proposing to apply a field use factor to the calculation of the convection-only mode energy consumption to account for the typical consumer use of this cooking mode. DOE determined the field use factor based on the quotient of the average convection-only cooking cycle length based on consumer use data presented in section III.C (18.70 minutes) divided by the average measured convection-only cooking cycle test length for the units in DOE's test sample (72.68 minutes). Based on this information, DOE is proposing a convection-only cooking field use factor of 0.26.

Similar to the proposed provisions for the microwave-only cooking mode, DOE is proposing to require that the convection-only test be repeated three times unless the total convection-only per-cycle energy consumption for the second measurement is within 1.5 percent of the value obtained from the first measurement. DOE notes that the proposed requirement for multiple repeat test runs would improve the accuracy of the test results.

2. Convection-Microwave Cooking Mode

In the June 2012 NODA, DOE presented test results to evaluate test loads and test methods for measuring the energy use of the convection-microwave cooking mode using real food loads. The test results for real food loads showed high test-to-test variation for all of the loads tested. DOE noted in the June 2012 NODA that in addition to the issues with test-to-test repeatability, the lab-to-lab reproducibility would also be difficult to maintain because different foods are produced under different conditions (*i.e.,* climate, geography, growing conditions, genetics, breeding, etc.) 77 FR 33106, 33115–16 (June 5, 2012). DOE also evaluated a food simulation load, the TX–151 solidifying powder, using the same basic test method as described above for the shortening tests. The June 2012 NODA test results again showed high levels of test-to-test variation. 77 FR 33106, 33116–8 (June 5, 2012).

In the June 2012 NODA, DOE requested comment on the suitability of incorporating real and simulation food loads for measuring the energy use of convection microwave ovens. Whirlpool commented that there is no known test procedure or test load that is appropriate for convection microwave ovens. Whirlpool stated that food loads are not appropriate for the reasons they provided in response to the October 2011 RFI, and that water loads are not appropriate for convection-only cooking mode because temperatures are much higher than the boiling temperature for water. Whirlpool also commented that IEC Standard 60350, ''Household electrical cooking appliances—Methods for measuring performance,'' is not applicable for a microwave oven because thermocouples are required to be used to measure the temperature of the stone test load during heating. According to Whirlpool, such measurements are not allowed in microwave ovens because the thermocouples will act as antennae and the resulting microwave leakage would reach unacceptable levels. In addition, Whirlpool stated that the microwave oven turntable would make temperature measurements during heating difficult or even impossible. (Whirlpool, No. 15 at p. 4)

Whirlpool also commented that the test-to-test variation for both real and simulated food loads presented by DOE in the June 2012 NODA is too high to allow for a repeatable and reproducible test procedure. Whirlpool noted that for real foods, the variation will likely be much higher when including variation in time of the year and geographical location of the food production, as well as lab-to-lab variations. (Whirlpool, No. 15 at p. 4) Whirlpool also stated that it had previously conducted tests using gels as a food simulation load, but abandoned them due to several issues related to measuring accuracy and repeatability, and the overly burdensome and time-consuming process of preparing the test loads. (Whirlpool, No. 15 at p. 5) As discussed in section III.C, AHAM and Schiffmann also commented that use of actual or simulated food loads for cooking energy consumption measurements does not produce repeatable or reproducible results. (AHAM, No. 18 at p. 2; Schiffmann, No. 19 at pp. 1–2)

Based on the test results in the June 2012 NODA, DOE agrees with commenters that test methods using actual or simulated food loads do not produce repeatable or reproducible results. DOE also agrees that using thermocouples during a convection-microwave cooking cycle would not be appropriate due to safety concerns. As a result, DOE is not proposing amendments to require the use of real or simulation food loads for measuring the energy consumption of convection microwave ovens.

In the June 2012 NODA, DOE stated that it may consider using the results

from the microwave-only cooking and convection-only cooking test measurements to calculate the convection-microwave cooking cycle energy consumption. 77 FR 33106, 33119 (June 5, 2012). AHAM commented that measuring the microwave-only and convection-only cooking modes separately and apportioning the energy use to calculate the per-cycle energy use for the convection-microwave cooking mode would be too burdensome compared to the trivial energy savings associated with convection microwave ovens. (AHAM, No. 18 at p. 3)

Because DOE was unable to identify a test load that produced repeatable and reproducible results for the convection-microwave cooking mode, DOE is proposing to use the results from the microwave-only and convection-only cooking cycle tests to determine the convection-microwave cooking cycle energy consumption. First, because the convection-microwave cooking cycle length is different from the microwave-only and convection-only cooking cycle lengths, DOE is proposing to apply a field use adjustment to both the per-cycle microwave-only and convection-only cooking energy consumption. The field use adjustment would be based on the ratio of the convection-microwave cooking cycle length to either the microwave-only cycle length (15.00/2.54 = 5.91) or convection-only cooking cycle length (15.00/18.70 = 0.80) based on the consumer use data presented in section III.C.

DOE is proposing that the per-cycle convection-microwave cooking mode energy consumption would then be calculated by apportioning the microwave-only cooking energy consumption and convection-only cooking energy consumption based on the amount of time typical convection microwave ovens use each cooking mode during a convection-microwave cooking cycle. DOE noted in the June 2012 NODA that for the majority of microwave ovens in its test sample, the default program setting for convection-microwave cooking only requires the user to set the overall cooking time, and the product cycles between microwave-only cooking and convection-only cooking. The nominal amount of time spent microwave-only cooking and convection only cooking for each individual microwave/convection cycle varies from model to model. However DOE noted that for an overall single cooking cycle, the microwave-only cooking accounted for 30 percent of the cooking time and convection-only cooking accounted for the remaining 70 percent of the total cooking time per-cycle on average for all of the units DOE tested. 77 FR 33106, 33114 (June 5, 2012). As a result, DOE is proposing to use weighting factors of 30 percent for microwave-only cooking and 70 percent for convection-only cooking to calculate the average per-cycle convection-microwave cooking energy consumption.

*F. Measures of Energy Consumption*

In today's NOPR, DOE is proposing to adopt an integrated annual energy use metric that combines the active mode energy consumption of each possible cooking mode (*i.e.,* microwave-only cooking, convection-only cooking, and convection-microwave cooking) with the standby and off mode energy consumption.

In order to develop an integrated metric that combines the active mode energy consumption of each possible cooking mode with the standby and off mode energy consumption, DOE evaluated the data from the consumer use survey conducted by LBNL, presented in section III.D. In addition, DOE also estimated the average power consumption for each operating mode based on its testing. Based on this data, DOE calculated the estimated annual energy use for each operating mode. The results of this analysis are presented in Table III.5 and Table III.6.

TABLE III.5—ESTIMATE OF CONSUMER USE FOR MICROWAVE-ONLY OVENS

| Mode | Cycle length (*min*) | Number of annual cycles | Annual hours (*hours*) | Average power (*W*) | Annual energy use (*kWh*) |
|---|---|---|---|---|---|
| Microwave-Only Cooking | 2.62 | 1026 | 44.9 | 1582.7 | 71.063 |
| Microwave-Only Fan-Only Mode | 0 | 0 | 0 | 0 | 0 |
| Standby/Off | ..... | ..... | 8715.1 | 2.7 | 23.531 |

TABLE III.6—ESTIMATE OF CONSUMER USE FOR CONVECTION MICROWAVE OVENS

| Mode | Cycle length (min) | Number of annual cycles | Annual hours (hours) | Average power (W) | Annual energy use (kWh) |
|---|---|---|---|---|---|
| Microwave-Only Cooking | 2.54 | 842 | 35.7 | 1582.7 | 56.502 |
| Convection-Only Cooking | 18.70 | 101 | 31.7 | 1299.4 | 41.191 |
| Convection-Microwave Cooking | 15.00 | 69 | 17.3 | 1421.3 | 24.588 |
| Microwave-Only Fan-Only Mode | 0 | 0 | 0 | 0 | 0 |
| Convection-Only Fan-Only Mode | *1.10 | 101 | 1.9 | 39.1 | 0.074 |
| Convection-Microwave Fan-Only Mode | *0.88 | 69 | 1.0 | 39.1 | 0.039 |
| Standby/Off | ..... | ..... | 8672.4 | 2.7 | 23.415 |

*The consumer use estimates are based on a microwave oven that is capable of operating in fan-only mode. The average fan-only mode cycle length was determined based DOE's testing of the convection-only cooking mode scaled based on the difference between the measured test procedure cycle length and the average consumer cycle length.

DOE is proposing to use the estimates of consumer use for each operating mode presented in Table III.5 and Table III.6 to calculate the total annual energy consumption for both microwave-only ovens and convection microwave ovens. DOE proposes to amend the microwave oven test procedure to determine the annual energy use associated with microwave-only ovens by:

(1) Calculating the product of the total weighted microwave-only per-cycle energy consumption and the number of annual microwave-only cooking cycles for microwave-only ovens;

(2) Calculating the products of the average standby and off mode power and the allocated annual hours for each respective mode;

(3) Summing these results; and

(4) Multiplying the sum by 0.001 to convert from Wh to kWh.

DOE proposes to amend the microwave oven test procedure to determine the annual energy use associated with convection microwave ovens by:

(1) Calculating the products of the microwave-only mode, convection-only mode, and convection-microwave mode per-cycle energy consumption and the allocated hours for each mode for convection microwave ovens;

(2) Calculating the products of the average standby and off mode power and the allocated annual hours for each respective mode;

(3) Summing these results; and

(4) Multiplying the sum by 0.001 to convert from Wh to kWh.

The total number of standby mode and off mode hours would be equal to the total number of non-active mode hours. This would be calculated as the number of total hours in a year (8760) minus the average cooking cycle times based on consumer use and the fan-only mode times (if a product is capable of fan-only mode) for each cooking mode. Because the convection-only cooking fan-only mode time measured under the proposed test procedure would be based on a longer cooking cycle, DOE is proposing to scale the fan-only mode time using the convection-only cooking cycle length field use factor (equal to 0.26) discussed above in section III.E.1. DOE also observed that microwave ovens that operate in fan-only mode after the convection-only cooking cycle also operate in fan-only mode after the convection-microwave cooking cycle. Because the length of the fan-only mode is based on either the cavity temperature or a fixed duration based on the cooking cycle length, DOE believes that the fan-only mode time would likely be equivalent for a convection-only cooking and convection-microwave cooking cycle of the same length. As a result, DOE is proposing to use the convection-only cooking fan-only mode time, but further scaled by the difference between the average convection-microwave cooking cycle length and convection-only cooking cycle length based on the consumer use data (15.00 minutes/18.70 minutes).

DOE is unaware of any microwave ovens currently available on the U.S. market that are capable of operating in both standby mode and off mode. As a result, DOE is not aware of any data available to determine the appropriate split of annual non-active mode hours between standby mode and off mode for products that are capable of operating in both modes. DOE is proposing in today's NOPR, therefore, to split the total hours evenly between standby and off modes for those products capable of functioning in both modes. DOE believes this would provide an incentive to manufacturers to offer an energy saving feature that allows consumers to manually select between standby mode and off mode. If data is made available that indicates a different allocation of hours between standby and off mode, DOE may consider revising this allocation.

### *G. Compliance With Other EPCA Requirements*

#### 1. Test Burden

EPCA requires that test procedures shall be reasonably designed to produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use. Test procedures must also not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

In the June 2012 NODA, DOE requested comments on the test burden associated with testing the microwave-only cooking mode and convection-only cooking mode. Whirlpool commented that incorporating the test methods from the draft revised IEC Standard 60705 for measuring the energy consumption of the microwave-only cooking mode would increase test burden. However, Whirlpool did not see any workable alternative. Whirlpool estimated that with one repetition of the testing series (*i.e.,* high/low final water temperature tests for 3 different water load sizes) and 3 trial runs to determine the appropriate heating times, a total of approximately 15 tests would be required, not including any fan-only mode cooling down tests. Based on an average test time of 15 minutes, Whirlpool stated that approximately six tests could be conducted per day, and thus a complete testing series for one product would require two and a half days to complete. (Whirlpool, No. 15 at p. 2) Whirlpool and AHAM both commented that a test procedure for measuring the energy consumption of the convection-only and convection-microwave cooking modes would add significant test burden compared to the small energy savings that would result from addressing convection microwave ovens. (AHAM, No. 18 at p. 3; Whirlpool, No. 15 at p. 6)

The proposed amendments in today's NOPR would add test procedures for measuring the active mode energy use of the microwave-only cooking mode based on the provisions in the November 2011 draft IEC Standard 60705. DOE notes that the cost of test equipment would be similar to the cost of equipment under the previous DOE microwave oven test procedure, but with two additional sized test containers (600 ml and 900 ml). DOE estimates that the one-time investment for test equipment (*i.e.,* 600 ml, 900 ml, 2000 ml test containers; power meter; thermocouples) is approximately $3,000, which is $300 more than the one-time investment for testing under the previous DOE microwave oven test procedure. Manufacturers that already have the test equipment required for the previous DOE test method would only require a one-time investment of $300 for the two additional sized test containers. DOE estimates that the labor for testing a single model would cost between $3,000 and $4,200, depending on the number of repeat tests required, which is approximately $2,600 to $3,600 more than the labor for testing using the previous DOE microwave oven test procedure,

The proposed convection-only test method would require the same equipment that is required for the DOE conventional ovens test procedure in 10 CFR part 430, subpart B, appendix I. DOE estimates that, in addition to the equipment required for proposed microwave-only testing, the one-time investment for test equipment for convection-only testing (*i.e.,* test block) would add $400. DOE estimates that the labor for convection-only testing would cost between $600 and $850 per model, depending on the number of repeat tests required.

DOE does not believe these costs represent an excessive burden for test labs or manufacturers given the significant investment necessary to manufacture, test, and market consumer appliances. For these reasons, DOE tentatively concludes that the proposed amended test procedures would produce test results that measure the energy consumption of microwave ovens during representative use, and that the test procedures would not be unduly burdensome to conduct.

#### 2. Certification Requirements

EPCA authorizes DOE to enforce compliance with the energy and water conservation standards established for certain consumer products. On March 7, 2011, the Department revised, consolidated, and streamlined its existing certification, compliance, and enforcement regulations for certain consumer products and commercial and industrial equipment covered under EPCA, including microwave ovens. 76 FR 12422. These regulations are codified in 10 CFR 429.23 (conventional cooking tops, conventional ovens, microwave ovens).

The certification requirements for microwave ovens consist of a sampling plan for selection of units for testing and requirements for certification reports. Because there are no existing energy conservation standards for microwave ovens, DOE is not proposing any amendments to the certification reporting requirements for these products.

## IV. Procedural Issues and Regulatory Review

### *A. Review Under Executive Order 12866*

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

### *B. Review Under the Regulatory Flexibility Act*

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq*) requires preparation of a regulatory flexibility analysis (RFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE's procedures and policies may be viewed on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*). DOE reviewed today's NOPR under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003.

In conducting this review, DOE first determined the potential number of affected small entities. The Small Business Administration (SBA) considers an entity to be a small business if, together with its affiliates, it employs fewer than the threshold number of workers specified in 13 CFR part 121 according to the North American Industry Classification System (NAICS) codes. The SBA's Table of Size Standards is available at: *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.* The threshold number for NAICS classification 335221, *Household Cooking Appliance Manufacturers,* which includes microwave oven manufacturers, is 750 employees. DOE surveyed the AHAM member directory to identify manufacturers of microwave ovens. In addition, as part of the appliance standards rulemaking, DOE asked interested parties and AHAM representatives within the microwave oven industry if they were aware of any small business manufacturers. DOE consulted publicly available data, purchased company reports from sources such as Dun & 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 estimates that there is one small business which manufactures a product which combines a microwave oven with other appliance functionality. However, DOE is not proposing at this time to amend the test procedures for microwave ovens to include provisions for measuring the energy use for the microwave portion of such combined products. As a result, DOE tentatively concludes and certifies that the proposed rule would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will transmit the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

### *C. Review Under the Paperwork Reduction Act of 1995*

Manufacturers of microwave ovens must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for microwave ovens, 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 microwave ovens. (76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

### *D. Review Under the National Environmental Policy Act of 1969*

In this proposed rule, DOE is adopting test procedure amendments that it expects will be used to develop and implement future energy conservation standards for microwave ovens. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule would amend the existing test procedures without affecting the amount, quality or distribution of energy usage, and, therefore, would not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

### *E. Review Under Executive Order 13132*

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 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 today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

*F. Review Under Executive Order 12988*

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

*G. Review Under the Unfunded Mandates Reform Act of 1995*

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

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

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

*I. Review Under Executive Order 12630*

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

*J. Review Under the 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 today's proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

*K. Review Under Executive Order 13211*

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

Today's regulatory action to amend the test procedure for measuring the energy efficiency of microwave ovens is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

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

Under section 301 of the DOE Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with

section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition. The proposed rule does not incorporate by reference testing methods from commercial standards, so these requirements do not apply.

## V. Public Participation

### *A. Attendance at Public Meeting*

The time, date and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this document. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov.* As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site (*http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/36*). Participants are responsible for ensuring their systems are compatible with the webinar software.

### *B. Procedure for Submitting Prepared General Statements for Distribution*

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make a follow-up contact, if needed.

### *C. Conduct of Public Meeting*

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments on the proceedings as well as on any aspect of the rulemaking until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will permit, as time allows, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *Docket* section at the beginning of this notice. In addition, any person may buy a copy of the transcript from the transcribing reporter.

### *D. 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 notice.

Submitting comments via regulations.gov. The regulations.gov web page will require you to provide your name and contact information. 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.

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

DOE processes submissions made through 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 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 to 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. It is not necessary to submit printed copies. No facsimiles (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 are 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 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.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

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).

*E. 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 on the following issues:

1. Microwave-Only Oven Test Method

DOE seeks comment on the proposal to measure the active mode energy use of the microwave-only cooking mode for microwave-only ovens based on the provisions in the November 2011 draft IEC Standard 60705. DOE also seeks comment on the requirement to repeat the full microwave-only test series three times unless the total microwave-only per-cycle energy consumption for the second measurement is within 1.5 percent of the value obtained from the first measurement. (*See* section III.D)

2. Convection Microwave Oven Test Method

DOE seeks comment on the proposal to measure the active mode energy use of the microwave-only cooking mode for convection microwave ovens based on the provisions in the November 2011 draft IEC Standard 60705. DOE seeks comment on the proposal to measure the active mode energy use of the convection-only cooking mode for convection microwave ovens based on the provisions in the DOE conventional oven test procedure in 10 CFR part 430, subpart B, appendix I, with additional modifications specific for microwave ovens. DOE also seeks comment on the requirement to repeat the convection-only test three times unless the total convection-only per-cycle energy consumption for the second measurement is within 1.5 percent of the value obtained from the first measurement. Finally DOE seeks comment on the proposed method for calculating the energy use of the convection-microwave cooking mode based on the test results from the microwave-only and convection-only tests. (*See* section III.E)

3. Fan-Only Mode Test Method

DOE seeks comment on the proposal to require that the microwave-only fan-only mode and convection-only fan-only mode be measured for only those products that are capable of operating in fan-only mode. DOE welcomes comment on the proposed requirement to measure the fan-only mode until the end of the fan-only mode, rather than for a fixed period of time. DOE also welcomes comment on whether the proposed requirement to close the microwave oven door within 30 ± 2 after the completion of the microwave-only cooking cycle is appropriate to accurately measure the microwave-only fan-only mode energy use. (*See* sections III.D and III.E)

4. Integrated Annual Energy Use Metric

DOE seeks comment on the proposal to establish an integrated annual energy use metric. DOE specifically seeks comment and additional data on the consumer usage habits for each operating mode for both microwave-only ovens and convection microwave ovens to supplement the data from the LBNL consumer use survey. (*See* section III.F)

5. Test Burden

DOE welcomes comment on the testing burden associated with the proposed amendments, in particular for the microwave-only and convection-only test methods. When providing comments, please quantify and describe the associated testing burdens (in terms of cost and time). (*See* section III.G)

## VI. Approval of the Office of the Secretary

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

**List of Subjects in 10 CFR Part 430**

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

Issued in Washington, DC, on January 18, 2013.

**Kathleen B. Hogan,**

*Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.*

For the reasons stated in the preamble, DOE is proposing to amend part 430 of title 10 of the Code of Federal Regulations, as set forth below:

## PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 2. Section 430.23 is amended:
■ a. By revising paragraph (i)(1);
■ b. By redesignating paragraphs (i)(12) and (i)(13) as (i)(13) and (i)(14), and

revising newly redesignated paragraph (i)(13); and

■ c. By adding paragraph (i)(12).

The revisions read as follows:

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

* * * * *

(i) *Kitchen ranges and ovens.* (1) The estimated annual operating cost for conventional ranges, conventional cooking tops, conventional ovens, and microwave ovens shall be the sum of the following products: (i) The total annual electrical energy consumption for any electrical energy usage, in kilowatt-hours (kWh) per year, times the representative average unit cost for electricity, in dollars per kWh, as provided pursuant to section 323(b)(2) of the Act; plus (ii) the total annual gas energy consumption for any natural gas usage, in British thermal units (Btu) per year, times the representative average unit cost for natural gas, in dollars per Btu, as provided pursuant to section 323(b)(2) of the Act; plus (iii) the total annual gas energy consumption for any propane usage, in Btu per year, times the representative average unit cost for propane, in dollars per Btu, as provided pursuant to section 323(b)(2) of the Act. The total annual energy consumption for conventional ranges, conventional cooking tops, conventional ovens, and microwave ovens shall be as determined according to 4.3, 4.2.2, 4.1.2, and 4.4.10 respectively, of appendix I to this subpart. The estimated annual operating cost shall be rounded off to the nearest dollar per year.

* * * * *

(12) The annual energy use for microwave ovens, expressed in kilowatt-hours per year, as determined in accordance with 4.4.10 of appendix I to this subpart.

(13) Other useful measures of energy consumption for conventional ranges, conventional cooking tops, conventional ovens, and microwave ovens shall be those measures of energy consumption which the Secretary determines are likely to assist consumers in making purchasing decisions and which are derived from the application of appendix I to this subpart.

* * * * *

■ 3. Appendix I to Subpart B of Part 430 is amended:

■ a. In section 1. *Definitions:*

■ 1. By revising section 1.6;

■ 2. By redesignating sections 1.14 through 1.19 as sections 1.15 through 1.20; and

■ 3. By adding section 1.14;

■ b. In section 2. *Test Conditions,* by revising sections 2.1.3, 2.5.1, 2.7, 2.7.1, 2.9.1.1, 2.9.3.1, 2.9.3.2, and 2.9.5 and adding sections 2.8, 2.8.1, 2.8.2, 2.8.3, 2.9.3.5, 2.9.6, and 2.9.7;

■ c. In section 3. *Test Methods and Measurements:*

■ 1. By redesignating section 3.1.4.1 as 3.1.4.8 and revising newly designated section 3.1.4.8;

■ 2. By adding sections 3.1.4.1 through 3.1.4.7;

■ 3. By redesignating section 3.2.4 as 3.2.4.8 and revising newly designated section 3.2.4.8;

■ 4. By adding sections 3.2.4, 3.2.4.1 through 3.2.4.7, and 3.2.4.7.1;

■ 5. By redesignating section 3.3.11 as 3.3.18 and revising newly designated section 3.3.20; and

■ 6. By adding sections 3.3.11 through 3.3.17 and 3.3.17.1;

■ d. In section 4. *Calculation of Derived Results From Test Measurements,* by adding sections 4.4, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.4.6, 4.4.7, 4.4.7.1, 4.4.8, 4.4.9, 4.4.10, 4.4.10.1, and 4.4.10.2.

The revisions read as follows:

**Appendix I to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Conventional Ranges, Conventional Cooking Tops, Conventional Ovens, and Microwave Ovens**

* * * * *

*1. Definitions*

* * * * *

1.6 *Fan-only mode* means an active mode that is not user-selectable and in which a fan circulates air internally or externally to the cooking product for a finite period of time after the end of the heating function, where the end of the heating function is indicated to the consumer by means of a display, indicator light, or audible signal. For microwave ovens, fan-only mode means a mode that is not user-selectable and in which a fan circulates air internally or externally to the microwave oven for a finite period of time after the end of the cooking cycle.

* * * * *

1.14 *Over-the-range* means the product is intended to be installed in the cabinetry above a conventional cooking product. The product is supported by surrounding cabinetry, walls, or other similar structures on the sides, top, and/or rear of the product.

* * * * *

*2. Test Conditions*

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2.1.3 *Microwave ovens.* Install the microwave oven in accordance with the manufacturer's instructions and connect to an electrical supply circuit with voltage as specified in section 2.2.1 of this appendix. Built-in and over-the-range microwave ovens shall be installed in an enclosure in accordance with the manufacturer's instructions. For over-the-range microwave ovens, install the appliance with the exhaust vent/recirculation fan installed in the configuration to vent the air indoors in accordance with manufacturer's instructions. For standby mode and off mode testing, install the microwave oven in accordance with Section 5, Paragraph 5.2 of IEC 62301 (Second Edition) (incorporated by reference; see § 430.3), disregarding the provisions regarding batteries and the determination, classification, and testing of relevant modes. A watt meter must be installed in the circuit and shall be as described in section 2.9.1.3 of this appendix.

* * * * *

2.5 *Ambient room air temperature.*

2.5.1 *Active mode ambient room air temperature.* During the active mode test, maintain an ambient room air temperature, $T_R$, of 77° ± 9 °F (25° ± 5 °C) for conventional ovens, cooking tops, and for microwave oven convection-only cooking tests, or 73.4° ± 3.6 °F (23° ± 2 °C) for microwave oven microwave-only cooking tests, as measured at least 5 feet (1.5 m) and not more than 8 feet (2.4 m) from the nearest surface of the unit under test and approximately 3 feet (0.9 m) above the floor. The temperature shall be measured with a thermometer or temperature indicating system with an accuracy as specified in section 2.9.3.1.

* * * * *

2.7 *Test blocks for conventional oven, conventional cooking top, and convection microwave ovens.* The test blocks shall be made of aluminum alloy No. 6061, with a specific heat of 0.23 Btu/lb-°F (0.96 kJ/[kg-°C]) and with any temper that will give a coefficient of thermal conductivity of 1073.3 to 1189.1 Btu-in/h-ft2-°F (154.8 to 171.5 W/[m-°C]). Each block shall have a hole at its top. The hole shall be 0.08 inch (2.03 mm) in diameter and 0.80 inch (20.3 mm) deep. Other means may be provided which will ensure that the thermocouple junction is installed at this same position and depth.

The bottom of each block shall be flat to within 0.002 inch (0.051 mm) TIR (total indicator reading). Determine the actual weight of each test block with a scale with an accuracy as indicated in Section 2.9.5.

2.7.1 *Conventional oven and convection microwave oven test block.* The test block for the conventional oven and convection microwave oven, $W_1$, shall be 6.25 ± 0.05 inches (158.8 ± 1.3 mm) in diameter, approximately 2.8 inches (71 mm) high and shall weigh 8.5 ± 0.1 lbs (3.86 ± 0.05 kg). The block shall be finished with an anodic black coating which has a minimum thickness of 0.001 inch (0.025 mm) or with a finish having the equivalent heat absorptivity.

* * * * *

2.8 *Microwave-only test load.*

2.8.1 *9.7 ounce (275 g) water containers.* The 9.7 ounce (275 g) cylindrical glass test containers shall be made of borosilicate glass with an external height of 4.92 ± .04 inches (125 ± 1 mm), an external diameter of 3.54 ± .04 inches (90 ± 1 mm), a capacity of 36.6 cubic inches (600 ml), and a maximum weight of 7.1 ounces (200 g).

2.8.2 *12.3 ounce (350 g) water containers.* The 12.3 ounce (350 g) cylindrical glass test containers shall be made of borosilicate glass with an external height of 2.99 ± .04 inches (76 ± 1 mm), an external diameter of 5.51 ±

.04 inches (140 ± 1 mm), a capacity of 54.9 cubic inches (900 ml), and a maximum weight of 8.8 ounces (250 g).

2.8.3 *35.3 ounce (1000 g) water containers.* The 35.3 ounce (1000 g) cylindrical glass test containers shall be made of borosilicate glass with an external height of 3.54 ± .04 inches (90 ± 1 mm), an external diameter of 7.48 ± .04 inches (190 ± 1 mm), a capacity of 122.0 cubic inches (2000 ml), and a maximum weight of 15.9 ounces (450 g).

* * * * *

2.9.1.1 *Watt-hour meter.* The watt-hour meter for measuring the electrical energy consumption of conventional ovens and cooking tops shall have a resolution of 1 watt-hour (3.6 kJ) or less and a maximum error no greater than 1.5 percent of the measured value for any demand greater than 100 watts. The watt-hour meter for measuring the active mode energy consumption of microwave ovens shall have a maximum error of no greater than 1 percent of the measured value.

* * * * *

2.9.3 *Temperature measurement equipment.*

2.9.3.1 *Room temperature indicating system.* The room temperature indicating system shall be as specified in Section 2.9.3.4 for ranges, ovens and cooktops. The room temperature indicating system for microwave ovens shall have a minimum resolution of 0.18 °F (0.1 °C) and a maximum error no greater than 0.18 °F (0.1 °C).

2.9.3.2 *Temperature indicator system for measuring conventional oven and convection microwave oven temperature.* The equipment for measuring the conventional oven and convection microwave oven temperature shall have an error no greater than ±4 °F (±2.2 °C) over the range of 65° to 500 °F (18 °C to 260 °C).

* * * * *

2.9.3.5 *Water test load temperatures.* The temperature measuring instrument used to measure the water test load temperature shall have a minimum resolution of 0.18 °F (0.1 °C) and a maximum error no greater 2.7 °F (1.5 °C). Any stirring device to which a temperature measuring instrument is attached shall have a heat capacity of 0.287 Btu/lb-°F (1.20 kJ/kg-K) or less.

* * * * *

2.9.5 *Scale.* The scale used for weighing the test blocks shall have a maximum error no greater than 1 ounce (28.4 g). The scale used for weighing the microwave-only water test load shall have a minimum resolution of .02 ounces (0.5 g) and a maximum error no greater than .04 ounces (1 g).

2.9.6 *Time measurement.* The time measurement instrument used for measuring the microwave oven test cycle length shall have a minimum resolution of 1 second and a maximum error no greater than 1 second.

2.9.7 *Insulation pad for water test load temperature measurements.* All water test loads shall be placed on an insulation pad when making temperature measurements. The insulation pad shall have a thickness of at least 0.5 inches and cover the entire base of the test container with a heat capacity of 0.310 Btu/lb-°F (1.30 kJ/kg-K) or less.

*3. Test Methods and Measurements*

3.1. *Test methods.*

* * * * *

3.1.4 *Microwave oven.*

3.1.4.1 *Microwave-only cooking cycle 9.7 ounce (275 g) water load test method.* Establish the testing conditions set forth in Section 2, ''TEST CONDITIONS,'' of this Appendix. Before beginning the test, the empty glass test container and microwave oven must be at their normal nonoperating temperatures as defined in section 1.12 and described in section 2.6. Pour 9.7 ± .04 ounces (275 ± 1 g) of water in to the 9.7 ounce (275 g) test container specified in section 2.8.1 and stir the water using a temperature measuring instrument specified in section 2.9.3.5 until the average temperature of the test container and water is balanced. The initial water temperature must be 50 ± 0.9 °F (10 ± 0.5 °C). Place the test load at the center of the turntable. If the appliance is not fitted with a turntable, place the test load on the reciprocating tray or on the lowest possible shelf position. Set the power control for the microwave-only cooking mode to the highest possible position. If the appliance is equipped with a boost function, activate the boost function. Start measurements after switching on the appliance in the microwave-only cooking mode; measurements must begin within 30 seconds after the preparation of the water load. The microwave oven must be operated to heat the test load to achieve a final temperature of 140–149 °F (60–65 °C), at which point the microwave oven must be switched off. Remove the test load from the microwave oven, and position the test load on the insulation pad specified in section 2.9.7. Stir the water with the temperature measuring instrument specified in section 2.9.3.5, and measure the final temperature within 20 seconds after the microwave-only heating cycle is finished. Allow the microwave oven to reach its normal nonoperating temperature, and repeat the procedure to heat the water test load to a final temperature of 131–140 °F (55–60 °C). The minimum difference between the final temperatures from the two tests must be 3.6 °F (2 °C). In between tests, forced air cooling may be used to assist in reducing the temperature of the appliance. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.2 *Microwave-only cooking cycle 9.7 ounce (275 g) water load fan-only mode test method.* If the microwave oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption for the 9.7 ounce (275 g) water load as follows. Calculate the time required to heat 9.7 ounces (275 g) of water by 90 °F (50 °C), $t_{275}$, using the equations specified in section 4.4.1. Follow the procedures in section 3.1.4.1, except the microwave oven must be operated to heat the test load for the calculated heating time, $t_{275}$, at which point the microwave oven must be switched off. Remove the test load from the microwave oven, and close the microwave oven door within 30 ± 2 seconds after the microwave-only heating cycle is finished. Measure the fan-only mode energy consumption until the end of the fan-only mode. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.3 *Microwave-only cooking cycle 12.3 ounce (350 g) water load test method.* Establish the testing conditions set forth in Section 2, ''TEST CONDITIONS,'' of this Appendix. Before beginning the test, the empty glass test container and microwave oven must be at their normal nonoperating temperatures as defined in section 1.12 and described in section 2.6. Pour 12.3 ± .04 ounces (350 ± 1 g) of water in to the 12.3 ounce (350 g) test container specified in section 2.8.2, and stir the water using a temperature measuring instrument specified in section 2.9.3.5 until the average temperature of the test container and water is balanced. The initial water temperature must be 50 ± 0.9 °F (10 ± 0.5 °C). Place the test load at the center of the turntable. If the appliance is not fitted with a turntable, place the test load on the reciprocating tray or on the lowest possible shelf position. Set the power control for the microwave-only cooking mode to the highest possible position. If the appliance is equipped with a boost function, activate the boost function. Start measurements after switching on the appliance in the microwave-only cooking mode; measurements must begin within 30 seconds after the preparation of the water load. The microwave oven must be operated to heat the test load to achieve a final temperature of 140–149 °F (60–65 °C), at which point the microwave oven must be switched off. Remove the test load from the microwave oven, and position the test load on the insulation pad specified in section 2.9.7. Stir the water with the temperature measuring instrument specified in section 2.9.3.5, and measure the final temperature within 20 seconds after the microwave-only heating cycle is finished. Allow the microwave oven to reach its normal nonoperating temperature, and repeat the procedure to heat the water test load to a final temperature of 131–140 °F (55–60 °C). The minimum difference between the final temperatures from the two tests must be 3.6 °F (2 °C). In between tests, forced air cooling may be used to assist in reducing the temperature of the appliance. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.4 *Microwave-only cooking cycle 12.3 ounce (350 g) water load fan-only mode test method.* If the microwave oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption for the 12.3 ounce (350 g) water load as follows. Calculate the time required to heat 12.3 ounces (350 g) of water by 90 °F (50 °C), $t_{350}$, using the equations specified in section 4.4.2. Follow the procedures in section 3.1.4.3, except the microwave oven must be operated to heat the test load for the calculated heating time, $t_{350}$, at which point the microwave oven

must be switched off. Remove the test load from the microwave oven, and close the microwave oven door within 30 ± 2 seconds after the microwave-only heating cycle is finished. Measure the fan-only mode energy consumption until the end of the fan-only mode. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.5 *Microwave-only cooking cycle 35.3 ounce (1000 g) water load test method.* Establish the testing conditions set forth in Section 2, ''TEST CONDITIONS,'' of this Appendix. Before beginning the test, the empty glass test container and microwave oven must be at their normal nonoperating temperatures as defined in section 1.12 and described in section 2.6. Pour 35.3 ± .04 ounces (1000 ± 1 g) of water in to the 35.3 ounce (1000 g) test container specified in section 2.8.3 and stir the water using a temperature measuring instrument specified in section 2.9.3.5 until the average temperature of the test container and water is balanced. The initial water temperature must be 50 ± 0.9 °F (10 ± 0.5 °C). Place the test load at the center of the turntable. If the appliance is not fitted with a turntable, place the test load on the reciprocating tray or on the lowest possible shelf position. Set the power control for the microwave-only cooking mode to the highest possible position. If the appliance is equipped with a boost function, activate the boost function. Start measurements after switching on the appliance in the microwave-only cooking mode; measurements must begin within 30 seconds after the preparation of the water load. The microwave oven must be operated to heat the test load to achieve a final temperature of 140–149 °F (60–65 °C), at which point the microwave oven must be switched off. Remove the test load from the microwave oven, and position the test load on the insulation pad specified in section 2.9.7. Stir the water with the temperature measuring instrument specified in section 2.9.3.5, and measure the final temperature is within 20 seconds after the microwave-only heating cycle is finished. Allow the microwave oven to reach its normal nonoperating temperature, and repeat the procedure to heat the water test load to a final temperature of 131–140 °F (55–60 °C). The minimum difference between the final temperatures from the two tests must be 3.6 °F (2 °C). In between tests, forced air cooling may be used to assist in reducing the temperature of the appliance. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.6 *Microwave-only cooking cycle 35.3 ounce (1000 g) water load fan-only mode test method.* If the microwave oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption for the 35.3 ounce (1000 g) water load as follows. Calculate the time required to heat 35.3 ounces (1000 g) of water by 90 °F (50 °C), $t_{1000}$, using the equations specified in section 4.4.3. Follow the procedures in section 3.1.4.5, except the microwave oven must be operated to heat the test load for the calculated heating time, $t_{1000}$, at which point the microwave oven must be switched off. Remove the test load from the microwave oven, and close the microwave oven door within 30 ± 2 seconds after the microwave-only heating cycle is finished. Measure the fan-only mode energy consumption until the end of the fan-only mode. Repeat the test series three times unless the total microwave-only per-cycle energy consumption, as calculated in section 4.4.6, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.7 *Convection microwave oven convection-only test method.* Establish the testing conditions set forth in section 2, ''TEST CONDITIONS,'' of this appendix. Before beginning the test, the convection microwave oven must be at its normal nonoperating temperature as defined in section 1.12 and described in section 2.6. Set the convection microwave oven test block $M_{CVblock}$ approximately in the center of the usable baking space on the grilling rack provided by the manufacturer. Program the convection microwave oven for normal baking in accordance with manufacturer's instructions, and set the convection temperature setting to 375 °F. If a convection microwave oven permits baking by either forced convection by using a fan, or without forced convection, test the oven in each of those two modes. The oven must remain on for one complete thermostat ''cut-off/cut-on'' action of the electrical resistance heaters after the test block temperature has increased 234 °F (130 °C) above its initial temperature. If the convection microwave oven allows for the turntable to be turned on/off, test the appliance with the turntable turned on. Once the cooking cycle is complete and turned off, measure the fan-only mode energy consumption with the door closed until the end of the fan-only mode. Repeat the test series three times unless the total convection-only per-cycle energy consumption, as calculated in section 4.4.8, from the second measurement is within 1.5 percent of the value obtained from the first measurement.

3.1.4.8 *Microwave oven test standby mode and off mode power.* Establish the testing conditions set forth in section 2, *Test Conditions,* of this appendix. For microwave ovens that drop from a higher power state to a lower power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301 (Second Edition) (incorporated by reference; see § 430.3), allow sufficient time for the microwave oven to reach the lower power state before proceeding with the test measurement. Follow the test procedure as specified in Section 5, Paragraph 5.3.2 of IEC 62301 (Second Edition). For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 and use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition), but with a single test period of 10 minutes ± 2 sec after an additional stabilization period until the clock time reaches 3:33. If a microwave oven is capable of operation in either standby mode or off mode, as defined in sections 1.18 and 1.13 of this appendix, respectively, or both, test the microwave oven in each mode in which it can operate.

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3.2.4 *Microwave oven test energy consumption.*

3.2.4.1 *Microwave-only cooking cycle 9.7 ounce (275 g) water load test measurements.* Measure the energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{275,h}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{275,l}$, in watt-hours for the test specified in section 3.1.4.1. In addition, measure the initial water temperature, $T_{275,h1}$ and $T_{275,l1}$, in °F (°C), the final water temperature, $T_{275,h2}$ and $T_{275,l2}$, in °F (°C), and the total heating time, $t_{275,h}$ and $t_{275,l}$ in seconds, for each test.

3.2.4.2 *Microwave-only cooking cycle 9.7 ounce (275 g) water load fan-only mode test measurements.* If the microwave oven is capable of operation in fan-only mode, measure the microwave-only fan-only mode energy consumption, $E_{F275}$, in watt-hours, and fan-only mode duration, $t_{F275}$, in seconds, as specified in section 3.1.4.2.

3.2.4.3 *Microwave-only cooking cycle 12.3 ounce (350 g) water load test measurements.* Measure the energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{350,high}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{350,l}$, in watt-hours for the test specified in section 3.1.4.3. In addition, measure the initial water temperature, $T_{350,h1}$ and $T_{350,l1}$, in °F (°C), the final water temperature, $T_{350,h2}$ and $T_{350,l2}$, in °F (°C), and the total heating time, $t_{350,h}$ and $t_{350,l}$, in seconds, for each test.

3.2.4.4 *Microwave-only cooking cycle 12.3 ounce (350 g) water load fan-only mode test measurements.* If the microwave oven is capable of operation in fan-only mode, measure the microwave-only fan-only mode energy consumption, $E_{F350}$, in watt-hours, and fan-only mode duration, $t_{F350}$, in seconds, as specified in section 3.1.4.4.

3.2.4.5 *Microwave-only cooking cycle 35.3 ounce (1000 g) water load test measurements.* Measure the energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{1000,h}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{1000,l}$, in watt-hours for the test specified in section 3.1.4.5. In addition, measure the initial water temperature, $T_{1000,h1}$ and $T_{1000,l1}$, in °F (°C), the final water temperature, $T_{1000,h2}$ and $T_{1000,l2}$, in °F (°C), and the total heating time, $t_{1000,h}$ and $t_{1000,l}$, in seconds, for each test.

3.2.4.6 *Microwave-only cooking cycle 35.3 ounce (1000 g) water load fan-only mode test measurements.* If the microwave oven is capable of operation in fan-only mode, measure the microwave-only fan-only mode energy consumption, $E_{F1000}$, in watt-hours, and fan-only mode duration, $t_{F1000}$, in seconds, as specified in section 3.1.4.6.

3.2.4.7 *Convection microwave oven convection-only test measurements.* If the oven thermostat controls the convection microwave oven temperature without cycling on and off, measure the energy consumed,

$E_{CV,O}$, when the temperature of the block reaches $T_{CV,O}$ ($T_{CV,O}$ is 234 °F (130 °C) above the initial block temperature, $T_{CV,I}$). If the oven thermostat operates by cycling on and off, make the following series of measurements: Measure the block temperature, $T_{CV,A}$, and the energy consumed, $E_{CV,A}$, at the end of the last ''ON'' period of the convection microwave oven before the block reaches $T_{CV,O}$. Measure the block temperature, $T_{CV,B}$, and the energy consumed, $E_{CV,B}$, at the beginning of the next ''ON'' period. Measure the block temperature, $T_{CV,C}$, and the energy consumed, $E_{CV,C}$, at the end of that ''ON'' period. Measure the block temperature, $T_{CV,D}$, and the energy consumed, $E_{CV,D}$, at the beginning of the following ''ON'' period. Energy measurements for $E_{CV,O}$, $E_{CV,A}$, $E_{CV,B}$, $E_{CV,C}$ and $E_{CV,D}$, should be expressed in watt-hours for convection microwave ovens. Measure the total heating time, $t_{CV}$, expressed in seconds. If the microwave oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption, $E_{CV,F}$, expressed in watt-hours, and fan-only mode duration, $t_{CV,F}$, expressed in seconds.

3.2.4.7.1 *Convection microwave oven convection-only average test energy consumption measurements.* If the convection microwave oven permits baking by either forced convection or without forced convection and the oven thermostat does not cycle on and off, measure the energy consumed, $(E_{CV,O})_1$, and heating time, $(t_{CV})_1$, with the forced convection mode and without the forced convection mode, $(E_{CV,O})_2$, $(t_{CV})_2$ when the temperature of the block reaches $T_{CV,O}$ ($T_{CV,O}$ is 234 °F (130 °C) above the initial block temperature, $T_{CV,I}$). If the conventional oven permits baking by either forced convection or without forced convection and the oven thermostat operates by cycling on and off, make the following series of measurements with and without the forced convection mode: Measure the block temperature, $T_{CV,A}$, and the energy consumed, $E_{CV,A}$, at the end of the last ''ON'' period of the convection microwave oven before the block reaches $T_{CV,O}$. Measure the block temperature, $T_{CV,B}$, and the energy consumed, $E_{CV,B}$, at the beginning of the next ''ON'' period. Measure the block temperature, $T_{CV,C}$, and the energy consumed, $E_{CV,C}$, at the end of that ''ON'' period. Measure the block temperature, $T_{CV,D}$, and the energy consumed, $E_{CV,D}$, at the beginning of the following ''ON'' period. Energy measurements for $E_{CV,O}$, $E_{CV,A}$, $E_{CV,B}$, $E_{CV,C}$ and $E_{CV,D}$ should be expressed in watt-hours for convection microwave ovens. Measure the total heating time, $t_{CV}$, expressed in seconds. If the microwave oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption in the forced convection mode, $(E_{CV,F})_1$, and without the forced convection mode, $(E_{CV,F})_2$, expressed in watt-hours, and the and fan-only mode duration, in the forced convection mode, $(t_{CV,F})_1$, and without the forced convection mode, $(t_{CV,F})_2$, expressed in seconds.

3.2.4.8 *Microwave oven test standby mode and off mode power.* Make measurements as specified in Section 5, Paragraph 5.3 of IEC 62301 (Second Edition) (incorporated by reference; see § 430.3). If the microwave oven is capable of operating in standby mode, as defined in section 1.18 of this appendix, measure the average standby mode power of the microwave oven, $P_{SB}$, in watts as specified in section 3.1.4.8 of this appendix. If the microwave oven is capable of operating in off mode, as defined in section 1.13 of this appendix, measure the average off mode power of the microwave oven, $P_{OM}$, as specified in section 3.1.4.8

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3.3.11 Record the measured energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{275,h}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{275,l}$, in watt-hours; the measured mass of the 9.7 ounce (275 g) water test container, $M_{275,c}$, in pounds (grams), the measured mass of the water for the 140–149 °F (60–65 °C) final water temperature test, $M_{275,h,w}$, and the 131–140 °F (55–60 °C) final water temperature test, $M_{275,l,w}$, in pounds (grams); the initial water temperature $T_{275,h1}$, and final water temperature, $T_{275,h2}$, for the 140–149 °F (60–65 °C) final water temperature test, and the initial water temperature $T_{275,l1}$, and final water temperature, $T_{275,l2}$, for the 131–140 °F (55–60 °C) final water temperature test, in °F (°C); the total heating time, $t_{275,h}$ for the 140–149 °F (60–65 °C) final water temperature test and $t_{275,l}$ for the 131–140 °F (55–60 °C) final water temperature test; as determined in section 3.2.4.1.

3.3.12 Record the measured fan-only mode energy consumption, $E_{F275}$, in watt-hours, and fan-only mode duration, $t_{F275}$, in seconds, as determined in section 3.2.4.2.

3.3.13 Record the measured energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{350,h}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{275,l}$, in watt-hours; the measured mass of the 12.3 ounce (350 g) water test container, $M_{350,c}$, in pounds (grams), the measured mass of the water for the 140–149 °F (60–65 °C) final water temperature test, $M_{350,h,w}$, and the 131–140 °F (55–60 °C) final water temperature test, $M_{350,l,w}$, in pounds (grams); the initial water temperature $T_{350,h1}$, and final water temperature, $T_{350,h2}$, for the 140–149 °F (60–65 °C) final water temperature test, and the initial water temperature $T_{350,l1}$, and final water temperature, $T_{350,l2}$, for the 131–140 °F (55–60 °C) final water temperature test, in °F (°C); the total heating time, $t_{350,h}$ for the 140–149 °F (60–65 °C) final water temperature test and $t_{350,l}$ for the 131–140 °F (55–60 °C) final water temperature test; as determined in section 3.2.4.3.

3.3.14 Record the measured fan-only mode energy consumption, $E_{F350}$, in watt-hours, and fan-only mode duration, $t_{F350}$, in seconds, as determined in section 3.2.4.4.

3.3.15 Record the measured energy consumption for the microwave-only cooking cycle test with a final water temperature of 140–149 °F (60–65 °C), $E_{1000,h}$, and the cooking cycle test with a final water temperature of 131–140 °F (55–60 °C), $E_{1000,l}$, in watt-hours; the measured mass of the 35.3 ounce (1000 g) water test container, $M_{1000,c}$, in pounds (grams), the measured mass of the water for the 140–149 °F (60–65 °C) final water temperature test, $M_{1000,h,w}$, and the 131–140 °F (55–60 °C) final water temperature test, $M_{1000,l,w}$, in pounds (grams); the initial water temperature $T_{1000,h1}$, and final water temperature, $T_{1000,h2}$, for the 140–149 °F (60–65 °C) final water temperature test, and the initial water temperature $T_{1000,l1}$, and final water temperature, $T_{1000,l2}$, for the 131–140 °F (55–60 °C) final water temperature test, in °F (°C); the total heating time, $t_{1000,h}$ for the 140–149 °F (60–65 °C) final water temperature test and $t_{1000,l}$ for the 131–140 °F (55–60 °C) final water temperature test; as determined in section 3.2.4.5.

3.3.16 Record the measured fan-only mode energy consumption, $E_{F1000}$, in watt-hours, and fan-only mode duration, $t_{F1000}$, in seconds, as determined in section 3.2.4.6.

3.3.17 For a convection microwave oven with a thermostat which operates by cycling on and off, record the convection microwave cooking test measurements $T_{CV,A}$, $E_{CV,A}$, $T_{CV,B}$, $E_{CV,B}$, $T_{CV,C}$, $E_{CV,C}$, $T_{CV,D}$, $E_{CV,D}$, $E_{CV,F}$, $t_{CV}$, and $t_{CV,F}$, as determined in section 3.2.4.7. If the thermostat controls the oven temperature without cycling on and off, record $E_{CV,O}$, $E_{CV,F}$, $t_{CV,}$ and $t_{CV,F}$, as determined in section 3.2.4.7. Record the measured test block weight, $M_{CV}$, in pounds, as specified in section 2.7.1.

3.3.17.1 For a convection microwave oven that can be operated with or without forced convection and the oven thermostat controls the oven temperature without cycling on and off, measure the energy consumed with the forced convection mode, $(E_{CV,O})_1$, heating time in the forced convection mode, $(t_{CV})_1$, and convection microwave oven fan-only mode energy consumption in the forced convection mode, $(E_{CV,F})_1$, and measure the energy consumed without the forced convection mode, $(E_{CV,O})_2$, heating time without the forced convection mode, $(t_{CV})_2$, and convection microwave oven fan-only mode energy consumption without the forced convection mode, $(E_{CV,F})_2$, as determined in section 3.2.4.7.1. If the convection microwave oven operates with or without forced convection and the thermostat controls the oven temperature by cycling on and off, record the convection microwave oven test measurements $T_{CV,A}$, $E_{CV,A}$, $T_{CV,B}$, $E_{CV,B}$, $T_{CV,C}$, $E_{CV,C}$, $T_{CV,D}$, $E_{CV,D}$, $t_{CV}$, $E_{CV,F}$, $t_{CV,F}$ as determined in section 3.2.4.7.1. Record the measured test block weight, $M_{CV}$, in pounds, as specified in section 2.7.1.

3.3.18 Record the average standby mode power, $P_{SB}$, for the microwave oven standby mode, as determined in section 3.2.4.8 for a microwave oven capable of operating in standby mode. Record the average off mode power, $P_{OM}$, for the microwave oven off mode power test, as determined in section 3.2.4.8 for a microwave oven capable of operating in off mode.

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*4. Calculation of Derived Results from Test Measurements*

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4.4 *Microwave oven.*

4.4.1 *9.7 ounce (275 g) water load microwave-only cooking cycle time and energy consumption.* Calculate the time

required, $t_{275}$, in seconds, and the energy consumption, $E_{275}$, in watt-hours, to heat 9.7 ounce (275 g) of water by 90 °F (50 °C), as follows:

$$\Delta T_{275,h} = T_{275,h2} - T_{275,h1}$$

$$\Delta T_{275,l} = T_{275,l2} - T_{275,l1}$$

$$Total\ \Delta T_{275,h} = \frac{\left(C_c \times M_{275,c} \times \Delta T_{275,h}\right)}{C_w \times M_{275,h}} + \Delta T_{275,h}$$

$$Total\ \Delta T_{275,l} = \frac{\left(C_c \times M_{275,c} \times \Delta T_{275,l}\right)}{C_w \times M_{275,l}} + \Delta T_{275,l}$$

$$norm\ \Delta T_{275,h} = total\ \Delta T_{275,h} \times \frac{M_{275,h,w}}{M_{275,w}}$$

$$norm\ \Delta T_{275,l} = total\ \Delta T_{275,l} \times \frac{M_{275,l,w}}{M_{275,w}}$$

$$t_{275} = t_{275,l} + \left(\frac{t_{275,h} - t_{275,l}}{norm\ \Delta T_{275,h} - norm\ \Delta T_{275,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{275,l}\right)$$

$$E_{275} = E_{275,low} + \left(\frac{E_{275,h} - E_{275,low}}{norm\ \Delta T_{275,h} - norm\ \Delta T_{275,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{275,low}\right)$$

*Where,*

$C_c$ = 0.131 Btu per lb-°F (0.55 joules per gram-°C), the specific heat of the borosilicate glass test container.

$C_w$ = 1.0 Btu per lb-°F (4.187 joules per gram-°C), the specific heat of water.

$\Delta T_{275,h}$ = the water temperature rise in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test.

$\Delta T_{275,l}$ = the water temperature rise in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test.

$\Delta T_n$ = 90 °F (50 °C), the nominal water temperature rise.

$E_{275}$ = the energy consumption required to heat 9.7 ounce (275 g) of water by 90 °F (50 °C), in watt-hours.

$E_{275,h}$ = the measured energy consumption in watt-hours during the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.11.

$E_{275,l}$ = the measured energy consumption in watt-hours during the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.11.

$M_{275,c}$ = the actual mass of the 9.7 ounce (275 g) water load test container in pounds (g), as recorded in section 3.3.11.

$M_{275,h,w}$ = the actual mass of water in pounds (g) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.11.

$M_{275,l,w}$ = the actual mass of water in pounds (g) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.11.

$M_{275,w}$ = 0.61 pounds (275 g), the nominal mass of water.

norm $\Delta T_{275,h}$ = the normalized water temperature rise in °F (°C) for the of 140–149 °F (60–65 °C) final water temperature test.

norm $\Delta T_{275,l}$ = the normalized water temperature rise in °F (°C) for the of 131–140 °F (55–60 °C) final water temperature test.

$t_{275}$ = the calculated time in seconds to heat up 9.7 ounces (275 g) of water by 90 °F (50 °C).

$t_{275,h}$ = the measured time in seconds, including the magnetron heating-up time, to heat 9.7 ounces (275 g) of water to a final temperature of 140–149 °F (60–65 °C), as recorded in section 3.3.11.

$t_{275,l}$ = the measured time in seconds, including the magnetron heating-up time, to heat 9.7 ounces (275 g) of water to a final temperature of 131–140 °F (55–60 °C), as recorded in section 3.3.11.

$T_{275,h1}$ = the initial water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.11.

$T_{275,h2}$ = the final water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.11.

$T_{275,l1}$ = the initial water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.11.

$T_{275,l2}$ = the final water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.11.

Total $\Delta T_{275,h}$ = the total temperature rise accounting for the heat capacity of the test container for the 140–149 °F (60–65 °C) final water temperature test, in °F (°C).

Total $\Delta T_{275,l}$ = the total temperature rise accounting for the heat capacity of the test container for the 131–140 °F (55–60 °C) final water temperature test, in °F (°C).

4.4.2 *12.3 ounce (350 g) water load microwave-only cooking cycle time and energy consumption.* Calculate the time required, $t_{350}$, in seconds, and the energy consumption, $E_{350}$, in watt-hours, to heat 12.3 ounces (350 g) of water by 90 °F (50 °C), as follows:

$$\Delta T_{350,l} = T_{350,l2} - T_{350,l1}$$

$$Total\ \Delta T_{350,h} = \frac{\left(C_c \times M_{350,c} \times \Delta T_{350,h}\right)}{C_w \times M_{350,h}} + \Delta T_{350,h}$$

$$Total\ \Delta T_{350,l} = \frac{\left(C_c \times M_{350,c} \times \Delta T_{350,l}\right)}{C_w \times M_{350,l}} + \Delta T_{350,l}$$

$$norm\ \Delta T_{350,h} = total\ \Delta T_{350,h} \times \frac{M_{350,h,w}}{M_{350,w}}$$

$$norm\ \Delta T_{350,l} = total\ \Delta T_{350,l} \times \frac{M_{350,l,w}}{M_{350,w}}$$

$$t_{350} = t_{350,l} + \left(\frac{t_{350,h} - t_{350,l}}{norm\ \Delta T_{350,h} - norm\ \Delta T_{350,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{350,l}\right)$$

$$E_{350} = E_{350,l} + \left(\frac{E_{350,h} - E_{350,l}}{norm\ \Delta T_{350,h} - norm\ \Delta T_{350,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{350,l}\right)$$

*Where,*

$\Delta T_n$, $C_c$, and $C_w$ as defined in 4.4.1.

$\Delta T_{350,h}$ = the water temperature rise in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test.

$\Delta T_{350,l}$ = the water temperature rise in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test.

$E_{350}$ = the calculated energy consumption required to heat 12.3 ounces (350 g) of water by 90 °F (50 °C), in watt-hours.

$E_{350,h}$ = the measured energy consumption in watt-hours during the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.13.

$E_{350,l}$ = the measured energy consumption in watt-hours during the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.13.

$M_{350,c}$ = the actual mass of the 12.3 ounce (350 g) water load test container in pounds (g), as recorded in section 3.3.13.

$M_{350,h,w}$ = the actual mass of water in pounds (g) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.13.

$M_{350,l,w}$ = the actual mass of water in pounds (g) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.13.

$M_{350,w}$ = 0.77 pounds (350 g), the nominal mass of water.

norm $\Delta T_{350,h}$ = the normalized water temperature rise in °F (°C) for the of 140–149 °F (60–65 °C) final water temperature test.

norm $\Delta T_{350,l}$ = the normalized water temperature rise in °F (°C) for the of 131–140 °F (55–60 °C) final water temperature test.

$t_{350}$ = the calculated time in seconds to heat up 12.3 ounces (350 g) of water by 90 °F (50 °C).

$t_{350,h}$ = the measured time in seconds, including the magnetron heating-up time, to heat 12.3 ounces (350 g) of water to a final temperature of 140–149 °F (60–65 °C), as recorded in section 3.3.13.

$t_{350,l}$ = the measured time in seconds, including the magnetron heating-up time, to heat 12.3 ounces (350 g) of water to a final temperature of 131–140 °F (55–60 °C), as recorded in section 3.3.13.

$T_{350,h1}$ = the initial water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.13.

$T_{350,h2}$ = the final water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.13.

$T_{350,l1}$ = the initial water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.13.

$T_{350,l2}$ = the final water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.13.

Total $\Delta T_{350,h}$ = the total temperature rise accounting for the heat capacity of the test container for the 140–149 °F (60–65 °C) final water temperature test, °F (°C).

Total $\Delta T_{350,l}$ = the total temperature rise accounting for the heat capacity of the test container for the 131–140 °F (55–60 °C) final water temperature test, °F (°C).

4.4.3 *35.3 ounce (1000 g) water load microwave-only cooking cycle time and energy consumption.* Calculate the time required, $t_{350}$, in seconds, and the energy consumption, $E_{1000}$, in watt-hours, to heat 35.3 ounce (1000 g) of water by 90 °F (50 °C), as follows:

$$\Delta T_{1000,h} = T_{1000,h2} - T_{1000,h1}$$

$$\Delta T_{1000,l} = T_{1000,l2} - T_{1000,l1}$$

$$Total\ \Delta T_{1000,h} = \frac{\left(C_c \times M_{1000,c} \times \Delta T_{1000,h}\right)}{C_w \times M_{1000,h}} + \Delta T_{1000,h}$$

$$Total\ \Delta T_{1000,l} = \frac{\left(C_c \times M_{1000,c} \times \Delta T_{1000,l}\right)}{C_w \times M_{1000,l}} + \Delta T_{1000,l}$$

$$norm\ \Delta T_{1000,h} = total\ \Delta T_{1000,h} \times \frac{M_{1000,h,w}}{M_{1000,w}}$$

$$norm\ \Delta T_{1000,l} = total\ \Delta T_{1000,low} \times \frac{M_{1000,l,w}}{M_{1000,w}}$$

$$t_{1000} = t_{1000,l} + \left(\frac{t_{1000,h} - t_{1000,l}}{norm\ \Delta T_{1000,h} - norm\ \Delta T_{1000,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{1000,l}\right)$$

$$E_{1000} = E_{1000,l} + \left(\frac{E_{1000,h} - E_{1000,l}}{norm\ \Delta T_{1000,h} - norm\ \Delta T_{1000,l}}\right) \times \left(\Delta T_n - norm\ \Delta T_{1000,l}\right)$$

*Where,*

$\Delta T_n$, $C_c$, and $C_w$ as defined in 4.4.1.

$\Delta T_{1000,h}$ = the water temperature rise in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test.

$\Delta T_{1000,l}$ = the water temperature rise in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test.

$E_{1000}$ = the calculated energy consumption required to heat 35.3 ounces (1000 g) of water by 90 °F (50 °C), in watt-hours.

$E_{1000,h}$ = the measured energy consumption in watt-hours during the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.15.

$E_{1000,l}$ = the measured energy consumption in watt-hours during the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.15.

$M_{1000,c}$ = the actual mass of the 35.3 ounce (1000 g) water load test container in pounds (g), as recorded in section 3.3.15.

$M_{1000,h,w}$ = the actual mass of water in pounds (g) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.15.

$M_{1000,l,w}$ = the actual mass of water in pounds (g) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.15.

$M_{1000,w}$ = 2.20 pounds (1000 g), the nominal mass of water.

norm $\Delta T_{1000,h}$ = the normalized water temperature rise in °F (°C) for the of 140–149 °F (60–65 °C) final water temperature test.

norm $\Delta T_{1000,l}$ = the normalized water temperature rise in °F (°C) for the of 131–140 °F (55–60 °C) final water temperature test.

$t_{1000}$ = the calculated time in seconds to heat up 35.3 ounces (1000 g) of water by 90 °F (50 °C).

$t_{1000,h}$ = the measured time in seconds, including the magnetron heating-up time, to heat 35.3 ounces (1000 g) of water to a final temperature of 140–149 °F (60–65 °C), as recorded in section 3.3.15.

$t_{1000,l}$ = the measured time in seconds, including the magnetron heating-up time, to heat 35.3 ounces (1000 g) of water to a final temperature of 131–140 °F (55–60 °C), as recorded in section 3.3.15.

$T_{1000,h1}$ = the initial water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.15.

$T_{1000,h2}$ = the final water temperature in °F (°C) for the 140–149 °F (60–65 °C) final water temperature test, as recorded in section 3.3.15.

$T_{1000,l1}$ = the initial water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.15.

$T_{1000,l2}$ = the final water temperature in °F (°C) for the 131–140 °F (55–60 °C) final water temperature test, as recorded in section 3.3.15.

Total $\Delta T_{1000,h}$ = the total temperature rise accounting for the heat capacity of the test container for the 140–149 °F (60–65 °C) final water temperature test, in °F (°C).

Total $\Delta T_{1000,l}$ = the total temperature rise accounting for the heat capacity of the test container for the 131–140 °F (55–60 °C) final water temperature test, in °F (°C).

4.4.4 *Total microwave-only cooking per-cycle energy consumption and heating time.* Calculate the total microwave-only cooking per-cycle energy consumption, $E_{MW,C}$, in watt-hours, and the per-cycle heating time, $t_{MW,C}$, in seconds, as follows:

$$E_{MW,C} = \frac{3 \times E_{275} + 6 \times E_{350} + 2 \times E_{1000}}{11}$$

$$t_{MW,C} = \frac{3 \times t_{275} + 6 \times t_{350} + 2 \times t_{1000}}{11}$$

Where:

$E_{275}$ and $t_{275}$ as defined in section 4.4.1, $W_{350}$ and $t_{350}$ are described in section 4.4.2, and $E_{1000}$ and $t_{1000}$ are described in section 4.4.3.

4.4.5 *Total microwave-only per-cycle fan-only mode energy consumption and duration.* Calculate the total microwave-only per-cycle fan-only mode energy consumption, $E_{MW,F}$, in watt-hours, and the per-cycle fan-only mode time, $t_{MW,F}$, in seconds, as follows:

$$E_{MW,F} = \frac{3 \times E_{F275} + 6 \times E_{F350} + 2 \times E_{F1000}}{11}$$

$$t_{MW,F} = \frac{3 \times t_{F275} + 6 \times t_{F350} + 2 \times t_{F1000}}{11}$$

Where:

$E_{F275}$ = the measured fan-only mode energy consumption after heating 275 g of water by 50 °C in watt-hours, as recorded in section 3.3.12.

$E_{F350}$ = the measured fan-only mode energy consumption after heating 350 g of water by 50 °C in watt-hours, as recorded in section 3.3.15.

$E_{F1000}$ = the measured fan-only mode energy consumption after heating 1000 g of water by 50 °C in watt-hours, as recorded in section 3.3.16.

$t_{F275}$ = the duration of fan-only mode after heating 275 g of water by 50 °C in seconds, as recorded in section 3.3.12.

$t_{F350}$ = the duration of fan-only mode after heating 350 g of water by 50 °C in seconds, as recorded in section 3.3.14.

$t_{F1000}$ = the duration of fan-only mode after heating 1000 g of water by 50 °C in seconds, as recorded in section 3.3.16.

4.4.6 *Total microwave-only per-cycle energy consumption.* Calculate the total microwave-only per-cycle energy consumption, $E_{MW}$, in watt-hours, using the equation below. The calculation is repeated two or three times as required in section 3.1.4. The average $E_{MW}$ is used for the calculations in sections 4.4.9 and 4.4.10.

$$E_{MW} = E_{MW,C} + E_{MW,F}$$

Where:

$E_{MW,C}$ as defined in 4.4.4.

$E_{MW,F}$ as defined in 4.4.5.

4.4.7 *Convection microwave oven convection-only cooking cycle test energy consumption.* For a convection microwave oven with a thermostat which operates by cycling on and off, calculate the convection microwave convection-only cooking cycle test energy consumption, $E_{CV,O}$, expressed in watt-hours, and defined as:

$$E_{CV,O} = \left( E_{CV,AB} + \left( \frac{T_{CV,O} - T_{CV,AB}}{T_{CV,CD} - T_{CV,AB}} \right) \times (E_{CV,CD} - E_{CV,AB}) \right)$$

Where:

$T_{CV,O}$ = 234 °F (130 °C) plus the initial test block temperature.

and,

$$E_{CV,AB} = \frac{E_{CV,A} + E_{CV,B}}{2}$$

$$E_{CV,CD} = \frac{E_{CV,C} + E_{CV,D}}{2}$$

$$T_{CV,AB} = \frac{T_{CV,A} + T_{CV,B}}{2}$$

$$T_{CV,CD} = \frac{T_{CV,C} + T_{CV,D}}{2}$$

Where:

$E_{CV,A}$ = electric energy consumed in Wh at the end of the last ''ON'' period before the test block reaches $T_{CV,O}$.

$E_{CV,B}$ = electric energy consumed in Wh at the beginning of the ''ON'' period following the measurement of $T_{CV,A}$.

$E_{CV,C}$ = electric energy consumed in Wh at the end of the ''ON'' period which starts with $T_{CV,B}$.

$E_{CV,D}$ = electric energy consumed in Wh at the beginning of the ''ON'' period which follows the measurement of $T_{CV,C}$.

$T_{CV,A}$ = block temperature in °F at the end of the last ''ON'' period of the convection microwave oven before the test block reaches $T_O$.

$T_{CV,B}$ = block temperature in °F at the beginning of the ''ON'' period following the measurement of $T_{CV,A}$.

$T_{CV,C}$ = block temperature in °F at the end of the ''ON'' period which starts with $T_{CV,B}$.

$T_{CV,D}$ = block temperature in °F at the beginning of the ''ON'' period which follows the measurement of $T_{CV,C}$.

4.4.7.1 *Convection microwave oven convection-only cooking cycle average test energy consumption.* If the convection microwave oven can be operated with or without forced convection, determine the convection microwave cooking average test energy consumption, $E_{CV,O}$, in watt-hours, the convection microwave cooking average heating time, $t_{CV}$, in seconds, the average convection microwave oven fan-only mode cooling energy consumption, $E_{CV,F}$, in watt-hours, and the convection microwave oven fan-only mode time, $t_{CV,F}$, in seconds, using the following equations:

$$E_{CV,O} = \frac{(E_{CV,O})_1 + (E_{CV,O})_2}{2}$$

$$t_{CV,O} = \frac{(t_{CV,O})_1 + (t_{CV,O})_2}{2}$$

$$E_{CVcool} = \frac{(E_{CV,F})_1 + (E_{CV,F})_2}{2}$$

$$t_{CV,F} = \frac{(t_{CV,F})_1 + (t_{CV,F})_2}{2}$$

Where:

$(E_{CV,O})_1$ = the test energy consumption using the forced convection mode in watt-hours for convection microwave ovens as recorded in section 3.3.17.1.

$(E_{CV,O})_2$ = the test energy consumption without using the forced convection mode in watt-hours for convection microwave ovens as recorded in section 3.3.17.1.

$(E_{CV,F})_1$ = the fan-only mode cooling energy consumption using the forced convection mode in watt-hours for convection microwave ovens as recorded in section 3.3.17.1.

$(E_{CV,F})_2$ = the fan-only mode cooling energy consumption without using the forced convection mode in watt-hours for convection microwave ovens as recorded in section 3.3.17.1.

$(t_{CV,O})_1$ = the test heating time using the forced convection mode in seconds for convection microwave ovens as measured as recorded in section 3.3.17.1.

$(t_{CV,O})_2$ = the test heating time without using the forced convection mode in seconds for convection microwave ovens as recorded in section 3.3.17.1.

$(t_{CV,F})_1$ = the fan-only mode time using the forced convection mode in seconds for convection microwave ovens as recorded in section 3.3.17.1.

$(t_{CV,F})_2$ = the fan-only mode time without using the forced convection mode in seconds for convection microwave ovens as recorded in section 3.3.17.1.

4.4.8 *Total convection microwave oven convection-only per-cycle energy consumption.* Calculate the total convection microwave oven convection-only per-cycle energy consumption, $E_{total,CV}$, in watt-hours, using the equations below. The calculation is repeated two or three times as required in section 3.1.4.7. The average $E_{total,CV}$ is used for the calculations in sections 4.4.9 and 4.4.10.

$$E_{CV} = (E_{CV,O} + E_{CV,F}) \times F_{CV}$$

Where:

$E_{CV,O}$ = the convection microwave oven convection-only cooking cycle test energy consumption in watt-hours as determined in section 3.3.17 and 4.4.7.

$E_{CV,F}$ = the convection microwave oven convection-only cooking cycle test energy consumption in watt-hours as determined in section 3.3.17 and 4.4.7.

$F_{CV}$ = 0.26, a field use factor based on consumer use of the convection-only cooking mode.

4.4.9 *Total convection microwave oven convection-microwave per-cycle energy consumption.* Calculate the total convection microwave oven convection-microwave per-cycle energy consumption, $E_{CMW}$, in watt-hours, as follows:

$$E_{CMW} = \left(E_{MW} \times \frac{t_{CMW,field}}{t_{MW,field}} \times 0.3\right) + \left(E_{CV} \times \frac{t_{CMW,field}}{t_{CV,field}} \times 0.7\right)$$

Where:

$E_{CV}$ as defined in 4.4.8.

$E_{MW}$ as defined in 4.4.6.

$t_{CMW,field}$ = 15.00, the average convection microwave oven convection-microwave cooking cycle length in minutes based on consumer use.

$t_{CV,field}$ = 18.70, the average convection microwave oven convection-only cooking cycle length in minutes based on consumer use.

$t_{MW,field}$ = 2.54, the average convection microwave oven microwave-only cooking cycle length in minutes based on consumer use.

0.3 = an experimentally established value for the percentage of time during a single convection-microwave cooking cycle that the appliance operates in microwave-only cooking mode.

0.7 = an experimentally established value for the percentage of time during a single convection-microwave cooking cycle that the appliance operates in convection-only cooking mode.

4.4.10 *Annual energy use.*

4.4.10.1 *Microwave-only oven annual energy use.* Calculate the microwave-only oven annual energy use, $E_{annual,MWO}$, in kilowatt-hours per year, as follows:

$$E_{annual,MWO} = [E_{MW} \times N_{MWO} + P_{SB} \times S_{MWO,SB} + P_{OM} \times S_{MWO,OFF}] \times K$$

Where:

$E_{MW}$ as defined in section 4.4.6.

$N_{MWO}$ = 1026, annual number of microwave-only cooking cycles for microwave-only ovens based on consumer use.

$P_{SB}$ = the average measured standby mode power in watts, as recorded in section 3.3.18.

$P_{OM}$ = the average measured off mode power in watts, as recorded in section 3.3.18.

$S_{MWO,TOT}$ equals the total number of standby mode and off mode hours per year for microwave-only ovens.

If the microwave-only oven has fan-only mode, $S_{MWO,TOT}$ equals $(8715.1 - (t_{MW,F}/3600))$ hours, where $t_{MW,F}$ is the

microwave-only oven fan-only mode duration, in seconds, as calculated in section 4.4.5, and 3600 is the conversion factor for seconds to hours; otherwise, $S_{MWO,TOT}$ is equal to 8715.1 hours.

If the microwave-only oven has both standby mode and off mode, $S_{MWO,SB}$ and $S_{MWO,OFF}$ both equal $S_{MWO,TOT}/2$.

If the microwave-only oven has standby mode but no off mode, the standby mode annual hours, $S_{MWO,SB}$, is equal to $S_{MWO,TOT}$ and the off mode annual hours, $S_{MWO,OFF}$, is equal to 0.

If the microwave-only oven has an off mode but no standby mode, $S_{MWO,SB}$ is equal to 0 and $S_{MWO,OFF}$ is equal to $S_{MWO,TOT}$.

K = 0.001 kWh/Wh conversion factor for watt-hours to kilowatt-hours.

4.4.10.2 *Convection microwave oven annual energy use.* Calculate the convection microwave oven annual energy use, $E_{annual,CMWO}$, in kilowatt-hours per year, as follows:

$$E_{annual,CMWO} = [E_{MW} \times N_{CMWO,MW} + E_{CV} \times N_{CMWO,CV} + E_{CMW} \times N_{CMWO,CMW} + P_{SB} \times S_{CMWO,SB} + P_{OM} \times S_{CMWO,OFF}] \times K$$

Where:

$E_{CMW}$ as defined in section 4.4.9.

$E_{MW}$ as defined in section 4.4.6.

$E_{CV}$ as defined in section 4.4.8.

$P_{SB}$, $P_{OM}$, and K as defined in section 4.4.10.1.

$N_{CMWO,MW}$ = 842, annual number of microwave-only cooking cycles for convection microwave ovens based on consumer use.

$N_{CMWO,CV}$ = 101, annual number of convection-only cooking cycles for convection microwave ovens based on consumer use.

$N_{CMWO,CMWcycles}$ = 69, annual number of convection-microwave cooking cycles for convection microwave ovens based on consumer use.

$S_{CMWO,TOT}$ equals the total number of standby mode and off mode hours per year for microwave-only ovens.

If the convection microwave oven has fan-only mode, $S_{CMWO,TOT}$ equals:

$$S_{CMWO,TOT} = 8675.3 - \frac{t_{MW,F} \times N_{CMWO,MW} + \left(t_{CV,F} \times F_{CV} \times N_{CMWO,CV}\right) + \left(t_{CV,F} \times F_{CV} \times \frac{t_{CMW,field}}{t_{CV,field}} \times N_{CMWO,CMW}\right)}{60}$$

Where:

$t_{MW,F}$ is the microwave-only fan-only mode duration, in minutes, as calculated in section 4.4.5; $t_{CV,F}$ is the measured convection-only fan-only mode duration, in minutes, as recorded in section 3.3.17; $F_{CV}$ as defined in section 4.4.8; $t_{CMW,field}$ and $t_{CV,field}$ as defined in section 4.4.9; and 60 is the conversion factor for minutes to hours. Otherwise, $S_{CMWO,TOT}$ is equal to 8675.3 hours.

If the convection microwave oven has both standby mode and off mode, $S_{CMWO,SB}$ and $S_{CMWO,OFF}$ both equal $S_{CMWO,TOT}/2$.

If the convection microwave oven has standby mode but no off mode, the standby mode annual hours, $S_{CMWO,SB}$, is equal to $S_{CMWO,TOT}$ and the off mode annual hours, $S_{CMWO,OFF}$, is equal to 0.

If the convection microwave oven has an off mode but no standby mode, $S_{MWO,SB}$ is equal to 0 and $S_{CMWO,OFF}$ is equal to $S_{CMWO,TOT}$.

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