DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE–2012–BT–TP–0013]

RIN 1904–AC71

Energy Conservation Program: Test Procedures for Cooking Products

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

ACTION: Final rule.

SUMMARY: On August 22, 2016, the U.S. Department of Energy (DOE) issued a supplemental notice of proposed rulemaking to amend the test procedure for conventional cooking products. That proposed rulemaking serves as the basis for this final rule. Specifically, this final rule amends DOE's test procedure for conventional electric cooking tops to incorporate by reference the relevant sections from European standard EN 60350–2:2013 ''Household electric cooking appliances Part 2: Hobs—Methods for measuring performance'' (EN 60350–2:2013). This final rule also includes methods for testing non-circular electric surface units, electric surface units with flexible concentric cooking zones, and full-surface induction cooking tops based on EN 60350–2:2013. In addition, DOE extends the test methods in EN 60350–2:2013 to measure the energy consumption of gas cooking tops by correlating test equipment diameter to burner input rate, including input rates that exceed 14,000 British thermal units per hour. This final rule also includes methods to calculate annual energy consumption and integrated annual energy consumption for conventional cooking tops based on the water-heating test method and provides updates to the sampling plan requirements. The final rule includes minor technical clarifications to the gas heating value correction and other grammatical changes to the regulatory text in the cooking products test procedure that do not alter the substance of the existing test methods. This final rule also repeals the regulatory provisions establishing the test procedure for conventional ovens under the Energy Policy and Conservation Act. DOE has determined that the conventional oven test procedure does not accurately represent consumer use as it favors conventional ovens with low thermal mass and does not capture cooking performance-related benefits due to increased thermal mass of the oven cavity.

DATES: The effective date of this rule is January 17, 2017. The final rule changes will be mandatory for representations of energy or power consumption of cooking products on or after June 14, 2017. The incorporation by reference of certain publications listed in this rule is approved by the Director of the **Federal Register** as of January 17, 2017.

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

A link to the docket Web page can be found at *https://www.regulations.gov/#!docketDetail;D=EERE-2012-BT-TP-0013.* The docket Web page will contain simple instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact the Appliance and Equipment Standards Program staff at (202) 586–6636 or by email: *ApplianceStandardsQuestions@ee.doe.gov.*

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SUPPLEMENTARY INFORMATION: This final rule incorporates by reference certain sections of the following industry standard into 10 CFR part 430:

(1) EN 60350–2:2013 ''Household electric cooking appliances, Part 2: Hobs—Methods for measuring performance'', July 2013.

- Copies of EN 60350–2:2013, a European standard approved by the European Committee for Electrotechnical Standardization (CENELEC), can be obtained from the British Standards Institute (BSI Group), 389 Chiswick High Road, London, W4 4AL, United Kingdom, or by going to *http://shop.bsigroup.com/.*

See section IV.N for a further discussion of this standard.

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I. Authority and Background

Conventional cooking products are included in the list of ''covered products'' for which the U.S. Department of Energy (DOE) is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6292(a)(10)) DOE's energy conservation standards and test procedures for conventional cooking products are currently prescribed at 10 CFR 430.32(j) and 10 CFR 430.23(i), respectively. The following sections discuss DOE's authority to establish test procedures for conventional cooking products and

relevant background information regarding DOE's consideration of test procedures for this equipment.

A. Authority

Title III of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6291, *et seq.;* ''EPCA'' or, ''the Act'') [1] sets forth a variety of provisions designed to improve energy efficiency. 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, as codified), establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.'' These include cooking products,[2] and specifically conventional cooking tops [3] and conventional ovens,[4] the primary subject of this document. (42 U.S.C. 6292(a)(10))

Under EPCA, the energy conservation 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 as the basis for (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and (2) making representations about the efficiency of those products. Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA.

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 that any test procedures prescribed or amended under this section shall be reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle 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 a proposed test procedure and offer the public an opportunity to present oral and written comments on it. (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)) DOE recognizes that the test procedure amendments adopted in this final rule will affect the measured energy use of some conventional cooking products. However, the current energy conservation standards for conventional cooking products are a prescriptive design standard prohibiting constant burning pilots for all gas cooking products manufactured on or after April 9, 2012. (10 CFR 430.32(j)) Because there are currently no performance-based standards for conventional cooking products, the EPCA provisions discussed in this preamble do not apply to this rulemaking.

DOE is currently considering amendments to the existing Federal energy conservation standards for conventional cooking products in a concurrent rulemaking, (Docket No. EERE–2014–BT–STD–0005). DOE will use the test procedure amendments adopted in this final rule as the basis for standards development in the concurrent energy conservation standards rulemaking.

DOE is establishing in this final rule that use of the amended test procedure for compliance with DOE energy conservation standards or representations with respect to energy consumption of conventional cooking products is required on the compliance date of any revised energy conservation standards, which are being considered in a concurrent rulemaking (Docket No. EERE–2014–BT–STD–0005). The existing test procedure for conventional cooking products must be used for any representations related to standby mode and off mode energy consumption of conventional cooking tops, but not including combined cooking products. Any representation related to energy or power consumption of cooking products made 180 days after the publication of this final rule in the **Federal Register**, including for combined cooking products, must be based upon results generated under the amended test procedure.

This final rule fulfills DOE's obligation to periodically review its test procedures under 42 U.S.C. 6293(b)(1)(A). DOE anticipates that its next evaluation of this test procedure will occur in a manner consistent with the timeline set out in this provision.

B. Background

DOE's test procedures for conventional cooking tops, conventional ovens, and microwave ovens are codified at appendix I to subpart B of 10 CFR part 430 (appendix I).

DOE established the test procedures for conventional cooking products in a final rule published in the **Federal Register** on May 10, 1978. 43 FR 20108, 20120–20128. DOE revised its test procedures for cooking products to more accurately measure their efficiency and energy use, and published the revisions as a final rule in 1997. 62 FR 51976 (Oct. 3, 1997). These test procedure amendments included: (1) A reduction in the annual useful cooking energy; (2) a reduction in the number of self-cleaning oven cycles per year; and (3) incorporation of portions of International Electrotechnical Commission (IEC) Standard 705–1988, ''Methods for measuring the performance of microwave ovens for household and similar purposes,'' and Amendment 2–1993 for the testing of microwave ovens. *Id.* The test procedures for conventional cooking products establish provisions for determining estimated annual operating cost, cooking efficiency (defined as the ratio of cooking energy output to cooking energy input), and energy factor (defined as the ratio of annual useful cooking energy output to total annual energy input). 10 CFR 430.23(i); appendix I. These provisions for conventional cooking products are not currently used for compliance with any energy conservation standards because the present standards are design requirements; in addition, there is no EnergyGuide [5] labeling program for cooking products.

DOE subsequently conducted a rulemaking to address standby and off mode energy consumption, as well as

[1] All references to EPCA refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Public Law 114–11 (April 30, 2015).

[2] DOE's regulations define ''cooking products'' as one of the following classes: Conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, microwave/conventional ranges and other cooking products. (10 CFR 430.2)

[3] Conventional cooking top means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a horizontal surface containing one or more surface units which include either a gas flame or electric resistance heating. (10 CFR 430.2)

[4] Conventional oven means a class of kitchen ranges and ovens which is a household cooking appliance consisting of one or more compartments intended for the cooking or heating of food by means of either a gas flame or electric resistance heating. It does not include portable or countertop ovens which use electric resistance heating for the cooking or heating of food and are designed for an electrical supply of approximately 120 volts. (10 CFR 430.2)

[5] For more information on the EnergyGuide labeling program, see: *www.access.gpo.gov/nara/cfr/waisidx_00/16cfr305_00.html.*

certain active mode testing provisions, for residential dishwashers, dehumidifiers, and conventional cooking products. DOE published a final rule on October 31, 2012 (77 FR 65942, the October 2012 Final Rule), adopting standby and off mode provisions that satisfy the EPCA requirement that DOE include measures of standby mode and off mode power in its test procedures for residential products, if technically feasible. (42 U.S.C. 6295(gg)(2)(A))

1. The January 2013 TP NOPR

On January 30, 2013, DOE published a notice of proposed rulemaking (NOPR) (78 FR 6232, the January 2013 TP NOPR) proposing amendments to appendix I that would allow for measuring the active mode energy consumption of induction cooking products (*i.e.,* conventional cooking tops equipped with induction heating technology for one or more surface units [6] on the cooking top). DOE proposed to incorporate induction cooking tops by amending the definition of ''conventional cooking top'' to include induction heating technology. Furthermore, DOE proposed to require for all cooking tops the use of test equipment compatible with induction technology. Specifically, DOE proposed to replace the solid aluminum test blocks currently specified in the test procedure for cooking tops with hybrid test blocks comprising two separate pieces: an aluminum body and a stainless steel base. In the January 2013 TP NOPR, DOE also proposed amendments to include a clarification that the test block size be determined using the smallest dimension of the electric surface unit. 78 FR 6232, 6234 (Jan. 30, 2013).

2. The December 2014 TP SNOPR

On December 3, 2014, DOE published a supplemental notice of proposed rulemaking (SNOPR) (79 FR 71894, the December 2014 TP SNOPR), modifying its proposal from the January 2013 TP NOPR for measuring the energy efficiency of induction cooking tops. DOE proposed to add a layer of thermal grease between the stainless steel base and aluminum body of the hybrid test block to facilitate heat transfer between the two pieces. DOE also proposed additional test equipment for electric surface units with large diameters (both induction and electric resistance) and gas cooking top burners with high input rates. 79 FR 71894 (Dec. 3, 2014). In addition, DOE proposed methods to test non-circular electric surface units, electric surface units with flexible concentric cooking zones, and full-surface induction cooking tops. *Id.*

In the December 2014 TP SNOPR, DOE also proposed to incorporate methods for measuring conventional oven volume, clarify that the existing oven test block must be used to test all ovens regardless of input rate, and provide a method to measure the energy consumption and efficiency of conventional ovens equipped with an oven separator. 79 FR 71894 (Dec. 3, 2014). On July 3, 2015, DOE published a final rule addressing the test procedure amendments for conventional ovens only. (80 FR 37954, the July 2015 TP Final Rule).

3. The August 2016 TP SNOPR

On August 22, 2016, DOE published an additional SNOPR (81 FR 57374, the August 2016 TP SNOPR) in which DOE modified its proposal from the December 2014 TP SNOPR for testing conventional cooking tops. Based on review of the public comments received in response to the December 2014 TP SNOPR and a series of manufacturer interviews conducted in February and March 2015 to discuss key concerns regarding the hybrid test block method proposed in the December 2014 TP SNOPR, DOE withdrew its proposal for testing conventional cooking tops with a hybrid test block. Instead, DOE proposed to amend its test procedure for conventional electric cooking tops to incorporate by reference the relevant selections from European standard EN 60350–2:2013 ''Household electric cooking appliances Part 2: Hobs—Methods for measuring performance'' (EN 60350–2:2013). DOE also revised its proposals for testing non-circular electric surface units, electric surface units with flexible concentric cooking zones, and full-surface induction cooking tops. In addition, DOE proposed to extend the test methods in EN 60350–2:2013 to measure the energy consumption of gas cooking tops by correlating test equipment diameter to burner input rate, including input rates that exceed 14,000 British thermal units per hour (Btu/h). DOE also proposed to modify the calculations of conventional cooking top annual energy consumption (AEC) and integrated annual energy consumption (IAEC) to account for the proposed water-heating test method. Additionally, in the August 2016 TP SNOPR, DOE proposed to incorporate by reference certain test structures for conventional cooking tops contained in American National Standards Institute (ANSI) Z21.1–2016 ''Household cooking gas appliances'' (ANSI Z21.1–2016) and addressed minor technical changes that did not alter the substance of the existing test methods. 81 FR 57374, 57376–57377 (Aug. 22, 2016).

With regard to conventional ovens, DOE determined that, based on further review of public comments and data provided by manufacturers, the conventional oven test procedure does not accurately represent consumer use as it favors conventional ovens with low thermal mass and does not capture cooking performance-related benefits due to increased thermal mass of the oven cavity. As a result, DOE also proposed in the August 2016 TP SNOPR to repeal the regulatory provisions establishing the test procedures of conventional ovens. 81 FR 57374, 57376 (Aug. 22, 2016).

In response to the August 2016 TP SNOPR, DOE received multiple comments urging it to extend the comment period. The Association of Home Appliance Manufacturers (AHAM) commented that the test procedure proposed in the August 2016 TP SNOPR is completely different from DOE's previously proposed versions, and that a 30-day comment period does not provide sufficient time for interested parties to comment. AHAM stated that because DOE's proposal is completely new, it should be treated as a NOPR pursuant to 42 U.S.C. 6293(b)(2) with no less than 60 days for public comment, including the opportunity to provide oral comments. AHAM also opposed the development of test procedures and proposed standards in parallel, and commented that DOE should finalize the test procedure before continuing with proposed standards. According to AHAM, manufacturers were required to divide their resources to address the concurrent proposals, and thus were given insufficient time to respond to either. AHAM stated that, as a result, DOE has denied interested parties the opportunity to evaluate the accuracy, repeatability, reproducibility and test burden of the proposed test procedure, which AHAM claimed DOE has not assessed itself. (AHAM, No. 30 at pp. 2, 3, 6, 7)

AHAM also asserted that the brief comment period does not provide interested parties with enough time to identify potential ambiguities in the test procedure, which it believes would lead to numerous requests for guidance after the test procedure is finalized, some of which could impact the measured energy use and DOE's interpretation of the anti-backsliding rule (42 U.S.C. 6295(o)(1)). AHAM also cautioned DOE about enforcement challenges due to manufacturers and third-party

[6] The term surface unit refers to burners for gas cooking tops, electric resistance heating elements for electric cooking tops, and inductive heating elements for induction cooking tops.

laboratories different interpretations of the test procedure. (AHAM, No. 30 at pp. 4–5, 7)

AHAM described conducting a round robin testing program to understand and evaluate the water-heating test method in the draft version of IEC Standard 60350–2 Edition 2.0 ''Household electric cooking appliances–Part 2: Hobs–Method for measuring performance'' (IEC 60350–2),[7] which is similar to the water-heating test method DOE has proposed. AHAM noted that the round robin testing for electric cooking tops was scheduled to be completed by December 2016. AHAM also noted that it further plans to evaluate the repeatability and reproducibility of DOE's proposed test procedure for gas cooking tops, and expects to complete a smaller-scale round robin testing program for gas cooking tops by mid-January 2017. AHAM does not expect this testing to be completed in the comment period provided in the August 2016 TP SNOPR and requested that DOE extend the comment period until January 31, 2017. AHAM also noted that because DOE's proposed test procedure differs from the international version of the water-heating test procedure that was used in AHAM's round robin testing program, AHAM's results cannot evaluate to what extent DOE's modifications to the test method will add variation to test results. (AHAM, No. 23 at pp. 1, 4–5, 6; AHAM, No. 30 at p. 3)

Furthermore, AHAM stated that if DOE continues to develop the test procedure and standards in parallel, DOE should issue a notice of data availability and/or supplemental proposed test procedure to address AHAM's comments, conduct additional testing, and gather more information. AHAM stated that DOE should provide no fewer than 30 days to comment on that notice, and preferably 60 days if changes are significant. (AHAM, No. 30 at pp. 2, 8)

GE Appliances, a Haier Company (GE), Whirlpool Corporation (Whirlpool), and Sub-Zero Group, Inc. (Sub-Zero) supported AHAM's comments. (GE, No. 31 at p. 1; Whirlpool, No. 29 at p. 1; Sub-Zero, No. 25 at p. 1) Sub-Zero added that requiring interested parties to substantively comment concurrently on both a new test procedure and a proposed standard for previously unregulated products is significantly burdensome to the industry. (Sub-Zero, No. 25 at p. 1) GE also commented that at the time it submitted comments on the August 2016 TP SNOPR, it had been able to obtain results for only approximately 25 percent of its models, for reasons including the lack of availability of test vessels and difficulty in obtaining valid test runs. GE commented that DOE should pause the rulemaking process and engage in additional outreach with manufacturers to ensure that the issues raised by AHAM are appropriately evaluated and addressed. (GE, No. 31 at pp. 1–2)

Southern California Gas Company (SCGC), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) (collectively, the Southern California investor-owned utilities (SoCal IOUs)) also commented that the proposed water-heating test method represents a significant change from DOE's previously proposed hybrid block test method and, as a result, DOE should extend the comment period to allow time for interested parties to evaluate the test procedure. (SoCal IOUs, No. 27 at p. 3) The American Gas Association (AGA) and American Public Gas Association (APGA) similarly stated that their comments will not be as comprehensive as they would have been if DOE had extended the comment period. (AGA and APGA, No. 26 at pp. 1–2)

DOE considered and evaluated water-heating test methods based on the IEC test procedure as part of the January 2013 TP NOPR and December 2014 TP SNOPR. 78 FR 6232, 6239–6241 (Jan. 30, 2013); 79 FR 71894, 71900–71903 (Dec. 3, 2014). As a result, DOE does not consider its proposal in the August 2016 TP SNOPR to be completely new and warranting treatment as a NOPR.

As discussed in section III.C.2 of this final rule, DOE is not requiring that each setting of the multi-ring surface unit be tested independently. Instead, DOE is aligning the test provisions with EN 60350–2:2013 to require testing of the largest measured diameter of multi-ring surface units only, unless an additional test vessel category is needed to meet the test vessel selection requirements in section 7.1.Z3 of EN 60350–2:2013, as explained in III.C.1. In that case, one of the smaller-diameter settings of the multi-ring surface unit that matches the next best-fitting test vessel diameter must be tested. As a result, the test procedure adopted in this final rule is equivalent to the test procedure considered and used in AHAM's round robin testing program.

As discussed in the August 2016 TP SNOPR, multiple manufacturers that produce and sell products in both the United States and Europe supported the use of the water-heating test method in IEC 60350–2. BSH Home Appliances Corporation (BSH) specifically noted that this test procedure is applied in Europe for its Energy Conservation Program and that international test laboratories and manufacturers have successfully used this test method. 81 FR 57374, 57382 (Aug. 22, 2016). DOE agrees that manufacturers that also produce and sell conventional cooking tops in Europe are likely to already have experience with the water-heating test method adopted in this final rule. DOE further observes that because AHAM and other manufacturers also participate in the development of IEC 60350–2,[8] these interested parties are likely already familiar with the repeatability, reproducibility and test burden associated with the provisions from EN 60350–2:2013 adopted in this final rule. Accordingly, DOE does not find that a comment period extension for the test procedure is warranted.

With respect to the process of establishing test procedures and standards for a given product, DOE notes that, while not legally obligated to do so, it generally follows the approach laid out in guidance found in 10 CFR part 430, subpart C, appendix A (Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products). That guidance provides, among other things, that, when necessary, DOE will issue final, modified test procedures for a given product prior to publication of the NOPR proposing energy conservation standards for that product. While DOE strives to follow the procedural steps outlined in its guidance, there may be circumstances in which it may be necessary or appropriate to deviate from it. In such instances, the guidance indicates that DOE will provide notice and an explanation for the deviation. For this test procedure rulemaking, DOE issued a supplemental proposed rulemaking (the August 2016 TP SNOPR) conventional cooking products which is not contemplated by the process rule, but DOE believed was necessary due to the significant comments regarding the test procedures for both induction cooking tops and commercial-style cooking products. With this action, DOE is finalizing the test procedure as its next regulatory

[7] DOE notes that the test methods in EN 60350–2:2013 are based on the same test methods in the latest draft version of IEC 60350–2. Based on the few comments received during the development of the draft, DOE expects that the IEC procedure, once finalized, will retain the same basic test method as currently contained in EN 60350–2:2013.

[8] IEC committee members for IEC 60350–2 are listed online at: *http://www.iec.ch/dyn/www/f?p=103:14:0::::FSP_ORG_ID,FSP_LANG_ID:2420,25*, and *https://ansi.org/standards_activities/iec_programs/governance_committees/gen_info.aspx?menuid=3*.

action for cooking products, as commenters suggested.

DOE appreciates AHAM's willingness to conduct a round robin testing program to inform the rulemaking and other interested parties, as well as AHAM's comments that derive from the round robin testing that has been completed. DOE requested the test data from AHAM's round robin testing program so that it could further evaluate for this final rule the concerns raised by interested parties, but has not received any such data. However, DOE conducted its own additional testing on both electric and gas cooking tops after the August 2016 TP SNOPR to evaluate the variability in testing results using the proposed water-heating test methods and to address specific issues raised by interested parties regarding the water-heating test method, as discussed in section III.C of this document. The results from DOE's testing are presented and discussed in relevant sections of this final rule.

II. Synopsis of the Final Rule

In this final rule, DOE amends 10 CFR 430 Appendix I, ''Uniform Test Method for Measuring the Energy Consumption of Conventional Cooking Products,'' as follows:

- Repeals the provisions in the existing cooking products test procedure relating to conventional ovens;
- Incorporates by reference the relevant sections of EN 60350–2:2013, which uses a water-heating test method to measure the energy consumption of electric cooking tops;
- Extends the water-heating test method specified in EN 60350–2:2013 to gas cooking tops by correlating the burner input rate and test vessel diameters specified in EN 30–2–1:1998 *Domestic cooking appliances burning gas—Part 2–1: Rational use of energy—General* (EN 30–2–1) to the test vessel diameters and water loads already included in EN 60350–2:2013;
- Adopts a modified water quantity, different than the quantity specified in EN 60350–2:2013, used to normalize the total energy consumption of the cooking top to estimate a representative AEC for the U.S. market;
- Clarifies that for all cooking tops, specialty surface units such as bridge zones, warming plates, grills, and griddles are not covered by appendix I;
- Clarifies that the 20-minute simmering period starts when the water temperature first reaches 90 °C and does not drop below 90 °C for more than 20 seconds after initially reaching 90 °C;
- Adopts a calculation of the AEC and IAEC of conventional cooking tops;
- Defines the term ''combined cooking product'' as a cooking product that combines a conventional cooking product with other appliance functionality, which may or may not include another cooking product;
- Clarifies that the active mode test procedures in appendix I applies to the conventional cooking top component of a combined cooking product and includes a method to apportion the combined low-power mode energy consumption measured for the combined cooking product to the individual cooking top component of the combined cooking product;
- Clarifies that the measurement of the heating value of natural gas or propane specified in section 2.9.4 of appendix I be corrected to standard pressure and temperature conditions in accordance with the U.S. Bureau of Standards, circular C417, 1938; and
- Corrects grammatical errors in certain sections of appendix I that serve as clarifications and do not change the substance of the test method.

In this final rule, DOE is also modifying the requirements in 10 CFR 430.23 to align with the changes adopted for appendix I, clarifying test procedures for the measurement of energy consumption for cooking tops.

Finally, DOE amends the sampling plan requirements in 10 CFR 429.23 ''Conventional cooking tops, conventional ovens, microwave ovens'' to include AEC and IAEC for conventional cooking tops.

III. Discussion

In this test procedure final rule, DOE is amending the test procedures for conventional cooking products contained in the relevant sections of part 430 of Title 10 of the CFR. The test procedures established in this final rule provide a measure of conventional cooking top energy consumption under representative conditions, which are discussed further in sections III.C, III.D, III.E, and III.F of this final rule, and repeals provisions in the existing cooking products test procedure relating to conventional ovens.

A. Scope

As discussed in section I.A of this document, DOE has the authority to amend test procedures for covered products. EPCA identifies kitchen ranges and ovens as a covered product. (42 U.S.C. 6292(a)(10)) In a final rule published on September 8, 1998 (63 FR 48038), DOE amended its regulations in certain places to substitute the term ''kitchen ranges and ovens'' with ''cooking products.'' DOE regulations currently define ''cooking products'' as consumer products that are used as the major household cooking appliances. They are designed to cook or heat different types of food by one or more of the following sources of heat: Gas, electricity, or microwave energy. Each product may consist of a horizontal cooking top containing one or more surface units and/or one or more heating compartments, and must be one of the following classes: Conventional ranges, conventional cooking tops, conventional ovens, microwave ovens, microwave/conventional ranges and other cooking products. 10 CFR 430.2

In this final rule, DOE is addressing test procedures for conventional cooking tops and is repealing the test procedures for conventional ovens. In addition, because DOE regulations currently continue to use the term ''kitchen ranges and ovens'' and other terms in certain places to describe the products that are the subject of this rulemaking, DOE is amending its regulations codified at 10 CFR 430 to consistently refer to the products as ''cooking products.''

1. Induction Cooking Tops

As discussed in section I of this final rule, the test procedures currently specified in appendix I do not apply to induction cooking products. In the January 2013 TP NOPR, DOE proposed to amend the definition of ''conventional cooking top'' to include products that feature electric inductive heating surface units. 78 FR 6232, 6234–6235 (Jan. 30, 2013). DOE similarly proposed in the January 2013 TP NOPR to revise the definition of ''active mode'' included in appendix I to account for electric inductive heating, consistent with the proposed definition of ''conventional cooking top.'' *Id.* In comments on the January 2013 TP NOPR, manufacturers did not oppose amended definitions to include induction cooking. 79 FR 71894, 71897 (Dec. 3, 2014). Additionally, DOE did not receive any comments on its proposal to revise the definitions in the December 2014 TP SNOPR and August 2016 TP SNOPR. As a result, DOE is amending the definitions of ''conventional cooking top'' and ''active mode'' in this final rule to account for induction technology, as discussed above.

2. Combined Cooking Products

Certain residential household cooking appliances combine a conventional cooking product component with other appliance functionality, which may or may not perform a cooking-related function. Examples of such ''combined cooking products'' include a

conventional range, which combines a conventional cooking top and one or more conventional ovens; a microwave/conventional cooking top, which combines a microwave oven and a conventional cooking top; a microwave/conventional oven, which combines a microwave oven and a conventional oven; and a microwave/conventional range, which combines a microwave oven and a conventional oven in separate compartments and a conventional cooking top. Because combined cooking products may consist of multiple classes of cooking products, any potential conventional cooking top or oven energy conservation standard would apply to the individual components of the combined cooking product. Thus, DOE stated in the August 2016 TP SNOPR that the proposed cooking top test procedures would also apply to the individual conventional cooking top portion of a combined cooking product. 81 FR 57374, 57378 (Aug. 22, 2016). Because combined cooking products are a kind of cooking product that combines a conventional cooking product with other appliance functionality and not a distinct product class, DOE proposed in the August 2016 TP SNOPR to remove the definitions of the various kinds of combined cooking products currently included in 10 CFR 430.2, and then proposed to add a definition of ''combined cooking product'' to appendix I, as this definition would be related to the test of combined cooking products and is not a unique product class itself. *Id.* DOE also noted that the definitions of ''conventional cooking top,'' ''conventional oven,'' ''microwave oven,'' and ''other cooking products'' refer to these products as classes of cooking products. Because these are more general product categories and not specific product classes, DOE proposed in the August 2016 TP SNOPR to amend the definitions of conventional cooking top, conventional oven, microwave oven, and other cooking products in 10 CFR 430.2 to reflect this clarification. *Id.*

DOE did not receive any comments on its proposal to revise the definitions related to combined cooking products and cooking product categories. For the reasons discussed above, DOE is adopting these amended definitions in this final rule.

As discussed in the August 2016 TP SNOPR, DOE observed that for combined cooking products, the annual combined low-power mode energy consumption can only be measured for the combined cooking product and not the individual components. 81 FR 57374, 57378 (Aug. 22, 2016). As discussed in section III.D.2 of this document, DOE is adopting the methods proposed in the August 2016 TP SNOPR to calculate the IAEC of the conventional cooking top component separately by allocating a portion of the combined low-power mode energy consumption measured for the combined cooking product to the conventional cooking top component using the estimated annual cooking hours for the given components comprising the combined cooking product. Similarly for microwave ovens, DOE is adopting the methods proposed in the August 2016 TP SNOPR to allocate a portion of the combined low-power mode energy consumption measured for the combined cooking product to the microwave oven component, based on the estimated annual cooking hours for the given components comprising the combined cooking product.

3. Gas Cooking Tops With High Input Rates

In the December 2014 TP SNOPR, DOE proposed to amend the conventional cooking top test procedure in appendix I to measure the energy use of gas surface units with high input rates and noted that the current definition for ''conventional cooking top'' in 10 CFR 430.2 already covers conventional gas cooking products with higher input rates (including commercial-style gas cooking products), as these products are household cooking appliances with surface units or compartments intended for the cooking or heating of food by means of a gas flame. DOE considers a cooking top burner with a high input rate to be a burner rated greater than 14,000 Btu/h. 79 FR 71894, 71897 (Dec. 3, 2014). DOE did not receive any comments on this interpretation of the definition of ''conventional cooking top.'' In addition, as discussed in section III.C.3 of this document, DOE is adopting test methods to measure the energy consumption of conventional gas cooking tops that use a range of test vessel diameters and water loads that are selected based on the input rate of the burner, including those with burners having input rates greater than 14,000 Btu/h (including commercial-style gas cooking tops). As a result, DOE maintains the interpretation for this final rule that the definition for ''conventional cooking top'' in 10 CFR 430.2 covers conventional gas cooking products with higher input rates, including commercial-style cooking tops.

B. Repeal of the Conventional Oven Test Procedure

As discussed in the August 2016 TP SNOPR, DOE determined that commercial-style ovens typically incorporate design features (*e.g.,* heavier-gauge cavity construction, high input rate burners, extension racks) that result in inherently lower efficiencies than for residential-style ovens with comparable cavity sizes, due to the greater thermal mass of the cavity and racks when measured using the test procedure adopted in the July 2015 TP Final Rule. 81 FR 57374, 57379 (Aug. 22, 2016). Furthermore, DOE concluded that certain additional factors that are not currently addressed in the test procedure, such as the impact of door openings on thermal recovery, could, if included in the test procedure, alter the efficiencies of commercial-style ovens relative to the efficiencies of residential-style ovens. For these reasons, DOE proposed in the August 2016 TP SNOPR to repeal the provisions in appendix I for measuring conventional oven IAEC. In addition, because DOE proposed to repeal the provisions for measuring conventional oven IAEC, DOE also proposed to remove the reference to AHAM OV–1–2011 ''Procedures for the Determination and Expression of the Volume of Household Microwave and Conventional Ovens'' contained in 10 CFR 430.3. *Id.*

AHAM supported DOE's proposal to repeal the provisions in appendix I for measuring conventional oven IAEC. AHAM asserted that, in general, test procedures should be adopted and revised to accommodate products on the market. AHAM stated that products should not have to adapt to the test procedure, which could result in a loss of consumer utility, as would be the case with the existing test procedure for conventional ovens. (AHAM, No. 30 at p. 18) The Appliance Standards Awareness Project, Alliance to Save Energy, American Council for an Energy-Efficient Economy, Consumer Federation of America, Consumers Union, National Consumer Law Center, Natural Resources Defense Council, and Northwest Power and Conservation Council (collectively, the Joint Efficiency Advocates) and the SoCal IOUs encouraged DOE to initiate work to develop a test procedure for conventional ovens. The Joint Efficiency Advocates added that a test procedure for conventional ovens would allow DOE to set performance standards for ovens in the future that could achieve significant energy savings and provide information to consumers about the cooking efficiency of conventional

ovens. (Joint Efficiency Advocates, No. 32 at pp. 1–2; SoCal IOUs, No. 27 at p. 3)

Because DOE did not receive any objections to its proposal, and for the reasons stated, DOE is repealing the test procedures pertaining to conventional ovens in this final rule.

C. Water Heating Test Method

In this final rule, DOE is incorporating by reference the relevant sections from EN 60350–2:2013 for measuring electric cooking top energy consumption. DOE is also extending the testing methods in EN 60350–2:2013 to measure the energy consumption of gas cooking tops by correlating test equipment diameter to burner input rate. These amendments are discussed in the following sections.

1. Incorporation by Reference of EN 60350–2:2013

The test method to measure the energy consumption of each electric cooking top surface unit provided in EN 60350–2:2013 consists of two phases. The first phase of the EN 60350–2 test requires heating a water-filled test vessel on a surface unit to a calculated ''turndown temperature'' at the maximum energy input setting. During the second phase of the test, the power input is reduced to a setting that will maintain the water temperature above 90 °C (a simmering temperature) but as close to 90 °C as possible without additional adjustment of the low-power setting.[9] The test ends 20 minutes after the temperature first increases above 90 °C.

To determine the turndown temperature, T_c, EN 60350–2:2013 requires an initial test to determine the number of degrees that the temperature continues to rise after turning the unit off from the maximum energy input setting. This initial measurement involves heating the water-filled test vessel at the maximum energy input setting until the water temperature reaches 70 °C, T_{70}, at which point the power is switched off.[10] The water temperature is measured as it continues to rise after the power is switched off. The temperature overshoot, ΔT_0, is calculated as the highest measured water temperature minus T_{70}. T_c is then calculated as 93 °C minus ΔT_0.

For the test load, EN 60350–2:2013 specifies a quantity of water to be heated in a standardized test vessel. The test vessel consists of a thin-walled stainless steel cylinder attached to a flat, stainless steel 430 base plate. The test method also specifies an aluminum lid with vent holes and a small center hole to fix the thermocouple in the center of the pot. There are eight standardized cooking vessel diameters ranging from 4.7 inches to 13 inches and the amount of water varies with the test vessel diameter. One cooking vessel is chosen to test a given surface unit based on the diameter of the surface unit. Table III.1 lists the full range of test vessel diameters, water loads, and the corresponding surface unit diameters as specified in EN 60350–2:2013 for electric cooking tops. EN 60350–2:2013 also groups the specified test vessels into categories representing different cookware types.

TABLE III.1—EN 60350–2:2013 TEST VESSEL DIAMETER AND WATER LOAD

Test vessel diameter inches (mm)	Mass of the water load lbs (kg)	Corresponding surface unit diameter inches (mm)	Standard cookware category
4.72 (120)	1.43 (0.65)	3.93 ≤ × < 5.12 (100 ≤ × < 130)	A
5.91 (150)	2.27 (1.03)	5.12 ≤ × < 6.30 (130 ≤ × < 160)	
7.09 (180)	3.31 (1.50)	6.30 ≤ × < 7.48 (160 ≤ × < 190)	B
8.27 (210)	4.52 (2.05)	7.48 ≤ × < 8.66 (190 ≤ × < 220)	C
9.45 (240)	5.95 (2.70)	8.66 ≤ × < 9.84 (220 ≤ × < 250)	
10.63 (270)	7.54 (3.42)	9.84 ≤ × < 11.02 (250 ≤ × < 280)	D
11.81 (300)	9.35 (4.24)	11.02 ≤ × < 12.20 (280 ≤ × < 310)	
12.99 (330)	11.33 (5.14)	12.20 ≤ × < 12.99 (310 ≤ × ≤ 330)	

The number of test vessels needed to assess the energy consumption of the cooking top is based on the number of controls that can be independently but simultaneously operated on the cooking top. By assessing the number of independent controls and not just the marked surface units, the test procedure accounts for cooking tops with cooking zones that do not have limitative markings. Each independently controlled surface unit or area of a ''cooking zone'' is tested individually. The temperature of the water and the total input energy consumption is measured throughout the test. EN 60350–2:2013 specifies that the total cooking top energy consumption is determined as the average of the energy consumed during each independent test divided by the mass of the water load used for the test. This average energy consumption in Watt-hours (Wh) is then normalized to a standard water load size (1,000 grams (g)) to determine the average per-cycle energy consumption of the cooking top. Normalizing to a single load size ensures that manufacturers are not penalized for offering a variety of surface unit diameters to consumers.

For standard circular electric surface units, the test vessel with a diameter that most closely matches the surface unit diameter is selected. Different surface units on a cooking top can be tested with the same test vessel diameter. However, if the number of independent controls/surface units for the cooking top exceeds two, the selected test vessels must come from at least two cookware categories. This means that one or more of the surface units on the cooking top will be tested with the next best-matched test vessel in another cookware category. By adding this requirement, EN 603050–2:2013 accounts for the variety of cookware that would be used on the cooking top and prevents the test procedure from penalizing cooking tops that have a range of surface unit sizes with a range of surface unit input rates.

For cooking tops without defined surface units, such as cooking tops with full-surface induction cooking zones, EN 60350–2:2013 specifies a method to select the appropriate test position for each test vessel based on a pattern starting from the geometric center of the

[9] At first, the lowest power setting is selected. If the temperature of the water is less than 90 °C during the simmering time, the test has to be repeated with an increased power setting.

[10] To obtain a higher accuracy of the temperature measurement, T_{70} is determined by the average of the recorded temperature between the time to reach 70 °C, t_{70}, minus 10 seconds, and t_{70} plus 10 seconds. If the result is within the tolerance of 70 °C ± 0.5 °C, then this temperature is noted. If not, the test is repeated.

cooking zone. Instead of requiring that test vessels be selected based on best fit, the test vessel diameters are explicitly defined, and vary with the number of controls, to capture how different cookware types may be used on the unmarked cooking surface.

As part of the August 2016 TP SNOPR, DOE conducted a series of interviews with manufacturers, as well as analyzed test results from DOE's water-heating testing and results from round robin testing performed in 2011 by the European Committee of Domestic Equipment Manufacturers (CECED) [11] [12] to evaluate the repeatability and reproducibility of EN 60350–2:2013. Based on this evaluation, DOE determined that the test methods to measure surface unit energy consumption specified in EN 60350–2:2013 produce sufficiently repeatable and reproducible test results. DOE also noted that the test vessels specified in EN 60350–2:2013 are compatible with all cooking top types, and that the range of test vessel diameters cover the full range of surface unit diameters available on the U.S. market. 81 FR 57374, 57382–57384 (Aug. 22, 2016).

DOE proposed in the August 2016 TP SNOPR to incorporate by reference certain sections of EN 60350–2:2013.[13] Specifically, DOE proposed to incorporate Section 5, ''General conditions for the measurements,'' which outlines the test room and test equipment conditions; Section 6.2, ''Cooking zones per hob,'' which outlines how to determine the number of controls and the dimensions of the cooking zones; and Section 7.1, ''Energy consumption and heating up time,'' which outlines both the test methods and equipment required to measure cooking top energy consumption. DOE proposed to omit Section 7.1.Z5, ''Procedure for measuring the heating up time,'' as it is not required to calculate the overall energy consumption of the cooking top and would increase manufacturer test burden. Additionally, DOE proposed to omit Section 7.1.Z7, ''Evaluation and calculation,'' as DOE proposed an alternative method to normalize the measured cooking top energy consumption discussed further in section III.D.1 of this document. DOE also proposed to incorporate by reference Annex ZA through Annex ZF of EN 60350–2:2013, which provide further requirements for measuring the energy consumption, clarify test vessel construction, and provide examples for how to select the appropriate test vessels. DOE also proposed to include many of the definitions related to the measure of cooking top energy consumption specified in Section 3 of EN 60350–2:2013. However, due to differences in terminology between the United States and Europe, such as the use of the word hob for cooking top, DOE proposed to explicitly define relevant terms from Section 3 of EN 60350–2:2013 in appendix I. 81 FR 57374, 57384 (Aug. 22, 2016).

In response to the August 2016 TP SNOPR, DOE received a number of comments regarding the proposed water-heating test method. These comments are discussed in the following sections.

Repeatability, Reproducibility, and Representativeness of the Water-Heating Test Method

The SoCal IOUs and Joint Efficiency Advocates supported DOE's proposal to incorporate by reference EN 60350–2:2013. The SoCal IOUs added that this test method is more representative of actual cooking compared to the hybrid block test method. (SoCal IOUs, No. 27 at p. 2; Joint Efficiency Advocates, No. 32 at p. 2)

AHAM commented that it does not have consumer data on the representativeness of the water-heating test method and interested parties were not provided with enough time to collect this data. AHAM further commented that DOE should conduct consumer surveys to collect the data necessary to support the proposed test procedure. (AHAM, No. 30 at p. 8) Nonetheless, AHAM agreed that the best test method for cooking tops would be a water-heating test method even though it opposed DOE's proposed test procedure. AHAM believes that DOE must determine whether the test is repeatable and reproducible and address the significant issues raised by interested parties before finalizing the test procedure. (AHAM, No. 30 at pp. 2, 3, 4–5) AHAM objected to the use of CECED round robin testing conducted 5 years ago on European products, which have different designs (*e.g.,* different heating element/burner construction), to demonstrate the repeatability and reproducibility of DOE's proposed test procedure. AHAM noted that the CECED round robin testing included only testing of a single surface unit for each cooking top, and that DOE's proposed test procedure is not the same as the test procedure evaluated in the CECED round robin testing. (AHAM, No. 30 at pp. 3, 8)

AHAM commented that its round robin testing, which included four test units encompassing a different combination of controls and heating elements relevant to the U.S. market, showed a much higher variance in test results. AHAM's submitted its measured values for the coefficient of variance of test results from laboratory to laboratory of 7.1 percent, 9.2 percent, and 8.4 percent for electric coil, electric smooth–radiant, and electric smooth–induction cooking tops, respectively. Based on this round robin testing, AHAM stated that EN 60350–2:2013 does not produce reproducible test results and that more work is needed to reduce this variation. (AHAM, No. 30 at pp. 8–9)

GE commented that, based on the variation in test results shown in the AHAM round robin testing program, there will be significant risks of setting energy conservation standards at unachievable levels. GE commented that because cooking products have limited technology options to improve efficiency, setting a standard based on a test procedure with significant variation in test results could cause products to become obsolete and create significant issues with the enforcement of standards. (GE, No. 31 at p. 2)

With regards to the CECED round robin test results, DOE notes that, based on product teardowns conducted as part of the concurrent standards rulemaking, the heating elements and glass cooking surfaces used in electric smooth cooking tops are typically purchased parts that are manufactured by companies that produce and supply these parts to countries worldwide.[14] As discussed in the August 2016 TP SNOPR, DOE also notes that while the solid plate cooking top technology evaluated in the CECED round robin testing program is not available on the U.S. market, DOE anticipates that the results obtained for this technology type are most similar to those obtained for electric coil cooking tops because in both cases the electric resistance heating element is in direct contact with the cooking vessel. Additionally, based on its review of

[11] Italian National Agency for New Technologies, Energy and Sustainable Economic Development—Technical Unit Energy Efficiency (ENEA–UTEE), ''CECED Round Robin Tests for Hobs and Microwave Ovens—Final Report for Hobs,'' July 2011.

[12] The CECED round robin testing program included 3 cooking top technologies (electric solid plate, electric smooth—radiant, and electric smooth—induction) tested at 12 different test facilities (6 manufacturer test labs and 6 independent test labs).

[13] The test procedure also includes test methods to measure heat distribution and other forms of cooking performance not related to the energy consumption of the cooking top.

[14] DOE observed during product teardowns conducted for the concurrent energy conservation standards for conventional cooking products that many electric smooth cooking top heating elements are supplied by E.G.O. Worldwide (*http://www.egoproducts.com/en/home/*).

electric cooking tops, DOE observed that both U.S. and European models use similar controls (*i.e.,* both step and infinite). Because the electric cooking top controls and technologies available on the U.S. market are the same or similar to those available in Europe, the CECED round robin test results are appropriate for evaluating the repeatability and reproducibility of the water-heating test method proposed in the August 2016 TP SNOPR.

Furthermore, as discussed in section III.C.2, DOE is not requiring that each setting of the multi-ring surface unit be tested independently. Instead, DOE is aligning the test provisions for multi-ring surface units with those in EN 60350–2:2013. As a result, the test procedure used in the CECED round robin testing program does not contain any significant differences from the test procedure for electric cooking tops adopted in this final rule.

After the August 2016 TP SNOPR, DOE conducted additional testing to investigate concerns raised by interested parties regarding potential sources of variability in the water-heating test method. DOE conducted testing on five electric cooking tops incorporating different heating technologies and control types (*i.e.,* either controls that can adjust surface unit power input only in discrete increments or those that provide essentially infinite power input adjustment). Table III.2 includes a list of the heating and control characteristics for each of the cooking tops in the DOE test sample.

TABLE III.2—ELECTRIC COOKING TOPS EVALUATED FOR THE FINAL RULE

Cooking top unit	Heating technology	Control type
1	Coil	Discrete Step.
2	Smooth—Radiant	Discrete Step.
3	Smooth—Radiant	Infinite.
4	Smooth—Induction	Discrete Step.
5	Smooth—Induction	Discrete Step.

For each model, DOE conducted testing on surface units capturing a range of heating element sizes. To evaluate the variability in test results, DOE conducted 2–3 tests per surface unit. For each individual test, DOE performed the full surface unit test method, including the preliminary test required to determine the turndown temperature and simmering setting for a given surface unit. To further evaluate the repeatability and reproducibility of test results, DOE varied test operators for surface unit tests. In addition, in evaluating variation in tests results, DOE included test results from previous testing of these test units conducted in support of the August 2016 TP SNOPR.

Table III.3 lists the coefficient of variation of the measured energy consumption among all of DOE's tests for each surface unit. The average coefficient of variation observed for DOE's test sample was 1.2 percent, which was slightly lower than the average coefficient of variation of 1.6 percent determined as part of the CECED round robin testing program, and in no case did the coefficient of variation for any individual surface unit exceed 2.0 percent.

TABLE III.3—VARIATION IN ELECTRIC COOKING TOP SURFACE UNIT TOTAL TEST ENERGY CONSUMPTION

Cooking top unit	Surface unit location	Surface unit diameter (in.)	Cookware diameter (mm)	Average per-cycle energy consumption (Wh)	Coefficient of variation (%)
1	BR	6	150	202.1	1.0
	BL	6	180	275.1	1.4
2	FL	9	240	500.9	1.8
	BR	6	150	192.2	0.4
	FL	6	150	189.8	0.7
3	BR	6	150	184.4	1.0
4	FR	7	180	239.2	0.6
	BR	6	150	173.1	2.0
5	FL	7	180	266.8	1.1
	FL	6	150	185.9	2.0

Based on DOE's testing and the CECED round robin testing, and because DOE expects that the coefficient of variation of the results for an overall cooking top will not exceed the coefficient of variation of the results for an individual surface unit, DOE concludes that the water-heating test method in EN 60350–2:2013 produces repeatable and reproducible test results. To better understand the higher variation in test results observed as part of AHAM's round robin testing, DOE requested the test data from AHAM for comparison. At the time of this final rule analysis, DOE had not received this test data for direct evaluation. Therefore, as discussed in the following sections, DOE conducted further testing itself to evaluate specific water-heating test method conditions (*e.g.,* turndown temperature and setting) that could potentially have contributed to the variation in test results observed in AHAM's round robin testing.

Turndown Temperature

AHAM commented that there is variability in determining the turndown temperature because switching off power to a surface unit is not an automated process and cannot always be performed immediately after the water temperature reaches 70 °C during the preliminary turndown test. AHAM stated that this introduces variability in results depending on the accuracy, resolution, and response time of the temperature measuring device. AHAM

presented test data from its round robin test program for an electric coil surface unit for which the three testing laboratories determined turndown temperatures of 82.3 °C, 80 °C, and 81 °C, respectively. According to AHAM, this variation would result in testing laboratories selecting different simmering settings, which would create variability in the simmering phase of the test. AHAM further believes this variability would cause issues with demonstrating compliance with standards and prevent consumers from accurately comparing energy use of products. AHAM stated that, given the short comment period provided on the August 2016 TP SNOPR, DOE should conduct additional work to understand and reduce this variation. (AHAM, No. 30 at p. 11)

DOE notes that the provisions specified in section 7.1.Z6.2 of EN 60350–2:2013 already minimize the variability associated with determining the turndown temperature. For example, the preliminary test to determine the turndown temperature requires that the average recorded temperature must be within the tolerance of 70 °C ± 0.5 °C throughout the period of 10 seconds before to 10 seconds after power to the surface unit is shut off. This tolerance helps to improve the accuracy of the turndown temperature that is eventually identified for the energy test. Moreover, section 7.1.Z6.2.3 of EN 60350–2:2013 places a tolerance on the actual turndown temperature used in the energy test. The test is invalid unless the actual turndown temperature corresponding to the moment the surface unit setting is changed falls within +1.0 Kelvin (K) to −0.5 K of the turndown temperature, T_c, determined during the preliminary test.

In addition to evaluating overall repeatability of the surface unit energy consumption measurement, DOE conducted tests designed to investigate the impact of turndown temperature variations. Because DOE performed the full test method each time a surface unit was tested (*i.e.,* the test to determine the turndown temperature, the test to determine the simmering setting, and the energy test), DOE captured a range of turndown temperatures that satisfied the tolerances in EN 60350–2:2013. Table III.4 includes sample tests for a surface unit on an electric coil cooking top and on a smooth–radiant cooking top, demonstrating the effects of varying the actual turndown temperature for the same simmering setting. DOE observed that the total measured per-cycle energy consumption from test to test exhibited a coefficient of variation of less than 1 percent for variations in turndown temperature that were within allowable tolerances, and DOE expects that the impacts on IAEC for an entire cooktop would be even less significant. As a result, DOE is maintaining the methodology for determining the turndown temperature as specified in EN 60350–2:2013.

TABLE III.4—EFFECTS OF VARIED TURNDOWN TEMPERATURE ON TOTAL ENERGY CONSUMPTION

Cooking top unit	Heating element type	Test	Pre-determined turndown temp, T_c (°C)	Actual turndown temp (°C)	Final water temperature T_{final} (°C)	Total per-cycle energy consumption (Wh)	Coefficient of variation (%)
1	Coil	A	83.8	83.8	92.0	278.7	0.38
		B	85.9	86.3	91.6	276.6	
2	Smooth—Radiant	A	82.1	81.8	91.5	188.7	0.67
		B	83.1	82.8	92.0	191.7	
		C	81.5	81.3	92.7	189.1	
		D	82.7	84.3	91.7	188.1	
		E	83.6	83.4	91.5	190.3	

Determining the Simmering Setting

AHAM commented that there is variability in determining the simmering setting for the simmer phase of the test. AHAM stated that the proposed test procedure does not specify an exact setting for the turndown temperature and because of the way cooking tops are designed, it is impossible to define a single approach for determining the simmering setting. AHAM noted that the simmering setting plays an important role in the overshoot temperature and the ability to maintain a temperature as close as possible to 90 °C during the simmer phase of the test. AHAM stated that based on its testing, the results of which are shown in Table III.5 and Table III.6, the simmering setting determined for the simmer phase is not consistent from laboratory to laboratory. (AHAM, No. 30 at p. 11)

TABLE III.5—AHAM ROUND ROBIN TESTING—ELECTRIC SMOOTH RADIANT SURFACE UNIT (1500W) SIMMERING SETTING VARIABILITY

Test lab	Simmering setting	Final water temperature (°C)	Energy use coefficient of variation (%)
Lab 1	4	96	16.3
Lab 2	3	94	
Lab 3	5	100.1	

TABLE III.6—AHAM ROUND ROBIN TESTING—ELECTRIC SMOOTH INDUCTION SURFACE UNIT (1800W WITH BOOST) SIMMERING SETTING VARIABILITY

Test lab	Simmering setting	Final water temperature (°C)	Energy use coefficient of Variation (%)
Lab 1	4.5	94.7	10.1
Lab 2	4	93.9	
Lab 3	3	90.9	

AHAM commented that the proposed DOE test procedure does not define a tolerance for staying as close as possible to the required simmer temperature of 90 °C without going below this value. AHAM stated that this can give rise to significant test burden by requiring multiple test runs for each surface unit to determine the turndown control setting that provides a simmer temperature as close as possible to 90 °C. AHAM added that, as indicated in Table III.5 and Table III.6, the simmering setting and the maximum water temperature during the simmer phase of the test varied and had a significant effect on the overall measured energy consumption. AHAM stated that this will lead to issues with enforcement testing and prevent consumers from accurately comparing energy use of products. (AHAM, No. 30 at pp. 9–10)

However, AHAM also commented that it may be difficult to place a maximum temperature tolerance on the simmer phase of the test. According to AHAM, a surface unit may not be able to achieve a specified maximum tolerance depending on the unit's controls (*e.g.,* infinite switch or a step control). AHAM expressed concern that the uncertainty in these measurements using the proposed DOE test procedure could cause manufacturers to switch from step controls to more expensive infinite controls. AHAM stated that the test procedure must not dictate product design. (AHAM, No. 30 at p. 10)

AHAM further commented that due to the differences in resolution, sensitivity and accuracy of the temperature measuring device, testing laboratories cannot precisely determine when the temperature of the water has reached 90 °C. AHAM stated that its members have considered using a smoothing average when the temperature briefly reaches 90 °C but immediately falls below that level to account for temperature measurement noise caused by the convection of water and by the temperature measurement setup itself. As a result, AHAM stated that minor oscillations of the measured temperature occur and the actual threshold of 90 °C cannot be determined. AHAM urged DOE to address the oscillation issue before finalizing the test procedure. (AHAM, No. 30 at pp. 12–13)

AHAM commented that, as demonstrated by its round robin testing, these issues regarding the simmer phase of the test, result in a large variability in the overall measured energy consumption. AHAM urged DOE to further investigate these issues with the simmer phase and propose methods to reduce the variation in test results. (AHAM, No. 30 at pp. 10, 11)

GE asserted that the AEC results from the AHAM round robin testing program, presented in Table III.7, which included three different units tested at three manufacturer laboratories, indicate that the simmer phase of the test is the largest contributor to the variation in test results. GE commented that significant variation in the measured AEC would obscure any proposed efficiency gains that could be realized by many of the technology options DOE considered in its standards analysis. (GE, No. 31 at p. 3)

TABLE III.7—AHAM ROUND ROBIN TESTING—ELECTRIC COOKING TOPS COEFFICIENT OF VARIANCE

Cooking top technology	Coefficient of variance of measured energy consumption (%)		
	Heat up to 90 °C phase	20-Minute simmer phase	Total test
Coil	2.1	19.5	7.1
Smooth—Radiant	1.1	25.0	9.2
Smooth—Induction	3.5	21.3	8.4

GE commented that measuring only the energy required to reach 90 °C would provide repeatable results and reduce the burden of determining the turndown temperature and simmering setting. As a result, GE recommended eliminating the simmer phase of the test. (GE, No. 31 at p. 3)

Section 7.1.Z6.2.3 of EN 60350–2:2013 includes instructions for determining the correct setting for the simmering phase of the test with minimal uncertainty. For the first test of a surface unit, the lowest simmering setting is selected. If during the simmering phase of the test the temperature of the water falls below 90 °C, the test is repeated using the next highest setting until the setting that maintains the water temperature above, but as close as possible to, 90 °C is identified.

Based on DOE's testing, only a single setting for each surface unit achieved a water temperature that met the requirements of the simmering phase of the test as specified in section 7.1.Z6.2.3 of EN 60350–2:2013. To demonstrate the effect of improper selection of the simmering setting, as shown in Table III.8, DOE investigated settings that were both higher and lower simmering settings for several surface units in the test sample. Assuming all aspects of the test procedure are conducted appropriately, the final measured water temperature is consistently positively correlated with the simmering setting so that there is no ambiguity regarding

which simmering setting will repeatedly correspond to the setting that maintains the water temperature above but as close as possible to 90 °C. As part of this investigation, DOE also compared the selected settings from the testing effort conducted in support of the August 2016 TP SNOPR to the more recent testing effort conducted in support of this final rule and found that the correct simmering setting did not change when the surface unit was retested.

TABLE III.8—EFFECTS OF VARYING THE SIMMERING SETTING ON TOTAL PER-CYCLE ENERGY CONSUMPTION

Cooking top unit	Heating element type	Control type	Test	Simmering setting	Final water temp (°C)	Total per-cycle energy consumption (Wh)
1	Coil	Discrete Step	A	2	92.0	278.7
			C	2.5	95.2	297.3
2	Smooth-Radiant	Discrete Step	A	2	91.5	188.7
			F	3	99.6	228.4
3	Smooth-Radiant	Infinite	A	40° from minimum*	87.1	262.7
			B	50° from minimum	88.1	263.7
			C	60° from minimum	90.3	273.9
			D	70° from minimum	93.1	289.3
4	Smooth-Induction	Discrete Step	A	3	92.2	176.6
			B	3.5	94.3	191.6
5	Smooth-Induction	Discrete Step	A	1	83.9	167.0
			B	2	91.5	191.4
			C	3	96.7	228.7

* For infinite controls, the simmering setting is the degrees of angular control knob rotation from the lowest input power setting.

DOE's testing presented in Table III.8 shows that if a lab selects simmering that is too high, the measured surface unit energy consumption will be significantly higher than at the correct simmering setting. DOE notes that the variability in the measured energy consumption observed in the AHAM round robin test results, as presented in Table III.5, Table III.6, and Table III.7 appears to be due in large part to the selection of different simmering settings and the resulting variation in the energy consumption during the simmering phase of the test. As discussed, DOE expects that correctly following the methodology of starting with the lowest simmering setting and repeating the test as necessary with the next highest setting until the setting that maintains the water temperature above but as close as possible to 90 °C is identified, will result in only a single appropriate simmering setting for a given surface unit. As presented in Table III.3, DOE's testing showed that the total measured energy consumption did not vary significantly when consistently applying the methodology in section 7.1.Z6.2.3 of EN 60350–2:2013 for determining the simmering setting.

With regard to AHAM's comment concerning the difficulty of placing a maximum temperature tolerance on the simmering phase of the test, DOE concludes that the methodology in section 7.1.Z6.2.3 of EN 60350–2:2013 for determining the simmer setting eliminates the need to specify a maximum tolerance on the simmering temperature. By selecting the lowest simmering setting first and repeating the test as necessary with the next highest setting until the water temperature is as close to 90 °C as possible, an incremental increase in the final water temperature associated with each step increase in the power setting will become apparent. This information can then be used to determine the correct simmering setting without specifically limiting the final temperature. Given the impact that selecting the correct simmering setting has on overall energy consumption of a surface unit, DOE is amending appendix I in this final rule to require that the simmering setting selection for the energy test cycle of each cooking area or cooking zone be recorded.

As noted in Table III.2, DOE's test sample included products with both discrete step and infinite controls to investigate the effect different controls might have on variability during the simmering phase of the test. Based on DOE's testing with different power level settings, as presented in Table III.8, DOE did not observe any differences in the process of selecting the correct simmering setting between the models with discrete step and models with infinite controls. Assuming reasonable increments (on the order of 10 degrees of rotation) as the setting is adjusted to determine the correct simmering setting, infinite controls do not require a fine tolerance on the selected setting that would substantially impact the per-cycle energy consumption. Additionally, DOE did not find that it was easier to maintain the water temperature closer to 90 °C with one control type compared to the other. The test-to-test variation in total per-cycle energy consumption was also similar for cooking tops with infinite controls and cooking tops with discrete step controls. DOE also surveyed the cooking top models available in Europe, where EN 60350–2:2013 is already used to rate cooking tops. DOE observed that both products with step controls and with infinite controls were widely available on the European market.

For the reasons discussed, DOE determines that the water-heating test procedure adopted in this final rule would not result in the unavailability of certain control types. Furthermore, as noted in section I.A of this document, based on the provisions under 42 U.S.C. 6293(b)(3), DOE designs its test procedures to produce test results that measure energy use during a representative average use cycle and that are not unduly burdensome to conduct. Therefore, DOE focuses the development of its test procedure around the general use and operations performed by a consumer and not around specific product designs. DOE notes that a manufacturer may apply for a waiver from the test procedure if a basic model contains one or more design characteristics which either prevent testing of the basic model according to the prescribed test procedures or cause the prescribed test procedures to evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics as to provide materially inaccurate comparative data. 10 CFR 430.27(a)(1). In such cases, a manufacturer may provide any alternate test procedures

known to the manufacturer to evaluate the performance of the product type in a manner representative of the energy consumption characteristics of the basic model. 10 CFR 430.27(b)(1)(iii).

Regarding AHAM's comment on the difficulty of determining when the water temperature first reaches 90 °C to start the 20-minute simmering phase of the test, DOE acknowledges that occasionally, when the temperature first reaches 90 °C, it may oscillate slightly above and below 90 °C due to noise in the temperature measurement. Based on DOE's testing, DOE observed temperature fluctuations around 90 °C at the start of the simmering phase primarily during tests of electric coil and smooth-radiant surface units. Figure III.1 shows an example of two separate tests conducted for the same surface unit on a smooth-radiant cooking top. After initially reaching 90 °C, the water temperature in each test drops below the 90 °C limit for no more than 20 seconds.

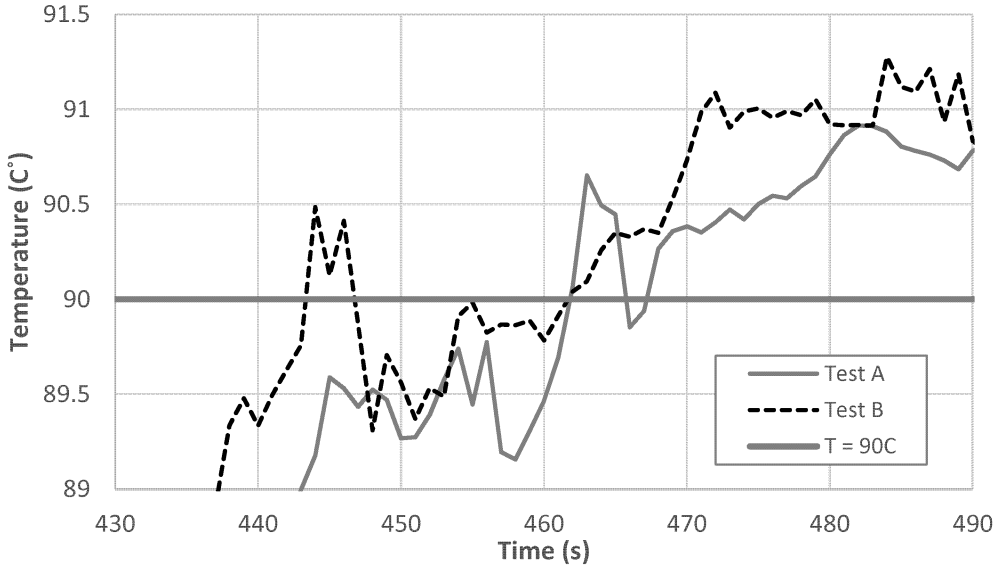

Figure III.1 Temperature Measurement Noise at the Start of the Simmer Phase for a Smooth – Radiant Cooking Top

Based on DOE's review of the temperature fluctuations observed for all electric and gas cooking tops in its test sample, DOE finds that a 20-second period would accurately account for any minor temperature fluctuations after the water temperature initially reaches 90 °C.

Allowing for temperature fluctuations around 90 °C during the first 20 seconds of the simmering phase is also consistent with the 20-second tolerance specified for determining the turndown temperature of a surface unit in section 7.1.Z6.2.2 of EN 60350–2:2013. DOE also notes that allowing for a 20 seconds of fluctuation about 90 °C at the start of the simmering phase does not significantly impact the total energy consumption measured for a surface unit. Table III.9 lists the final temperature and total per-cycle energy consumption for Test A and B that were also shown in Figure III.1.

TABLE III.9—EFFECT OF A 20-SECOND TOLERANCE AT THE START OF THE SIMMER PHASE

	Final water temperature T_{final} (°C)	Total per-cycle energy consumption (Wh)
Test A	92.0	191.7
Test B	91.5	190.3

Based on the comments from interested parties on the difficulty of determining when the water temperature first reaches 90 °C to start the 20-minute simmering phase of the test and DOE's analysis discussed, DOE is clarifying in this final rule that the 20-minute simmering period starts when the water temperature first reaches 90 °C and does not drop below 90 °C for more than 20 seconds after initially reaching 90 °C.

Heating Element Cycling

AHAM commented that cycling of power to the heating element is unpredictable and causes variation in test results. AHAM stated that it is unknown if the surface unit will cycle the heating element off during a critical phase of the test procedure (*i.e.,* at the start of the simmer phase or when determining the simmering setting). AHAM stated that the algorithm that governs the cycling of the heating element is important for cooking performance because it controls the temperature of the food being cooked. AHAM also noted that electric smooth cooking tops are equipped with a sensor that monitors the temperature of the glass surface and cycles the heating element as needed as a safety function to prevent the glass from breaking. AHAM commented that the uncertainty regarding how cycling of the heating element will impact test results, and test burden is a significant concern and could drive redesign of products. (AHAM, No. 30 at p. 12)

DOE recognizes that electric coil and smooth–radiant cooking tops typically control the heat input to the food load by cycling the heating element on and off at different rates based on the control setting rather than fully modulating the power to the heating element. DOE observed during its testing that during the heat-up phase of the test, when the

surface unit is set to the maximum setting, the heating element typically remains on the entire time. When the control setting is turned down to a lower level for the simmering phase of the test, the heater cycles on and off to achieve a lower level of heat. DOE observed only one electric smooth–radiant surface unit in its sample for which the heater cycled on and off during the heat-up phase of the test. However, after cycling off, the heating element cycled back on within a few seconds and, as a result, the water temperature continued to rise at a fairly steady rate. DOE concludes from the infrequency of heating element cycling during the heat-up phase that it observed among all electric cooking tops during testing that it is unlikely that other electric smooth-radiant cooking tops would require any substantive amount of heating element cycling to protect the glass surface. Therefore, given the short duration and infrequency of heating element cycling that may occur when the surface unit is set at the maximum setting during the heat-up phase of the test, DOE does not expect any measurable impacts of heating element cycling on the total measured per-cycle energy consumption.

Temperature Sensor Requirements

AHAM commented that the accuracy of the water temperature measurement is a critical part of the test procedure, but that EN 60350–2:2013 does not specify whether a resistance temperature detector (RTD) type probe or a thermocouple should be used. AHAM noted that RTDs are highly accurate, but can be sensitive, expensive, and may not be compatible with induction cooking tops. AHAM also noted that thermocouples offer durability but are not as accurate. According to AHAM, a laboratory using an RTD may obtain different turndown temperature and simmering settings than one using a thermocouple, resulting in variation in the total energy consumption measurement. AHAM commented that DOE should require a thermocouple in the test procedure and investigate the specific type of thermocouple that should be required to standardize the water temperature measurement. (AHAM, No. 30 at p. 12)

DOE conducted its testing using a thermocouple and infers, based on the various references to thermocouples in EN 60350–2:2013 (*e.g.,* use of thermocouples for other liquid heating measurements, reference to thermocouple standards in the bibliography), that the water-heating test method specified in EN 60350–2:2013 is intended to be conducted using a thermocouple to measure water temperature. DOE also notes that similar IEC water-heating test standards, such as IEC 60705 Amendment 1 to Edition 4.0, ''Household microwave ovens—Methods for measuring performance'', specify thermocouples for measuring water temperature. For these reasons, DOE agrees with AHAM that the test procedure should clarify that a thermocouple should be used for measuring water temperature.

Section 5.3 of EN 60350–2:2013 includes specifications for the water temperature measuring device, which includes requirements that the accuracy of the water temperature measuring device must be ±0.5 K of the temperature being measured. DOE notes that specific thermocouple types may have different accuracies. As a result, DOE concludes that specifying the thermocouple type is not necessary given that EN 60350–2:2013 already includes requirements for the accuracy of the water temperature measurement.

Surface Unit Diameter Measurement

AHAM commented that the proposed test procedure does not specify the equipment for measuring the surface unit cooking zone diameter, which is necessary for determining the size of the test cookware. According to AHAM, if the test procedure does not include requirements for the measuring equipment, the printed diameters of cooking tops may change to resemble standard sizes in the test procedure. To ensure consistency and accuracy in test measurements, AHAM stated that DOE should require a diameter measurement accurate to within ±1 mm and specify that the outer diameter of the cooking zone printed marking should be used for the measurement. (AHAM, No. 30 at p. 13)

DOE recognizes that measurements of surface unit cooking zone diameters will affect the test vessel diameters and load sizes selected for the test of electric cooking tops. DOE agrees that clarifying that the outer diameter of the cooking zone printed marking should be used for the measurement will provide more consistent measurements of surface unit cooking zone diameters. As a result, DOE is amending the test procedure in this final rule to clarify that the outer diameter of the cooking zone printed marking shall be used for the measurement. DOE does not find that specifying a tolerance on the accuracy of the surface unit diameter measurement in the test procedure is necessary. The provisions for measuring the dimensions of the cooking zone in section 6.2.Z2 of EN 60350–2:2013 and the cooking zone size categories in Table Z3 of EN 60350–2:2013 are provided in millimeters. DOE concludes that these values indicate that surface unit diameter measurements must be made to the nearest millimeter.

Availability of Test Vessels

AHAM commented that suppliers for test vessels are extremely limited and are located only in Europe, which adds time and cost for U.S. manufacturers. Furthermore, according to AHAM, if the test procedure is required to demonstrate compliance with standards, demand is expected to increase. AHAM stated that this may overburden existing suppliers, making it difficult for manufacturers and testing laboratories to procure test vessels in a timely manner and would make the test procedure unduly burdensome to conduct. (AHAM, No. 30 at pp. 6, 13)

AHAM stated that because testing has been limited and most manufacturers have only a single set of test vessels, AHAM has not yet been able to understand the durability of the test vessels. AHAM added that the quality of test vessels provided by suppliers in the United States has yet to be determined and may result in differences from test vessels procured from European suppliers. According to AHAM, DOE should identify acceptable suppliers in the United States and ensure that the test vessels are comparable from supplier to supplier. AHAM also stated that DOE should evaluate the durability of the test vessels to better quantify the test burden and how frequently test vessels need to be replaced. (AHAM, No. 30 at pp. 6, 13)

Section 7.1.Z2 of EN 60350–2:2013 includes detailed specifications for the materials and dimensions of the test vessels, such that any precision machine shop can construct the test vessels with the specified materials. DOE has also determined that test vessels meeting the requirements in EN 60350–2:2013 are available from multiple sources. DOE was able to source two full sets of test vessels, at two different points in time using different material stocks, from a small business precision machine shop. DOE also notes that the test methods and test vessels specified EN 60350–2:2013 are used in countries both within and outside of Europe, and that suppliers are not limited to those recommended in EN 60350–2:2013.[15]

To evaluate whether consistent test results can be produced using different

[15] European cookware supplier recommended in EN 60350–2:2013: RYBU GmbH (*http://www.rybu.de*)

sets of test vessels, DOE conducted testing after the August 2016 TP SNOPR using its two sets of test vessels. DOE conducted testing on four surface units on three cooking tops with both sets of test vessels. DOE's test results presented in Table III.10 show that the variance of test results was, on average, 1.6 percent, which is similar to the overall variation in test results using the water-heating test method presented in Table III.3. Based on this testing, DOE has determined that test vessels constructed using the detailed specifications provided in section 7.1.Z2 of EN 60350–2:2013 produce reproducible results.

TABLE III.10—VARIATION DUE TO DIFFERENT TEST VESSELS

Cooking top unit	Surface unit location	Surface unit diameter (in.)	Simmering setting	Cookware diameter (mm)	Average per-cycle energy consumption (Wh)	Coefficient of variation (%)
2	FL	6	2	150	189.8	0.7
4	BR	6	3	150	173.1	2.1
5	BR	6	2.5	150	172.8	2.6
	BR	6	3	150	187.0	1.2

Each set of test vessels used in DOE's testing also were subject to a different number of tests, but DOE's observation is that the test vessels met the specifications provided section 7.1.Z2 of EN 60350–2:2013 and remained within the allowable tolerances, such that the test procedure produces repeatable and reproducible results. The flatness of the test vessel bottoms have been observed to stay in tolerance for several years, but manufacturers may wish to examine the test vessels for compliance with the allowable tolerances more frequently. If the test vessels are no longer in tolerance, it may be possible to repair the equipment without replacing it. For the reasons discussed, DOE concludes that there are multiple sources that can supply the test vessels and that the specifications provided in section 7.1.Z2 of EN 60350–2:2013 for the test vessels are sufficient. As a result, DOE is not including any additional requirements for suppliers and durability of the test vessels.

Final Rule Test Procedure Amendments

Based on DOE's testing and investigations discussed, DOE concludes that the water-heating test method is both repeatable and reproducible for electric cooking tops. DOE posits that the variation in test results observed in AHAM's round robin testing may be related to the lack of familiarity with the test method rather than variability inherent to the test method itself. For these reasons, DOE is amending the test procedure in this final rule to incorporate by reference the testing provisions in EN 60350–2:2013 as proposed in the August 2016 TP SNOPR and presented, with the clarifications to the simmering temperature, temperature sensor requirements, and surface unit diameter measurement.

2. Multi-Ring and Non-Circular Surface Units

Many smooth–electric radiant cooking tops incorporate ''multi-ring'' elements that have multiple concentric heating elements for a single surface unit. When a single ring is selected for use, the smallest-diameter heating element is energized. Each setting which increases the number of rings sequentially energizes additional concentric heating elements, increasing the diameter of the surface unit accordingly. Multiple heating elements give the user flexibility to adjust the surface unit to fit a certain cookware size. Results from DOE testing presented in the December 2014 TP SNOPR showed a significant decrease in efficiency at the smaller-diameter settings as compared to the largest-diameter setting of a multi-ring surface unit. 81 FR 57374, 57384 (Aug. 22, 2016).

As discussed in the August 2016 TP SNOPR, EN 60350–2:2013 requires that the energy consumption of only the largest diameter of a multi-ring surface unit be measured, unless an additional test vessel category is needed to meet the test vessel selection requirements in section 7.1.Z3 of EN 60350–2:2013, as explained in section III.C.1 of this document. In that case, one of the smaller-diameter settings of the multi-ring surface unit that matches the next best-fitting test vessel diameter must be tested. However, DOE proposed in the August 2016 TP SNOPR to require each setting of the multi-ring surface unit be tested independently. 81 FR 57374, 57384–57385 (Aug. 22, 2016). DOE noted that because each setting could be used as an individual surface unit, each setting should factor into the AEC of the cooking top. Specifically DOE proposed that each diameter setting of the multi-ring surface unit would be tested and included as a unique surface unit in the average energy consumption calculation for the cooking top. *Id.*

The Joint Efficiency Advocates supported DOE's proposal to require each diameter setting of a multi-ring surface unit to be tested separately. The Joint Efficiency Advocates stated that testing each diameter setting separately will better capture the energy consumption of cooking tops with these elements and encourage manufacturers to develop ways to improve the efficiency of the smaller-diameter settings. (Joint Efficiency Advocates, No. 32 at p. 2)

AHAM and GE opposed DOE's proposal to require testing of each diameter setting of a multi-ring surface unit. AHAM stated that this proposal unduly increases the test burden, by up to 75 percent, depending on the number of heating elements. GE stated that because energy, in the form of radiation, escapes from the areas of the multi-ring element not covered by the test vessel when testing the inner ring heating elements, cooking tops with multi-ring surface units tested according to the proposed DOE test procedure will have a higher AEC than the same cooking top without multi-ring surface units. AHAM and GE also stated that requiring testing of each diameter setting of a multi-ring surface unit could drive manufacturers to eliminate this design, resulting in a loss of consumer utility of customizing element size to the size of their cookware. AHAM and GE noted that without these multi-ring surface units, consumers could use smaller pots on larger heating elements, which would result in 20-percent greater energy use [16]

[16] AHAM described two tests that were conducted on a multi-ring surface unit with a 210 mm test vessel. For the first test, the test vessel was placed on the inner ring as specified in the proposed test procedure with the small element activated. The second test was conducted with the test vessel placed in the center and the larger burner was

because the heating element is not completely covered by the cookware. (AHAM, No. 30 at pp. 5, 14; GE, No. 31 at pp. 3–4) AHAM and GE stated that based on the increased test burden, loss of consumer utility, and resulting inefficiency, DOE should remove the requirement to test each diameter setting of a multi-ring surface unit and instead follow EN 60350–2:2013 to only require testing of the largest measured diameter of multi-ring surface units. (AHAM, No. 30 at p. 14; GE, No. 31 at p. 4)

To better understand the utility provided by multi-ring surface units, DOE reviewed electric smooth–radiant cooking tops with multi-ring elements on the market in the United States. DOE estimates that multi-ring surface units add approximately 1.5 additional surface unit diameters per cooking top, providing consumers with the ability to better match cookware diameter to surface unit diameter. However, DOE is not aware of any data demonstrating how frequently consumers use the smaller diameter settings of multi-ring surface units.

DOE agrees with AHAM and GE that removing the multi-ring surface unit functionality from a cooking top could lead to increased energy consumption. As shown in Table III.11, DOE tested two multi-ring elements with the next best-fitting cookware from a different standardized cookware category (see Table Z3 of EN 60350–2:2013). By testing each surface unit with a smaller diameter cookware, DOE simulated the additional energy use that would result if the surface unit did not have the multi-ring functionality. DOE found that the normalized surface unit per-cycle energy consumption of the surface unit increases by greater than 25 percent if the cookware diameter is not matched to the surface unit diameter.

TABLE III.11—EFFECTS OF A SMALLER TEST VESSEL DIAMETER ON A MULTI-RING SURFACE UNIT

Cooking top unit	Surface unit location	Maximum surface unit diameter (mm)	Cookware diameter (mm)	Normalized surface unit energy consumption (Wh/g)	Increase in normalized energy consumption
2	FR	305	300	0.18	.....
			240	0.23	29.2
	BL	203	210	0.18	.....
			180	0.23	27.2

Based on the test results presented, DOE would expect an increase in actual cooking top energy consumption and loss of utility for consumers if the multi-ring feature were removed by manufacturers due to its negative impacts on the measured AEC. For these reasons, and in consideration of the uncertainty regarding the frequency of use of the smaller diameter settings of multi-ring surface units and the added testing burden associated with testing multi-ring surface units, DOE is not adopting a requirement that each diameter of a multi-ring surface unit be tested separately as part of the test method adopted in this final rule. Instead, DOE has determined that the provisions for testing multi-ring surface units in EN 60350–2:2013, which require that the energy consumption of only the largest diameter of a multi-ring surface unit be measured, unless an additional test vessel category is needed to meet the requirements of the test procedure, will produce an appropriate measurement of energy use for such surface units while minimizing testing burden and avoiding the unavailability of cooking tops with multi-ring surface units. DOE notes that the provisions in EN 60350–2:2013 ensure that if a cooking top with a multi-ring surface unit does not include other surface units with a variety of diameters, the smaller diameter settings of multi-ring surface units would be tested to fulfill the cookware category requirements in EN 60350–2:2013. Therefore, DOE is incorporating by reference the provisions for testing multi-ring surface units in EN 60350–2:2013 as discussed.

In the August 2016 TP SNOPR, DOE proposed to incorporate by reference section 7.Z1 in EN 60350–02:2013, which specifies that for cooking zones that include a circular and an elliptical or rectangular part, only the circular section be tested. Additionally, DOE proposed to incorporate by reference section 7.1.Z4 and Annex ZA of EN 60350–2:2013, which define the center of elliptical and rectangular surface units by their geometric centers and provide the required test positions of test vessels on these kinds of surface units. 81 FR 57374, 57384 (Aug. 22, 2016). DOE did not receive any comments on these proposed provisions regarding the testing of cooking zones that include a circular and an elliptical or rectangular part. DOE is adopting these provisions in this final rule.

In the August 2016 TP SNOPR, DOE also maintained its proposal to not require testing of certain types of non-circular cooking top elements, specifically, bridge zones, warming plates, grills, griddles, and roaster extensions. DOE clarified that it was not proposing to require testing of bridge modes that couple several surface units together for use as a warming plate or for use with a roasting pan. However, if the individual circular heating elements can be used independently of the bridge mode, DOE proposed that the individual circular heating elements should be tested and included in the calculation of cooking top AEC. 81 FR 57374, 57385 (Aug. 22, 2016).

AHAM agreed with DOE's proposal to not require testing of bridge zones, warming plates, grills and griddles. AHAM noted that these cooking top elements may not heat the test load to the temperature of 90 °C required under EN 60350–2:2013 and that the purpose of these cooking top elements is not to boil water. AHAM added that requiring testing of these elements would increase test burden and require the development of unique test vessels/loads as well as further evaluation of repeatability and reproducibility. (AHAM, No. 30 at p. 14) The SoCal IOUs stated that because DOE's proposed test procedure already includes provisions for testing non-circular cooking top elements, no additional testing burden would be introduced by requiring testing of bridge zones, warming plates, grills and griddles. The SoCal IOUs recommended that DOE extend the water-heating test method to include these non-circular cooking top elements to ensure that sufficient data is collected to develop

activated (as a consumer would, if this utility is removed).

standards that maximize energy savings. (SoCal IOUs, No. 27 at p. 3)

As noted in the December 2014 TP SNOPR, bridge zones, warming plates, grills, and griddles are not intended for use with a typical circular piece of cookware. DOE also noted that appropriate test loads for these non-circular cooking top elements would depend on the intended function of each cooking top element. 79 FR 71894, 71906 (Dec. 3, 2014). Because DOE has not developed test loads for bridge zones, warming plates, grills, and griddles, which are not intended for use with typical circular piece of cookware, the test procedure proposed in the August 2016 TP SNOPR did not address these cooking top elements. DOE is only requiring testing of non-circular cooking top elements in cases where those elements are designed for circular pieces of cookware (*e.g.,* bridge zone individual circular heating elements that can be used independently of the bridge mode). Because the additional equipment necessary for the test method to be representative would place an unreasonable burden on test laboratories and manufacturers, and for the reasons discussed, DOE is not requiring testing of bridge zones, warming plates, grills, and griddles.

In the August 2016 TP SNOPR, DOE clarified that a flexible cooking area (*i.e.,* a full-surface induction cooking zone, able to heat multiple items of cookware simultaneously, with independent control options for each piece of cookware) does not constitute a bridge mode. 81 FR 57374, 57385 (Aug. 22, 2016). As discussed in section III.C.1 of this document, DOE is incorporating by reference Annex ZA of EN 60350–2:2013 for testing flexible cooking areas, which specifies that for a cooking area without limitative marking, *e.g.,* a full-surface induction zone, the number of controls is defined by the number of cookware items that can be used independently and simultaneously, and the number of controls determines the number of tests.

3. Gas Cooking Tops

The test methods specified in the relevant sections of EN 60350–2:2013 were intended for use with only electric cooking tops. In the August 2016 TP SNOPR, DOE proposed to extend this water-heating test method to gas cooking tops based on the test provisions in another European water-heating test standard, EN 30–2–1:1998 *Domestic cooking appliances burning gas—Part 2–1: Rational use of energy—General.* EN 30–2–1 is similar to the electric cooking top water-heating test method in that it specifies a series of test vessels and water loads that are dependent on a nominal characteristic of the surface unit. EN 30–2–1 specifies the diameter of the test vessel and the mass of the water load based on the heat input of the gas burner being tested. 81 FR 57374, 57385–57386 (Aug. 22, 2016).

However, DOE noted in the August 2016 TP SNOPR that because the two test methods differ slightly (*e.g.,* differences in the test vessels, water load sizes, and heating phases measured during the test), the resulting measured energy consumption would not be comparable between gas and electric cooking tops. As a result, DOE did not propose to incorporate both test methods by reference. DOE noted that it was not aware of data showing that consumers cook food differently with gas cooking tops than with electric cooking tops. Thus, DOE proposed to extend the test methods specified for electric cooking tops in EN 60350–2:2013 to gas cooking tops, but using the test vessel diameters and the corresponding water loads from EN 60350–2:2013 that most closely match the test vessel diameters specified in EN 30–2–1. DOE determined that using the same test vessels and water loads as specified for electric cooking tops, as well as the same general test method, would reduce the burden on manufacturers by minimizing the amount of new test equipment required to be purchased. 81 FR 57374, 57386 (Aug. 22, 2016). In addition, unlike for electric cooking tops, DOE did not propose to require a minimum number of cookware categories for the test of a gas cooking top. Given that the diameter of the gas flame cannot be adjusted when the burner is at its maximum setting, DOE determined that only the best fitting test vessel would be used for the surface unit test. *Id.*

The SoCal IOUs supported the extension of the water-heating test method to gas cooking tops, but stated that DOE should conduct a sensitivity analysis of the impact of ambient temperature and pressure conditions on the test results for gas and electric cooking products. The SoCal IOUs stated that this will ensure consistent test results across various regions, climates, and altitudes. The SoCal IOUs also commented that validating the ambient condition requirements would address the impact of the proposed correction to the gas heating value to standard temperature and pressure conditions. (SoCal IOUs, No. 27 at pp. 2–3) As discussed in section III.C.1 of this final rule, DOE is incorporating the ambient air pressure and temperature conditions specified in section 5.1 of EN 60350–2:2013. As a result, these test conditions will be standardized such that test results should not be impacted by tests being conducted in different locations.

AHAM commented that it does not have any consumer data on the representativeness of the proposed water heating method for gas cooking tops, and DOE did not provide AHAM and manufacturers with enough time to collect such data and to understand whether the proposed test method provides representative results for gas cooking tops. AHAM further commented that DOE should conduct consumer surveys to collect the data necessary to support the proposed test method for gas cooking tops. (AHAM, No. 30 at pp. 15, 17)

AHAM commented that DOE needs to assess the impact of using the electric cooking top test procedure for gas cooking tops. AHAM noted that Europe uses different test procedures for each technology because gas cooking tops use more of a system approach when compared to electric cooking tops. AHAM added that the heat transferred to the test load depends on the design of the burner, flow of gas, mass of the grate, and height of the grate from the burner. (AHAM, No. 30 at p. 15) AHAM commented that because of the short comment period, it was not been able to run its proposed round robin testing program for gas cooking tops to evaluate the proposed test method. AHAM also noted that it was conducting investigative testing to compare DOE's proposal to EN 30–2–1, as well as a combination of DOE's proposed test procedure and the test vessels specified in EN 30–2–1. AHAM commented that it does not have the data to determine, nor has DOE demonstrated, that the proposed test procedure for gas cooking tops produces repeatable and reproducible test results. AHAM stated that DOE cannot rely on the CECED round robin testing to demonstrate repeatability and reproducibility because the CECED round robin did not test according to DOE's proposed test procedure for gas cooking tops. (AHAM, No. 30 at pp. 3, 15)

Because DOE has proposed to establish the same test procedure for electric cooking tops to gas, AHAM noted that the same testing issues it identified for electric cooking tops also apply for gas cooking tops. (AHAM, No. 30 at p. 15)

AHAM additionally commented that several manufacturers observed during testing that, in some instances, the overshoot temperature went beyond the simmer temperature of 90 °C, such that the turndown calculation showed a negative temperature value. According

to AHAM, this means that some products may not be able to complete a valid test. (AHAM, No. 30 at pp. 16–17)

AHAM also noted that, based on its limited investigative testing, testing laboratories did not always center the test vessel because some grate designs cannot support the test vessels specified in DOE's proposed test procedure. AHAM indicated that the test vessel was either unbalanced on the grates, or was too big for the design of the grates. As a result, laboratories selected either a larger or smaller test vessel to conduct a test. AHAM stated that DOE should investigate and address this issue before finalizing the test procedure. (AHAM, No. 30 at p. 16)

As noted for electric cooking tops, DOE requested test data and information from AHAM's testing of gas cooking tops to better understand the issues raised on their comments. DOE has not received this test data or information which would allow for a direct evaluation of the issues identified. As described in section III.C.1 of this document, DOE conducted testing after the August 2016 TP SNOPR to investigate the concerns raised by interested parties regarding potential sources of variability in the water-heating test method. In addition to the electric cooking top testing, DOE also conducted testing on five gas cooking tops that covered a range of manufacturers, burner input rates, installation widths, burner quantities, and grate weights. DOE's test sample also included cooking tops marketed as either residential-style or commercial-style. Table III.12 lists the characteristics for each of the gas cooking tops in the DOE test sample.

TABLE III.12—DOE GAS COOKING TOPS TEST SAMPLE

Cooking top unit	Width (in.)	Number of burners	Minimum input rate (Btu/h)	Maximum input rate (Btu/h)	Burner configuration	Grate type	Grate weight per burner (lbs)
1	30	4	9,000	9,000	Open	Steel-wire	0.5
2	30	4	5,000	15,000	Sealed	Cast Iron	3.7
3	36	6	18,000	18,000	Sealed—Stacked	Cast Iron	4.2
4	36	6	9,200	15,000	Sealed—Stacked	Cast Iron (continuous)	5.8
5	36	6	15,000	18,500	Sealed	Cast Iron (continuous)	7.0

To evaluate the variability in test results, DOE conducted two to three tests on each burner. For each individual test, DOE performed the full test method, including the preliminary test required to determine the turndown temperature and simmering setting for a given burner. In addition, in evaluating the test-to-test variation, DOE included test results from previous testing conducted in support of the August 2016 TP SNOPR. The coefficient of variation for the measured AEC observed for DOE's gas cooking top test sample was, on average, 1.0 percent. DOE also noted that the average per-cycle energy consumption coefficient of variation for each burner was 1.7 percent, which is similar to the variation observed for electric cooking tops presented in section III.C.1 of this document. Based on this testing, DOE concludes that the water-heating test method in EN 60350–2:2013, extended to gas cooking tops based on EN 30–2–1, produces repeatable and reproducible test results.

TABLE III.13—COEFFICIENT OF VARIATION IN ANNUAL ENERGY CONSUMPTION FOR GAS COOKING TOPS

Cooking top unit	Average annual energy consumption (kBtu/yr)	Coefficient of variation
1	640.4	2.4%
2	854.4	1.4%
3	974.6	0.4%
4	963.5	0.3%
5	893.1	0.3%

DOE observed similar variation in the turndown temperature for gas cooking tops as for electric cooking tops, and noted that the observed variation in the turndown temperature did not measurably affect the variability in the per-cycle energy consumption. As noted in III.C.1 of this document, the provisions specified in section 7.1.Z6.2 of EN 60350–2:2013 reduce the variability associated with determining the turndown temperature by including tolerances on the temperature at which gas flow to the burner is shut off.

As discussed in section III.C.1 of this document, the preliminary test to determine the turndown temperature specifies that the test load be heated at the maximum input rate until the water temperature reaches 70 °C (T_{70}), at which point the burner is immediately shut off. After the burner is shut off, the water temperature is recorded until it has reached its maximum value above T_{70}. In this final rule, DOE is clarifying that the temperature overshoot (ΔT_o), as shown in figure Z2 in section 7.1.Z6.2.2 of EN 60350–2:2013 is the difference between the maximum recorded water temperature and T_{70}. DOE notes that the while the figure correctly shows that $\Delta T_o = T_{max} - ;T_{70}$, the text in section 7.1.Z6.2.2 of EN 60350–2:2013 incorrectly defines ΔT_o as the highest recorded temperature. The turndown temperature for the energy test (T_c) is then calculated as $T_c = 93\ °C - \Delta T_o$. With regards to concerns that the overshoot temperature can be large enough such that the turndown calculation results in a negative temperature value, DOE did not observe any cases during its testing where the turndown temperature would approach a negative value. DOE notes that a negative turndown temperature would require a temperature overshoot during the preliminary turndown test of greater than 93 °C, and a final water temperature higher than the boiling point of water, whereas DOE typically observed temperature overshoots of 10 °C or less. In addition, EN 60350–2:2013 specifies that if T_c is less than or equal to 80 °C, then 80 °C is used as T_c.

Similarly, DOE evaluated the variation in the simmering setting for gas cooking tops, using the same test methodology as for electric cooking tops. As part of its testing effort, DOE first selected the lowest setting and then incrementally increased the setting in each consecutive test until the simmering temperature was above, but as close to, 90 °C as possible. DOE did not observe any differences between gas and electric cooking tops regarding the

process of selecting the correct simmering setting. Based on DOE's test results, as presented in Table III.13, the water-heating test method, including the process for selecting the simmering setting, did not result in significant variability in test results.

Furthermore, throughout its testing of gas cooking tops, which covered a range of burner/grate designs, DOE did not observe any difficulty or issues with positioning the test load on the grates. The maximum test vessel diameter specified in the test method for gas cooking tops is approximately 12 inches, which is a common pan diameter in the United States. For all of the cooking tops in DOE's test sample, the grates were able to support the test vessel and water loads specified in the test method for the full duration of the test. None of the grates in DOE's test sample exhibited signs that the test vessels and water loads were too big or heavy for the design of the grates.

In the August 2016 TP SNOPR, DOE proposed to use the same test vessels and water loads as specified for electric cooking tops in EN 60350–2:2013, correlating those test vessel sizes to nominal burner input rate. Specifically, DOE proposed to include a table of burner input rates and test vessel sizes in section 2.7.2 of appendix I, along with the mass of the water load to be used in both English and Metric units. However, DOE incorrectly specified the mass of the water load in pounds for the 300 mm test vessel diameter, although the mass listed in kilograms (kg), 4.24 kg, was correct. As part of this final rule, DOE is correcting the conversion to English units for the 300 mm test vessel so that it correctly corresponds to the test vessel diameter and water load listed in EN 60350–2:2013. Table III.14 lists the correct test vessel diameters adopted for the test of conventional gas cooking tops.

TABLE III.14—TEST VESSEL DIAMETERS AND WATER LOADS FOR THE TEST OF CONVENTIONAL GAS COOKING TOPS

Nominal gas burner input rate		Test vessel diameter inches (mm)	Water load mass lbs (kg)
Minimum Btu/h (kW)	Maximum Btu/h (kW)		
3,958 (1.16)	5,596 (1.64)	8.27 (210)	4.52 (2.05)
5,630 (1.65)	6,756 (1.98)	9.45 (240)	5.95 (2.70)
6,790 (1.99)	8,053 (2.36)	10.63 (270)	7.54 (3.42)
8,087 (2.37)	14,331 (4.2)	10.63 (270)	7.54 (3.42)
>14,331 (4.2)	.....	11.81 (300)	9.35 (4.24)

AHAM commented that the design of gas cooking top burners (*i.e.,* shape, whether it is open versus sealed, or stacked) and grates (*i.e.,* size, weight, material, distance from burner to grate, and whether the grates are continuous to allow a pot to be moved from one burner to another without lifting it) vary from one product to another and offer different consumer utility. AHAM also commented that each burner or grate design element affects how the test load is heated and the measured energy consumption. AHAM urged DOE to evaluate these design differences and their effect on the test procedure, including the resulting effect on repeatability and reproducibility, so that the test procedure does not dictate future design of burners and grates and result in a loss of consumer utility. (AHAM, No. 30 at pp. 15–16)

The test procedure is designed to measure energy consumption that is representative of consumer use. As noted in Table III.12, DOE's test sample included products with a range of burner types (stacked, sealed, and open), burner input rates, grate materials (steel wire and cast iron), and continuous and non-continuous grates. As shown in Table III.13, DOE's testing demonstrated that the water-heating test method produces repeatable and reproducible results for gas cooking tops. DOE did not observe that any single design feature produced significant variation in test results. DOE recognizes that certain design features relating to the burner and grate design may impact the measured energy use. DOE considers any consumer utility provided by different design features that may impact energy use as part of the energy conservation standards rulemaking when evaluating product classes and proposed standards.

Sub-Zero expressed concern that limitations of the test procedure would unfairly impact the consumer utility offered by high performance commercial-style cooking products in a rulemaking to establish standards for these products. (Sub-Zero, No. 25 at p. 1) Sub-Zero commented that the commercial-style cooking top market segment appeals to consumers that demand performance similar to that found in restaurant equipment at a safety and convenience level that are necessary for residential use. Sub-Zero stated that these consumers use their products in a way that is often different from the typical household user. For example, Sub-Zero noted that users of commercial-style gas cooking tops often sauté at very high burner outputs, manipulate the pans to mix the ingredients like professional chefs, flame the contents, and operate most of the cooking top burners simultaneously. (Sub-Zero, No. 25 at pp. 1–2)

Sub-Zero opposed DOE's proposal to test all gas cooking tops in the same manner despite commercial-style products differing markedly in construction and usage. Sub-Zero commented that gas burner design attributes such as safety, performance, efficiency are systematic, and that a change to one attribute significantly affects the others. Sub-Zero noted that specific design features associated with commercial-style gas cooking tops that impact efficiency include:

- High input rate burners with large diameters and high controllability of the flame, for quicker heat-up times as well as the ability to simmer foods such as chocolates and sauces;
- Heavy cast iron grates for better heat distribution and strength to support large loads;
- Greater distance from the burner to the grate for heat distribution and reduction of carbon monoxide; and
- Larger open area for primary and secondary air for combustion and exhaust of combustion byproducts. (Sub-Zero, No. 25 at pp. 2–3)

Sub-Zero requested that DOE reconsider the impact that the proposed test procedure will have on small, niche market, commercial-style cooking product manufacturers. Sub-Zero expressed concern that a single regulatory approach would not allow companies like Sub-Zero to adequately serve their customer base and would negatively impact consumer utility. (Sub-Zero, No. 25 at p. 3)

In its testing of commercial-style gas cooking products, DOE did not identify any provisions of the test method that

would be more difficult for commercial-style products to meet than residential-style products. Because the test procedure adopted in this final rule specifies a water-heating test method, DOE determined that the test procedure is representative of how consumers would use any gas cooking top, regardless of whether the cooking top is marketed as commercial-style. By correlating burner input rate to test vessel and water load size, the test method properly accounts for the grates' ability to support large loads. Furthermore, DOE expects that benefits resulting from the improved controllability of the flame, high input rates for quicker heat-up times, and the design of the burner for low simmering settings, features cited by Sub-Zero as factors differentiating commercial-style cooking tops on the market, would be captured by the test method. Specifically, if the higher input rates result in faster heat-up times and the burner design allow for more precise simmering control, DOE expects that the cooking top may use less energy consumption during both the heat-up and simmering phase of the test as compared to other commercial-style cooking tops not equipped with these features.

For the reasons discussed above, DOE is adopting its proposal from the August 2016 TP SNOPR for the test of gas cooking tops. The adopted test procedure for gas cooking tops uses the same test vessels and water loads as specified for electric cooking tops, but correlates them to the nominal burner input rate. The adopted test procedure follows the same general test methods proposed in EN 60350–2:2103 and incorporates the minor modifications originally proposed in the August 2016 TP SNOPR, as clarified above, that are necessary to adapt the electric cooking top test procedure to the gas fuel type.

D. Annual Energy Consumption

In this final rule, DOE amends the cooking top test procedure to include a method to calculate both AEC and IAEC using the average of the test energy consumption measured for each surface unit of the cooking top, normalized to a representative water load size. DOE is also including a method to allocate a portion of the combined low-power mode energy consumption for combined cooking products to the conventional cooking top component. These amendments are discussed in the following sections.

1. Conventional Cooking Top Annual Energy Consumption

In section 4.2.2 of the existing test procedure in appendix I, the AEC for electric and gas cooking tops and ovens is specified as the ratio of the annual useful cooking energy output to the cooking efficiency measured with an aluminum test block. The cooking efficiency is the average of the surface unit efficiencies measured for the cooking top. The annual useful cooking energy output was determined during the initial development of the cooking products test procedure. It correlated cooking field data to results obtained using the aluminum test block method and the DOE test procedure. In subsequent analyses for cooking products energy conservation standards and updates to the test procedure, the annual useful cooking energy output was scaled to adjust for changes in consumer cooking habits.

In the August 2016 TP SNOPR, DOE pointed out that, unlike the existing test procedure in appendix I, EN 60350–2:2013 does not include a method to determine surface unit efficiency and the total cooking top efficiency. DOE also identified several issues associated with specifying an efficiency metric for a water-heating test method. As a result, DOE proposed to include a method to calculate both AEC and IAEC. 81 FR 57374, 57387 (Aug. 22, 2016).

Section 7.1.Z7.2 of EN 60350–2:2013 specifies that the energy consumption of the cooking top be normalized to 1,000 g of water. In the August 2016 TP SNOPR, DOE noted that 1,000 g of water, which is associated with a test vessel diameter of approximately 6 inches, may not be representative of the average load used with cooking tops found in the U.S. market. To determine the representative load size for both electric and gas cooking tops, DOE reviewed the surface unit diameters and input rates for cooking tops (including those incorporated into combined cooking products) available on the market. Using the methodology in 7.1.Z2 of EN 60350–2 for selecting test vessel diameters, DOE determined that the average water load size for both electric and gas cooking top models available on the U.S. market was 2,853 g. 81 FR 57374, 57387 (Aug. 22, 2016).

In the August 2016 TP SNOPR, DOE proposed to calculate the normalized cooking top energy consumption for electric products as

$$E_{CTE} = \frac{2{,}853g}{n_{tv}} \times \sum_{tv=1}^{n_{tv}} \frac{E_{tv}}{m_{tv}}$$

and the normalized cooking top energy consumption for gas product as

$$E_{CTG} = \frac{2{,}853g}{n_{tv}} \times \sum_{tv=1}^{n_{tv}} \frac{E_{tv}}{m_{tv}}$$

Where:

E_{CTE} is the energy consumption of an electric cooking top calculated per 2,853 g of water, in Wh;

E_{CTG} is the energy consumption of a gas cooking top calculated per 2,853 g of water, in Wh;

E_{tv} is the energy consumption measured for a given test vessel, tv, in Wh;

m_{tv} is the mass of water in the test vessel, in g; and,

n_{tv} is the number of test vessels used to test the complete cooking top.

Id.

To extrapolate the cooking top's normalized test energy consumption to an annual energy consumption, DOE considered the cooking top usage data regarding the frequency of cooking events from the 2009 DOE Energy Information Administration (EIA) *Residential Energy Consumption Survey* (*RECS*),[17] presented in Table III.15.

TABLE III.15—*RECS* 2009 USAGE DATA FOR CONVENTIONAL COOKING TOPS

Cooking top type	RECS average cooking frequency (meals per day)	Annual cooking frequency (meals per year)
Electric	1.21	441.5
Smooth Electric[a]	1.21	441.5
Gas	1.25	456.3

[a] Smooth Electric as listed here includes both smooth electric radiant and induction cooking tops.

[17] Available online at: *http://www.eia.gov/consumption/residential/data/2009/*.

However, because *RECS* does not provide details about the cooking load (*e.g.,* load size or composition) nor the duration of the cooking event, DOE proposed in the August 2016 TP SNOPR to normalize the number of cooking cycles to account for differences between the duration of a cooking event represented in the *RECS* data and DOE's proposed test load for measuring the energy consumption of the cooking top to calculate the AEC. 81 FR 57374, 57387 (Aug. 22, 2016). Based on DOE's review of recent field energy consumption survey data of residential cooking [18] [19] and analysis of energy consumption using test data from the DOE test sample and the *RECS* data presented above, DOE observed a significant difference between the AEC determined using the proposed test procedure and the *RECS* cooking frequency compared to the field energy consumption data. As a result, DOE determined that the number of cooking cycles per year used in the AEC calculation needs to be adjusted. 81 FR 57374, 57387–57388 (Aug. 22, 2016). DOE used the average ratio between the maximum AEC measured in the DOE test sample and the estimated field energy use of both gas and electric cooking tops to determine a normalization factor of 0.47, which DOE proposed to apply to the number of cycles per year such that,

N_{CE}= 441.5 × 0.47 = 207.5 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for electric cooking tops.

N_{CG} = 456.3 × 0.47 = 214.5 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for gas cooking tops.

81 FR 57374, 57388 (Aug. 22, 2016).

The Joint Efficiency Advocates commented that DOE's proposal for calculating AEC for cooking tops appears to be reasonable. (Joint Efficiency Advocates, No. 32 at p. 2) AHAM did not support DOE's proposal to normalize the test energy consumption using a water load size of 2,853 g. AHAM stated that DOE did not provide its review of the cooking tops available on the market for interested parties to evaluate, and that it was unclear whether DOE considered only cooking tops in its test sample or all cooking tops available on the market. (AHAM, No. 30 at p. 18)

In determining the water load size used to normalize the test energy consumption, DOE surveyed 335 electric cooking tops and 283 gas cooking tops available on the market in the United States.[20] Using the rated electric surface unit diameter or gas burner input rate for each model, DOE determined the test vessel diameters and water load sizes that would be required to test each cooking top model. Based on this extensive review of cooking top models available on the market, DOE concludes that the water load size of 2,853 g used to normalize the test energy consumption is appropriate. For these reasons, and for the reasons discussed above, DOE is adopting in this final rule its proposal to calculate the AEC of a conventional cooking top by multiplying the normalized test energy consumption of the cooking top by the normalized cooking frequency and the number of days in a year (365). IAEC for the cooking top is in turn calculated by adding the annual conventional cooking top combined low-power mode energy consumption.

2. Combined Cooking Products

As noted in section III.A.1 of this document, DOE's test procedures apply to conventional cooking tops, including the individual cooking top component of a combined cooking product. However, in the August 2016 TP SNOPR, DOE noted that the annual combined low-power mode energy consumption can only be measured for the combined cooking product as a whole and not for the individual components. To determine the IAEC of only the conventional cooking top component of a combined cooking product, DOE proposed to allocate a portion of the measured combined low-power mode energy consumption for the combined cooking product to the conventional cooking top component based on the ratio of the annual cooking hours for the cooking top to the sum of the annual cooking hours for all components making up the combined cooking product. DOE also proposed to use the same apportioning method to determine the annual combined low-power mode energy consumption for any microwave oven component of a combined cooking product. 81 FR 57374, 57388 (Aug. 22, 2016).

As part of the August 2016 TP SNOPR, DOE proposed to use the following annual cooking hours to apportion the measured combined low-power mode energy consumption for combined cooking products. For conventional cooking tops, DOE determined the annual cooking hours to be 213.1 hours based on the total inactive mode and off mode hours specified in the current version of appendix I, sections 4.2.2.1.2 and 4.2.2.2.2. For conventional ovens, DOE similarly determined the annual cooking hours to be 219.9, based on the total inactive mode and off mode hours specified in the current version of appendix I, section 4.1.2.3, and using the annual hours already established for a conventional oven. For microwave ovens, DOE determined the number of annual cooking hours to be 44.9 hours, based on consumer usage data presented in a February 4, 2013 NOPR proposing active mode test procedures for microwave ovens. 81 FR 57374, 57388 (Aug. 22, 2016).

In the August 2016 TP SNOPR, DOE proposed to calculate the IAEC for the conventional cooking top component of a combined cooking product as the sum of the AEC and the portion of the combined cooking product's annual combined low-power mode energy consumption allocated to the cooking top component. Because appendix I currently contains test procedures for microwave ovens that measure only standby mode and off mode test energy consumption, DOE also proposed to include an annual combined low-power mode energy consumption calculation for the microwave oven component of a combined cooking product. *Id.*

The Joint Efficiency Advocates commented that DOE's proposal to apportion the combined low-power mode energy consumption of combined cooking products appears to be reasonable. (Joint Efficiency Advocates, No. 32 at pp. 2–3)

AHAM opposed the proposed apportionment approach, claiming that it would effectively set new standby power standards for conventional cooking tops, conventional ovens, and microwave ovens. (AHAM, No. 30 at p. 19) AHAM commented that if the combined cooking product under test was a microwave/conventional range with two cavities consuming a total measured standby power of 4 Watts, standby mode energy use would be apportioned to both the microwave oven and conventional range components. AHAM and GE commented that third-

[18] California Energy Commission. 2009 *California Residential Appliance Saturation Study,* October 2010. Prepared for the California Energy Commission by KEMA, Inc. Contract No. 200–2010–004. <*http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-V2.PDF*>

[19] FSEC 2010. Updated Miscellaneous Electricity Loads and Appliance Energy Usage Profiles for Use in Home Energy Ratings, the Building America Benchmark and Related Calculations. Published as FSEC–CR–1837–10, Florida Solar Energy Center, Cocoa, FL.

[20] DOE's survey of cooking top surface units and corresponding test vessel sizes is available at: *https://www.regulations.gov/document?D=EERE-2012-BT-TP-0013-0033.*

party laboratories would not know the inner workings of the appliance, and could not measure the standby power of only one portion of the product because many products have only one power cord and control panel. AHAM stated, therefore, that this approach would make it impossible for third-party laboratories to perform verification testing. (AHAM, No. 30 at p. 19; GE, No. 31 at p. 4)

GE expressed concern that the DOE's proposed amendments for combined cooking product standby power would inappropriately compare energy usage between products in a manner that would not represent actual consumer use. GE noted that apportioning standby power to the cooking top on a combined cooking product negatively impacts the cooking top IAEC. However, GE noted that on a majority of combined cooking products, the cooking tops controls consist of electromechanical switches that have no standby power. GE stated that, as a result, when comparing the IAEC between an electromechanically controlled stand-alone cooking top and a similarly controlled combined cooking product that has a cooking top, the combined product's cooking top will appear to use more energy. (GE, No. 31 at p. 4)

GE commented that rather than apportioning energy consumption, DOE should instead adopt the same prescriptive approach for cooking tops and combined cooking products that it has proposed for conventional oven energy conservation standards, to require that electronically controlled products be equipped with a switch-mode power supply to manage the unit's standby power. GE noted that this would enable consumers to accurately compare the energy use of cooking tops across combined and stand-alone cooking tops. In addition, GE stated that this approach would avoid effectively setting a new standard for conventional ovens through a test procedure change, and preclude any verification issues. (GE, No. 31 at p. 4)

The proposed methodology to calculate the IAEC for the conventional cooking top component of a combined cooking product does not require a testing laboratory to understand the inner design or functionality of the product to conduct verification testing. As discussed above, the total measured standby energy consumption of the combined cooking product would be apportioned based on the ratio of the annual cooking hours for the cooking top to the sum of the annual cooking hours for all components making up the combined cooking product.

As part of the concurrent standards rulemaking for conventional cooking products, DOE proposed standards for conventional cooking tops based on the IAEC metric. 81 FR 60784, 60785 (September 30, 2016). DOE is not proposing standards to include prescriptive standby power design requirements for the individual components of a combined cooking product. DOE also notes that the current standby power standard levels for microwave ovens apply only to standalone microwave ovens and did not include combined cooking products. 78 FR 36316, 36328 (June 17, 2013). DOE may consider the effects of setting prescriptive standby power design requirements for microwave ovens that are a part of a combined cooking product as part of a future rulemaking to consider standards for these products.

DOE will consider how the methods for calculating the IAEC that are adopted in this final rule will impact stand-alone cooking tops and combined cooking products that include a cooking top as part of the concurrent energy conservation standards rulemaking for conventional cooking products. DOE will also consider as part of the standards rulemaking the merits of the approach of adopting a prescriptive standard for the power supply for conventional cooking tops.

As discussed in section III.B of this document, DOE is repealing the test procedures for conventional ovens in this final rule. As a result, DOE is not incorporating methods to calculate the IEAC for the conventional oven component of a combined cooking product.

DOE is also modifying the test procedures codified at 10 CFR 430.23 that measure the energy consumption of combined cooking products to reflect the amendments adopted for appendix I in this final rule.

3. Full Fuel Cycle Metric

In response to the August 2016 TP SNOPR, AGA and APGA commented that DOE should consider a full fuel cycle (FFC) energy use metric for measuring the total energy consumption of fuel gas and electricity for cooking products. AGA and APGA stated that, compared to a site energy use metric, an FFC metric that uses a correction factor provides a more comprehensive measurement that complies with the DOE policy to incorporate FFC in its appliance efficiency programs. AGA and APGA commented that direct comparisons of baseline and proposed efficiency standard levels are needed to inform all interested parties of the FFC implications of standards proposals, which can only be accomplished where energy savings opportunities are expressed in both site energy and FFC energy. (AGA and APGA, No. 28 at p. 3)

As DOE has noted for other products, such as residential furnaces and boilers (81 FR 2628, 2638–2639 (Jan. 15, 2016)), DOE does not believe the test procedure is the appropriate vehicle for deriving an FFC energy use metric for cooking products. As discussed in the Notice of Policy Amendment Regarding Full-Fuel Cycle Analyses, DOE intends to use the *National Energy Modeling System* (*NEMS*) as the basis for deriving the energy and emission multipliers used to conduct FFC analyses in support of energy conservation standards rulemakings. 77 FR 49701 (Aug. 17, 2012). DOE also uses *NEMS* to derive factors to convert site electricity use or savings to primary energy consumption by the electric power sector. *NEMS* is updated annually in association with the preparation of the EIA's *Annual Energy Outlook.* Based on its experience to date, DOE expects that the energy and emission multipliers used to conduct FFC analyses will change each year. If DOE were to include a secondary FFC energy descriptor as part of the cooking products test procedure, DOE would need to update the test procedure annually. As part of the concurrent energy conservation standard rulemaking for conventional cooking products, DOE estimated the FFC energy savings and took those savings into account in proposing amended standards. 81 FR 60784, 60798, 60831–60832 (Sept. 2, 2016).

E. Installation Test Conditions

In the August 2016 TP SNOPR, DOE proposed to amend section 2.1 of the current appendix I, which defines installation test conditions for cooking products, to incorporate by reference the following test structures specified in ANSI Z21.1–2016 sections 5.1 and 5.19 for both gas and electric conventional cooking products:

- Figure 7, ''Test structure for built-in top surface cooking units and open top broiler units;''
- Figure 5, ''Test structure for floor-supported units not having elevated cooking sections;'' and
- Figure 6, ''Test structure for floor-supported units having elevated cooking sections.''

81 FR 57374, 57388 (Aug. 22, 2016).

AGA and APGA supported incorporating by reference the test structure requirements in ANSI Z21.1. (AGA and AGPA, No. 28 at p. 3) AHAM opposed DOE's proposal to require ANSI Z21.1 test structures for both gas

and electric cooking products. AHAM asserted that this would increase testing burden for laboratories, requiring them to procure additional test structures if the products are not ANSI-listed. AHAM stated that if the cooking top is a UL-listed product, the UL specified test structure should be used, and that if the cooking top is covered by ANSI Z21.1, the ANSI specified test structure should be used. (AHAM, No. 30 at p. 19)

DOE recognizes that requiring the test structures in ANSI Z21.1 for all conventional cooking products may increase testing burden. DOE notes that ANSI Z21.1 and UL 858 ''Standard for Household Electric Ranges'' include specific safety requirements for gas and electric cooking products, respectively. Because these standards include specific test structures for safety testing, which may be intended to represent worst-case installation configurations and operating conditions, DOE is not aware of data demonstrating that these test structures are representative of typical consumer use. For example, section 59.4 and 59.5 in UL 858 specify that the side walls of the test enclosures, including the walls that extend above the cooking surface, be installed as closely as possible to the side of the appliance. However, DOE notes that manufacturer's installation instructions typically specify minimum clearances of walls and other structures surrounding the product when installing products in homes. DOE is also not aware of data showing how these test structures affect measured energy use. For these reasons, in this final rule, DOE is not including a requirement to install gas and electric conventional cooking products in accordance with the test structures specified in ANSI Z21.1. Instead, DOE is maintaining the existing installation requirements in appendix I. DOE notes these requirements do not preclude the use of any testing structures, as long as those structures comply with the installation requirements in appendix I.

In the August 2016 TP SNOPR, DOE proposed to clarify its definition of ''built-in'' and ''freestanding'' cooking products based on the definitions of installation configurations included in ANSI Z21.1. DOE proposed to clarify that ''built-in'' means a product that is enclosed in surrounding cabinetry, walls, or other similar structures on at least three sides, and that can be supported by surrounding cabinetry (*e.g.,* drop-in cooking tops) or the floor (*e.g.,* slide-in conventional ranges). DOE also proposed to clarify that ''freestanding'' means a product that is supported by the floor and is not designed to be enclosed by surrounding cabinetry, walls, or other similar structures. 81 FR 57374, 57388–57389. DOE did not receive any comments on the proposed clarifications to the definitions of ''built-in'' and ''freestanding.'' DOE is adopting these clarified definitions in this final rule.

In the August 2016 TP SNOPR, DOE noted that in general, where the test procedure references manufacturer instructions used to determine the installation conditions for the unit under test, those instructions must be those normally shipped with the product, or if only available online, the version of the instructions available online at the time of test. 81 FR 57374, 57389 (Aug. 22, 2016). DOE also noted that some manufacturer's instructions may specify that the cooking product may be used in multiple installation conditions, such as built-in and freestanding. DOE stated that because built-in products are installed in configurations with more surrounding cabinetry that may limit airflow and venting compared to freestanding products, products capable of built-in installation configurations may require additional features such as exhaust fans or added insulation to meet the same safety requirements (*e.g.,* surface temperature requirements specified in Table 12 of ANSI Z21.1) that impact energy use of the unit. As a result, DOE proposed in the August 2016 TP SNOPR that if the manufacturer's instructions specify that the cooking product may be used in multiple installation conditions, it should be installed according to the built-in configuration. *Id.* DOE did not receive any comments on these proposed clarifications. As a result, and for the reasons discussed above, DOE is adopting these clarifications regarding manufacturer's instructions and installation requirements in this final rule.

DOE also notes that some manufacturer instructions may specify multiple installation conditions for cooking tops (*i.e.,* installed in a countertop up against a rear wall or in an island countertop with no rear wall.) Because the countertop with a rear wall may limit airflow and venting compared to an island installation, and as a result impact the energy use of the unit, DOE is clarifying in this final rule that if the manufacturer's instructions specify that the cooking top may be used in multiple installation conditions, it shall be tested against, or as near as possible to, a rear wall.

F. Technical Clarification to the Correction of the Gas Heating Value

As discussed in the August 2016 TP SNOPR, DOE proposed to clarify in section 2.9.4 in the existing test procedure in appendix I that the measurement of the heating value of natural gas or propane specified in appendix I be corrected to standard pressure and temperature conditions in accordance with the U.S. Bureau of Standards, circular C417, 1938. DOE noted that this clarification would ensure that the same correction methods are used by all operators of the test. 81 FR 57374, 57389 (Aug. 22, 2016).

AGA and APGA supported the technical clarification to require that the gas heating value be corrected to standard and temperature conditions in accordance with the U.S. Bureau of Standards, circular C417. AGA and APGA stated that this would help ensure consistent test results in various testing laboratories. (AGA and APGA, No. 28 at p. 3) Because DOE did not receive any objections to its proposal, and for the reasons stated above, DOE is adopting the clarification that the measurement of the heating value of natural gas or propane specified in appendix I be corrected to standard pressure and temperature conditions in accordance with the U.S. Bureau of Standards, circular C417, 1938.

G. Grammatical Changes to Certain Sections of Appendix I

In the August 2016 TP SNOPR, DOE proposed minor grammatical corrections or modifications to clarify the text in certain sections of appendix I and proposed to remove the watt meter requirements specified in section 2.9.1.2 of appendix I, which are no longer used in the test procedure. 81 FR 57374, 57389 (Aug. 22, 2016). DOE did not receive comment on these proposals, and as a result, adopts these grammatical changes as part of this final rule. DOE notes that these minor modifications do not change the substance of the test methods or descriptions provided in these sections.

H. Compliance With Other EPCA Requirements

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

In the August 2016 TP SNOPR, DOE determined that the proposed amendments to the test procedure would produce test results that measure the energy consumption of conventional cooking tops during representative use, and that the test procedures would not

be unduly burdensome to conduct. 81 FR 57374, 57389 (Aug. 22, 2016).

DOE stated in the August 2016 TP SNOPR that, although the proposed test procedures differ from the method currently included in appendix I for testing cooking tops, the essential method of test which includes an initial temperature rise of the test load and a simmering phase, is performed in approximately the same amount of time as the existing test procedure in appendix I. DOE noted that the existing test equipment in appendix I would be replaced with the eight test vessels described in section 7.1.Z2 of EN 60350–2:2013. DOE estimated that current testing represents a cost of roughly $700 per test for labor, with a one-time investment of $2,000 for test equipment ($1,000 for test blocks and $1,000 for instrumentation). DOE also noted that the proposed reusable test vessels would represent an additional one-time expense of $5,000 for the test vessels. DOE also noted in the August 2016 TP SNOPR that the only additional instrumentation required would be an absolute pressure transducer to measure the ambient air pressure of the test room. DOE estimated the cost of this transducer to be $100 or less for a model compatible with typical existing data collection systems used by the manufacturer. DOE noted that the allowable range of room air pressure specified in EN 60350–2:2013 is wide enough that a pressurized test chamber would not be required. Air pressure at elevations less than 3,000 feet above sea level falls within the range. DOE stated that it does not believe this additional cost represents an excessive burden for test laboratories or manufacturers given the significant investments necessary to manufacture, test and market consumer appliances. Given the similarities (in terms of the test equipment, test method, the time needed to perform the test, and the calculations necessary to determine IAEC), DOE stated in the August 2016 TP SNOPR that the proposed amendments to test procedure for cooking tops would not be unreasonably burdensome to conduct as compared to the existing test procedure in appendix I. 81 FR 57374, 57389 (Aug. 22, 2016).

AHAM commented that it has not been able to fully evaluate the proposed test procedure to determine whether it is unduly burdensome to conduct. However, AHAM stated that based on its testing conducted at the time of its comments, the overall test is burdensome and there may be ways that DOE can reduce the test burden. AHAM stated that determining the appropriate simmering setting requires trial and error to meet the tolerances of the test procedure, which may require multiple test runs. Because of this, and because only one surface unit can be tested at a time and then must be cooled to ambient room temperature, testing time is variable and may increase substantially for a test laboratory that is unfamiliar with a unit or if a unit has more than the typical four surface units to test. AHAM added that DOE's proposal to require testing of each individual each diameter setting of a multi-ring surface unit is overly burdensome, noting that a cooking top with dual- and tri-ring surface units would require seven tests, instead of four. (AHAM, No. 30 at p. 5)

GE commented that DOE's proposed additional test procedure requirements beyond those in the Canadian and European test procedures make testing more burdensome while introducing more variability into test results. GE commented that DOE's proposed test procedure would require approximately 25 separate tests and approximately 3 weeks for a standard unit, compared to four tests and approximately 2 days to test a standard unit for Canada. (GE, No. 31 at p. 2)

DOE recognizes that the water-heating test procedure will typically require several repetitions of the test cycle to determine the appropriate setting for the simmering phase of the test. However, based on DOE's testing, in cases where the water temperature falls below the minimum allowable simmering temperature of 90 °C, this typically occurs near the beginning of the simmering phase of the test. As a result, the test can be immediately stopped to conserve testing time. Additionally, by providing guidance on the acceptable oscillation of the water temperature about 90 °C during the first 20 seconds of the simmering phase of the test, as discussed in section III.C.1 of this document, the uncertainty regarding whether a test will pass or fail is reasonably reduced. DOE also observed from its testing that after conducting a few tests on a model, a test laboratory is able to better predict the appropriate simmering setting for other surface units on that cooking top, based on the ratio of simmer energy consumption to total energy consumption. As a result, DOE expects that as manufacturers and test laboratories conduct tests and become familiar with models, the time required for subsequent tests on a given model should decrease. Furthermore, DOE notes that the preliminary test to determine the turndown temperature does not need to be rerun prior to the next energy consumption test cycle on the same surface unit.

With regard to the time required to cool the appliance in between tests to achieve the normal non-operating temperature, section 5.5 of EN 60350–2:2013 specifies that forced cooling may be used to assist in reducing the temperature of the appliance. DOE notes that this reduces the time to cool the appliance in between tests. In this final rule, DOE is clarifying that forced cooling may be used to reduce the temperature of the appliance to achieve the normal non-operating temperature as specified in section 5.5 of EN 60350–2:2013. During its investigative testing conducted in support of this final rule, DOE observed that forced air cooling can reduce the time between tests by almost half for electric smooth–radiant cooking tops, electric coil cooking tops, and gas cooking tops. Because induction cooking tops directly heat the test vessel, minimizing heat transfer to the glass ceramic surface of the cooking top, the time to cool an induction cooking top is typically much shorter than for other cooking top types.

In addition, as discussed in section III.C.2 of this final rule, DOE is not requiring that each setting of the multi-ring surface unit be tested independently and is instead aligning the test provisions with EN 60350–2:2013 and the draft IEC 60350–2 to require testing of the largest measured diameter of multi-ring surface units only, unless an additional test vessel category is needed to meet the requirements of the test procedure. In that case, one of the smaller-diameter settings of the multi-ring surface that matches the next best-fitting test vessel diameter must be tested. As a result, DOE's amended test procedure will in most cases require only one full test cycle (including the preliminary turndown test and energy cycle test) per surface unit or burner, and is equivalent to the number of tests required under EN 60350–2:2013. Using the example provided by AHAM of a cooking top with dual- and tri-ring surface units, DOE's amended test procedure will require only four full test cycles, instead of seven.

Based on the discussion above and DOE's experience conducting tests using the amended test procedure, DOE estimates that testing of a cooking top model would require on average 2 to 3 days depending on the number of surface units or burners. As a result, DOE does not consider the amended test procedure to be unduly burdensome to conduct.

DOE also notes that the test procedure used in Canada is equivalent to the existing DOE test procedure in appendix I, which involves heating a solid

aluminum test block on each surface unit of the cooking top. That test procedure includes only one test block size for gas cooking tops and two test block sizes for electric cooking tops. DOE also notes that the aluminum test block is not compatible with induction cooking tops. The test method involves heating the test block at the maximum energy input setting. After the test block temperature increases by 144 degrees Fahrenheit (°F), the surface unit is immediately reduced to 25 percent ± 5 percent of the maximum power input for 15 ± 0.1 minutes. Based on DOE's experience conducting tests using this test procedure, the second phase of the test requires trial and error to determine the appropriate simmering setting to achieve 25 percent ± 5 percent of the maximum power input because most electric cooking tops cycle the heating element on and off rather than fully modulating the input power. Therefore, the setting that achieves, on average, 25 percent ± 5 percent of the maximum power input will not be clear to a test technician at the start of the test and the setting selected must be evaluated after the test is complete test to determine if it meets the requirements. As a result, testing under the Canadian test procedure imposes a similar test burden as the water-heating test method adopted in this final rule.

DOE previously noted that the reusable test vessels would represent a one-time expense of $5,000. As the test vessels are heated and cooled over time, it is possible that the test vessels bottoms will no longer meet the allowable tolerances for flatness. Based on discussions with test vessel suppliers, DOE notes that test vessels may need to be repaired or replaced after a few years of use, depending on their frequency of use. Certain test vessel diameters will be used more frequently than others, as certain surface unit diameters are more common in cooking tops on the U.S. market than others. Thus, DOE anticipates that the entire set of cookware would not need to be replaced or repaired at the same frequency.

For the reasons discussed above, DOE has determined that the amended test procedure adopted in this final rule produces test results that measure the energy consumption of conventional cooking tops during representative use, and that the test procedures are not unduly burdensome to conduct.

In the concurrent rulemaking to establish energy conservation standards for conventional cooking products, DOE proposed in an SNOPR published on September 2, 2016 to update the sampling plan requirements for cooking products in 10 CFR 429.23(a) to include the AEC and IAEC metrics for conventional gas and electric cooking tops. 81 FR 60784, 60799. DOE did not receive any comments on this proposal in response to the September 2016 SNOPR. In this final rule, DOE is adopting these amendments to the sampling plan requirements for the selection of units for testing, as well as calculation procedures for determining a basic model's represented rating in 10 CFR 429.23(a) for cooking products to include the AEC and IAEC metrics for conventional gas and electric cooking tops.[21] Changes to the certification requirements in 10 CFR 429.23(b) will be addressed in the concurrent standards rulemaking.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget (OMB) 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 that when an agency promulgates a final rule under 5 U.S.C. 553, after being required by that section or any other law to publish a general notice of proposed rulemaking, the agency shall prepare a final regulatory flexibility analysis (FRFA). As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003 to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *http://energy.gov/gc/office-general-counsel.*

DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. This final rule would amend the test method for measuring the energy efficiency of conventional cooking tops, including methods applicable to induction cooking products and gas cooking tops with higher input rates. DOE has concluded that the rule would not have a significant impact on a substantial number of small entities. The factual basis for this certification is as follows:

The Small Business Administration (SBA) considers a business entity to be a small business, if, together with its affiliates, it employs less than a threshold number of workers or earns less than the average annual receipts specified in 13 CFR part 121. The threshold values set forth in these regulations use size standards and codes established by the North American Industry Classification System (NAICS) that are available at: *http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.* The threshold number for NAICS classification code 335221, titled ''Household Cooking Appliance Manufacturing,'' is 1,500 employees or fewer; this classification includes manufacturers of residential conventional cooking products.

As discussed in the August 2016 TP SNOPR, DOE surveyed the AHAM member directory to identify manufacturers of residential conventional cooking tops. 81 FR 57374, 57390 (Aug. 22, 2016). DOE also consulted publicly-available data, purchased company reports from vendors such as Dun and Bradstreet, and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a ''small business manufacturing facility'' and have their manufacturing facilities located within the United States. Based on the 2016 threshold number of workers for small business, DOE estimates that there are ten small businesses that manufacture conventional cooking products covered by the test procedure amendments. This number represents an increase from nine small businesses analyzed as part of the August 2016 TP SNOPR due to a change in the SBA's threshold number of workers for NAICS classification code 335221 since the time of the SNOPR analysis.[22] DOE further estimates that eight of these ten small businesses actually manufacture the products they sell. The other two are rebranders and

[21] In the September 2016 SNOPR for the concurrent standards rulemaking for conventional cooking products, the first sentence of 10 CFR 429.23(a)(2)(i), ''(i) The mean of the sample, where:'', was unintentionally left out of the **Federal Register** publication. DOE is including this language in the amendments adopted in this final rule.

[22] The SBA's threshold number of workers for NAICS classification code 335221 changed from 750 at the time of the August 2016 TP SNOPR to 1,500 for this final rule.

do not manufacture the products they sell.

In August 2016 TP SNOPR, DOE concluded that the proposed test procedures for cooking tops that incorporate provisions from EN 60350–2:2013 to address active mode energy consumption for all conventional cooking top technology types, including induction surface units and surface units with higher input rates, would not have a significant economic impact on a substantial number of small entities. 81 FR 57374, 57390 (Aug. 22, 2016). DOE's estimates for the cost of testing and of new test equipment, have not changed from the August 2016 TP SNOPR. The amended test procedure would be used to develop and test compliance with any future energy conservation standards for cooking tops that may be established by DOE. The test procedure amendments involve the measurement of active mode energy consumption through the use of a water-heating test method that requires different test equipment than previously specified for conventional cooking tops. The test equipment consists of a set of eight stainless steel test vessels. DOE estimates the cost for this new equipment to be approximately $5,000–$10,000, depending on the number of sets the manufacturer wishes to procure.

DOE estimates a cost of approximately $46,288 for an average small manufacturer to test a full product line of induction surface units and surface units with high input rates not currently covered by the existing test procedure in appendix I. DOE updated this estimate to reflect the most recent changes to the small business classification, which includes the identification of an additional small manufacturer and the determination that two of the small businesses are rebranders and do not manufacture the products they sell. This updated estimate assumes $700 per test for labor with up to 66 total tests per manufacturer needed, assuming 21 models [23] with either four or six individual surface unit tests per cooking top model. This cost is small (0.07 percent) compared to the average annual revenue of the eight identified small businesses that manufacture cooking products in the United States, which DOE estimates to be over $162 million.[24]

In the August 2016 TP SNOPR, DOE determined that the proposed modification to the calculation of the IEAC of the cooking top portion of a combined cooking product requires the same methodology, test equipment, and test facilities used to measure the combined low-power mode energy consumption of stand-alone cooking products and would not result in any additional facility or testing costs. Additionally, DOE determined that its proposal to incorporate test structures from ANSI Z21.1 by reference to standardize the installation conditions used during the test of conventional cooking tops would not significantly impact small manufacturers under the applicable provisions of the Regulatory Flexibility Act.[25] 81 FR 57374, 57390 (Aug. 22, 2016).

As discussed in section III.E of this document, in this final rule, DOE is no longer including a requirement to install gas and electric conventional cooking products in accordance with the test structures specified in ANSI Z21.1. Instead, DOE is maintaining the existing installation requirements in appendix I. DOE notes these requirements would not preclude the use of any testing structures, as long as those structures comply with the installation requirements in appendix I. Because DOE is not changing the existing installation requirements, DOE concludes that these requirements will not significantly impact small manufacturers.

After estimating the potential impacts to the updated list of small business and considering feedback from interested parties regarding test burdens, DOE concludes that the cost effects accruing from the final rule would not have a ''significant economic impact on a substantial number of small entities,'' and that the preparation of a FRFA is not warranted. DOE has submitted a certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of conventional cooking products must certify to DOE that their products comply with any applicable energy conservation standards. To certify compliance, manufacturers must first obtain test data for their products according to the DOE test procedures, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including conventional cooking products. (See generally 10 CFR part 429.) 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 30 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 final rule, DOE amends its test procedure for conventional cooking products. 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 rule amends an existing rule without affecting the amount, quality or distribution of energy usage, and, therefore, will 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

[23] DOE considered different configurations of the same basic model (where surface units were placed in different positions on the cooking top) as unique models.

[24] Based on publicly available information from online sources such as Hoovers, Cortera, and Glassdoor.

[25] DOE estimated a cost of $500 for an average small manufacturer to fabricate the test structures for the test of cooking tops and combined cooking products, which is negligible when compared to the average annual revenue of the eight identified small manufacturers.

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

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

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

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

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

I. Review Under Executive Order 12630

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

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed this final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

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

This regulatory action is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

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

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–

91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The amendments to the test procedure for conventional cooking products adopted in this final rule incorporate testing methods contained in certain sections of the commercial standard, EN 60350–2:2013 ''Household electric cooking appliances Part 2: Hobs—Methods for measuring performance.'' While the amended test procedure is not exclusively based on the provisions in this industry standard, many components of the test procedure have been adopted without amendment. DOE has evaluated this standard and is unable to conclude whether it fully complies with the requirements of section 32(b) of the FEAA (*i.e.,* whether it was developed in a manner that fully provides for public participation, comment, and review.) DOE has consulted with both the Attorney General and the Chairman of the FTC about the impact on competition of using the methods contained in these standards and has received no comments objecting to their use.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule before its effective date. The report will state that it has been determined that the rule is not a ''major rule'' as defined by 5 U.S.C. 804(2).

N. Description of Materials Incorporated by Reference

In this final rule, DOE incorporates by reference certain sections of the test standard published by CENELEC, titled ''Household electric cooking appliances Part 2: Hobs—Methods for measuring performance,'' EN 60350–2:2013. EN 60350–2:2013 is an industry accepted European test procedure that measures cooking top energy consumption and performance. DOE has determined that EN 60350–2:2013, with the clarifications discussed in sections III.C.2, III.C.3 and III.D of this document, provides test methods for determining the annual energy use metrics and are applicable to all residential conventional cooking tops sold in the United States. The test procedure adopted in this final rule references various sections of EN 60350–2:2013 that address test setup, instrumentation, test conduct, and measurement procedure. EN 60350–2:2013 is readily available on the British Standards Institute's Web site at *http://shop.bsigroup.com/.*

V. Approval of the Office of the Secretary

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

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

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

Issued in Washington, DC, on November 22, 2016.

Kathleen B. Hogan,

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

For the reasons set forth in the preamble, DOE amends parts 429 and 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

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

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

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

■ 2. Section 429.23 is amended by revising the section heading and paragraph (a) to read as follows:

§ 429.23 Cooking products.

(a) *Sampling plan for selection of units for testing.* (1) The requirements of § 429.11 are applicable to cooking products; and

(2) For each basic model of cooking products a sample of sufficient size shall be randomly selected and tested to ensure that any represented value of estimated annual operating cost, standby mode power consumption, off mode power consumption, annual energy consumption, integrated annual energy consumption, or other measure of energy consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(i) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(ii) The upper 97½ percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{.975}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.975}$ is the t statistic for a 97.5% one-tailed confidence interval with n–1 degrees of freedom (from appendix A).

* * * * *

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 4. Section 430.2 is amended by:

■ a. Revising the definitions for ''Conventional cooking top'' and ''Conventional oven'';

■ b. Removing the definition of ''Conventional range'';

■ c. Revising the definition of ''Cooking products'';

■ d. Removing the definitions of ''Microwave/conventional cooking top'', ''Microwave/conventional oven'', and ''Microwave/conventional range''; and

■ e. Revising the definitions of ''Microwave oven'' and ''Other cooking products''.

The revisions read as follows:

§ 430.2 Definitions.

* * * * *

Conventional cooking top means a category of cooking products which is a household cooking appliance consisting of a horizontal surface containing one or more surface units that utilize a gas flame, electric resistance heating, or electric inductive heating. This includes any conventional cooking top

component of a combined cooking product.

* * * * *

Conventional oven means a category of cooking products which is a household cooking appliance consisting of one or more compartments intended for the cooking or heating of food by means of either a gas flame or electric resistance heating. It does not include portable or countertop ovens which use electric resistance heating for the cooking or heating of food and are designed for an electrical supply of approximately 120 volts. This includes any conventional oven(s) component of a combined cooking product.

Cooking products means consumer products that are used as the major household cooking appliances. They are designed to cook or heat different types of food by one or more of the following sources of heat: Gas, electricity, or microwave energy. Each product may consist of a horizontal cooking top containing one or more surface units and/or one or more heating compartments.

* * * * *

Microwave oven means a category of cooking products 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. This includes any microwave oven(s) component of a combined cooking product.

* * * * *

Other cooking products means any category of cooking products other than conventional cooking tops, conventional ovens, and microwave ovens.

* * * * *

■ 5. Section 430.3 is amended by:
■ a. Removing paragraphs (i)(6) and (i)(8);
■ b. Redesignating paragraphs (i)(7) and (i)(9) as (i)(6) and (i)(7);
■ c. Redesignating paragraphs (l) through (u) as paragraphs (m) through (v), respectively; and
■ d. Adding new paragraph (l).

The revisions and additions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(l) *CENELEC.* European Committee for Electrotechnical Standardization, 17, Avenue Marnix, B–1000 Brussels, phone: +32 2 519 68 71, available from the HIS Standards Store, *https://www.ihs.com/products/cenelec-standards.html*

(1) EN 60350–2:2013, (''EN 60350–2:2013''), *Household electric cooking appliances Part 2: Hobs—Methods for measuring performance,* (June 3, 2013), IBR approved for appendix I to subpart B, as follows:

(i) Section 5—General conditions for the measurements, (excluding 5.4);

(ii) Section 6—Dimensions and mass, Section 6.2—Cooking zones per hob;

(iii) Section 7—Cooking zones and cooking areas, Section 7.1—Energy consumption and heating up time, (excluding 7.1.Z1, 7.1.Z5, 7.1.Z7);

(iv)Annex ZA—Further requirements for measuring the energy consumption and heating up time for cooking areas;

(v) Annex ZB—Aids for measuring the energy consumption;

(vi)Annex ZC—Examples how to select and position a cookware set for measuring the heating up time (7.1.Z5) and energy consumption (7.1.Z6);

(vii) Annex ZD—Example—Multiple zones; and

(viii) Annex ZF—Normative references to international publications with their corresponding European publications.

(2) [Reserved]

* * * * *

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

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

* * * * *

(i) *Cooking products.* (1) Determine the integrated annual electrical energy consumption for conventional electric cooking tops, including any integrated annual electrical energy consumption for combined cooking products according to sections 4.1.2.1.2 and 4.2.2.1 of appendix I to this subpart. For conventional gas cooking tops, the integrated annual electrical energy consumption shall be equal to the sum of the conventional cooking top annual electrical energy consumption, $E_{CCE,}$ as defined in section 4.1.2.2.2 or 4.2.2.2 of appendix I to this subpart, and the conventional cooking top annual combined low-power mode energy consumption, E_{CTSO}, as defined in section 4.1.2.2.3 appendix I to this subpart, or the annual combined low-power mode energy consumption for the conventional cooking top component of a combined cooking product, E_{CCTLP}, as defined in section 4.2.2.2 of appendix I to this subpart.

(2) Determine the annual gas energy consumption for conventional gas cooking tops according to section 4.1.2.2.1 of appendix I to this subpart.

(3) Determine the integrated annual energy consumption for conventional cooking tops according to sections 4.1.2.1.2, 4.1.2.2.2, 4.2.2.1, and 4.2.2.2, respectively, of appendix I to this subpart. Round the integrated annual energy consumption to one significant digit.

(4) The estimated annual operating cost corresponding to the energy consumption of a conventional cooking top, shall be the sum of the following products:

(i) The integrated annual electrical energy consumption for any electric energy usage, in kilowatt-hours (kWh) per year, as determined in accordance with paragraph (i)(1) of this section, 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, as determined in accordance with paragraph (i)(2) of this section, 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, as determined in accordance with paragraph (i)(2) of this section, times the representative average unit cost for propane, in dollars per Btu, as provided pursuant to section 323(b)(2) of the Act.

(5) Determine the standby power for microwave ovens, excluding any microwave oven component of a combined cooking product, according to section 3.2.3 of appendix I to this subpart. Round standby power to the nearest 0.1 watt.

(6) For convertible cooking appliances, there shall be—

(i) An estimated annual operating cost and an integrated annual energy consumption which represent values for the operation of the appliance with natural gas; and

(ii) An estimated annual operating cost and an integrated annual energy consumption which represent values for the operation of the appliance with LP-gas.

(7) Determine the estimated annual operating cost for convertible cooking appliances that represents natural gas usage, as described in paragraph (i)(6)(i) of this section, according to paragraph (i)(4) of this section, using the total annual gas energy consumption for natural gas times the representative average unit cost for natural gas.

(8) Determine the estimated annual operating cost for convertible cooking appliances that represents LP-gas usage, as described in paragraph (i)(6)(ii) of

this section, according to paragraph (i)(4) of this section, using the representative average unit cost for propane times the total annual energy consumption of the test gas, either propane or natural gas.

(9) Determine the integrated annual energy consumption for convertible cooking appliances that represents natural gas usage, as described in paragraph (i)(6)(i) of this section, according to paragraph (i)(3) of this section, when the appliance is tested with natural gas.

(10) Determine the integrated annual energy consumption for convertible cooking appliances that represents LP-gas usage, as described in paragraph (i)(6)(ii) of this section, according to paragraph (i)(3) of this section, when the appliance is tested with either natural gas or propane.

(11) Other useful measures of energy consumption for conventional cooking tops shall be the measures of energy consumption that the Secretary determines are likely to assist consumers in making purchasing decisions and that are derived from the application of appendix I to this subpart.

* * * * *

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

Appendix I to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Cooking Products

Note: Any representation related to energy or power consumption of cooking products made after June 14, 2017 must be based upon results generated under this test procedure. Upon the compliance date(s) of any energy conservation standard(s) for cooking products, use of the applicable provisions of this test procedure to demonstrate compliance with the energy conservation standard will also be required.

1. Definitions

The following definitions apply to the test procedures in this appendix, including the test procedures incorporated by reference:

1.1 *Active mode* means a mode in which the product is connected to a mains power source, has been activated, and is performing the main function of producing heat by means of a gas flame, electric resistance heating, electric inductive heating, or microwave energy.

1.2 *Built-in* means the product is enclosed in surrounding cabinetry, walls, or other similar structures on at least three sides, and can be supported by surrounding cabinetry or the floor.

1.3 *Combined cooking product* means a household cooking appliance that combines a cooking product with other appliance functionality, which may or may not include another cooking product. Combined cooking products include the following products: Conventional range, microwave/conventional cooking top, microwave/conventional oven, and microwave/conventional range.

1.4 *Combined low-power mode* means the aggregate of available modes other than active mode, but including the delay start mode portion of active mode.

1.5 *Cooking area* is an area on a conventional cooking top surface heated by an inducted magnetic field where cookware is placed for heating, where more than one cookware item can be used simultaneously and controlled separately from other cookware placed on the cooking area, and that is either—

(1) An area where no clear limitative markings for cookware are visible on the surface of the cooking top; or

(2) An area with limitative markings.

1.6 *Cooking zone* is a conventional cooking top surface that is either a single electric resistance heating element or multiple concentric sizes of electric resistance heating elements, an inductive heating element, or a gas surface unit that is defined by limitative markings on the surface of the cooking top and can be controlled independently of any other cooking area or cooking zone.

1.7 *Cooking top control* is a part of the conventional cooking top used to adjust the power and the temperature of the cooking zone or cooking area for one cookware item.

1.8 *Cycle finished mode* is a standby mode in which a conventional cooking top provides continuous status display following operation in active mode.

1.9 *Drop-in* means the product is supported by horizontal surface cabinetry.

1.10 *EN 60350–2:2013* means the CENELEC test standard titled, ''Household electric cooking appliances Part 2: Hobs—Methods for measuring performance,'' Publication 60350–2 (2013) (incorporated by reference; see § 430.3).

1.11 *Freestanding* means the product is supported by the floor and is not specified in the manufacturer's instructions as able to be installed such that it is enclosed by surrounding cabinetry, walls, or other similar structures.

1.12 *IEC 62301 (First Edition)* means the test standard published by the International Electrotechnical Commission, titled ''Household electrical appliances—Measurement of standby power,'' Publication 62301 (First Edition 2005–06) (incorporated by reference; see § 430.3).

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

1.14 *Inactive mode* means a standby mode that facilitates the activation of active mode by remote switch (including remote control), internal sensor, or timer, or that provides continuous status display.

1.15 *Maximum power setting* means the maximum possible power setting if only one cookware item is used on the cooking zone or cooking area of a conventional cooking top.

1.16 *Normal non-operating temperature* means a temperature of all areas of an appliance to be tested that is within 5 °F (2.8 °C) of the temperature that the identical areas of the same basic model of the appliance would attain if it remained in the test room for 24 hours while not operating with all oven doors closed.

1.17 *Off mode* means any mode in which a cooking product is connected to a mains power source and is not providing any active mode or standby function, and where the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position is included within the classification of an off mode.

1.18 *Standard cubic foot (or liter (L)) of gas* means that quantity of gas that occupies 1 cubic foot (or alternatively expressed in L) when saturated with water vapor at a temperature of 60 °F (15.6 °C) and a pressure of 30 inches of mercury (101.6 kPa) (density of mercury equals 13.595 grams per cubic centimeter).

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

(1) Facilitation of the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer;

(2) Provision of continuous functions, including information or status displays (including clocks) or sensor-based functions. A timer is a continuous clock function (which may or may not be associated with a display) that allows for regularly scheduled tasks and that operates on a continuous basis.

1.20 *Thermocouple* means a device consisting of two dissimilar metals which are joined together and, with their associated wires, are used to measure temperature by means of electromotive force.

1.21 *Symbol usage.* The following identity relationships are provided to help clarify the symbology used throughout this procedure.

A—Number of Hours in a Year
C—Specific Heat
E—Energy Consumed
H—Heating Value of Gas
K—Conversion for Watt-hours to Kilowatt-hours or Btu to kBtu
Ke—3.412 Btu/Wh, Conversion for Watt-hours to Btu
M—Mass
n—Number of Units
P—Power
Q—Gas Flow Rate
T—Temperature
t—Time
V—Volume of Gas Consumed

2. Test Conditions

2.1 *Installation.* Install a freestanding combined cooking product with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above the appliance and 1 foot beyond both sides of the appliance, and with no side walls. Install a drop-in or built-in cooking product in a test enclosure in accordance with manufacturer's instructions. If the

manufacturer's instructions specify that the cooking product may be used in multiple installation conditions, install the appliance according to the built-in configuration and, for cooking tops, with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above the appliance and 1 foot beyond both sides of the appliance. Completely assemble the product with all handles, knobs, guards, and similar components mounted in place. Position any electric resistance heaters, gas burners, and baffles in accordance with the manufacturer's instructions.

2.1.1 *Conventional electric cooking tops.* Connect these products to an electrical supply circuit with voltage as specified in section 2.2.1 of this appendix with a watt-hour meter installed in the circuit. The watt-hour meter shall be as described in section 2.8.1.1 of this appendix. For standby mode and off mode testing, install these products 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.

2.1.2 *Conventional gas cooking tops.* Connect these products to a gas supply line with a gas meter installed between the supply line and the appliance being tested, according to manufacturer's specifications. The gas meter shall be as described in section 2.8.2 of this appendix. Connect conventional gas cooking tops with electrical ignition devices or other electrical components to an electrical supply circuit of nameplate voltage with a watt-hour meter installed in the circuit. The watt-hour meter shall be as described in section 2.8.1.1 of this appendix. For standby mode and off mode testing, install these products 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.

2.1.3 *Microwave ovens, excluding any microwave oven component of a combined cooking product.* 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. Install the microwave oven also 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 shall be installed in the circuit and shall be as described in section 2.8.1.2 of this appendix.

2.1.4 *Combined cooking products standby mode and off mode.* For standby mode and off mode testing of combined cooking products, install these products 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.

2.2 *Energy supply.*

2.2.1 *Electrical supply.*

2.2.1.1 *Voltage.* For the test of conventional cooking tops, maintain the electrical supply requirements specified in Section 5.2 of EN 60350–2:2013 (incorporated by reference; see § 430.3). For microwave oven testing, maintain the electrical supply to the unit at 240/120 volts ±1 percent. For combined cooking product standby mode and off mode measurements, maintain the electrical supply to the unit at 240/120 volts ±1 percent. Maintain the electrical supply frequency for all products at 60 hertz ±1 percent.

2.2.2.1 *Gas burner adjustments.* Test conventional gas cooking tops with all of the gas burners adjusted in accordance with the installation or operation instructions provided by the manufacturer. In every case, adjust the burner with sufficient air flow to prevent a yellow flame or a flame with yellow tips.

2.2.2.2 *Natural gas.* For testing convertible cooking appliances or appliances which are designed to operate using only natural gas, maintain the natural gas pressure immediately ahead of all controls of the unit under test at 7 to 10 inches of water column (1743.6 to 2490.8 Pa). The regulator outlet pressure shall equal the manufacturer's recommendation. The natural gas supplied should have a heating value of approximately 1,025 Btu per standard cubic foot (38.2 kJ/L). The actual gross heating value, H_n, in Btu per standard cubic foot (kJ/L), for the natural gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using equipment that meets the requirements described in section 2.8.4 of this appendix or by the use of bottled natural gas whose gross heating value is certified to be at least as accurate a value that meets the requirements in section 2.8.4 of this appendix.

2.2.2.3 *Propane.* For testing convertible cooking appliances with propane or for testing appliances which are designed to operate using only LP-gas, maintain the propane pressure immediately ahead of all controls of the unit under test at 11 to 13 inches of water column (2740 to 3238 Pa). The regulator outlet pressure shall equal the manufacturer's recommendation. The propane supplied should have a heating value of approximately 2,500 Btu per standard cubic foot (93.2 kJ/L). Obtain the actual gross heating value, H_p, in Btu per standard cubic foot (kJ/L), for the propane to be used in the test either from measurements made by the manufacturer conducting the test using equipment that meets the requirements described in section 2.8.4 of this appendix, or by the use of bottled propane whose gross heating value is certified to be at least as accurate a value that meets the requirements described in section 2.8.4 of this appendix.

2.2.2.4 *Test gas.* Test a basic model of a convertible cooking appliance with natural gas or propane. Test with natural gas any basic model of a conventional cooking top that is designed to operate using only natural gas as the energy source. Test with propane gas any basic model of a conventional cooking top which is designed to operate using only LP gas as the gas energy source.

2.3 *Air circulation.* Maintain air circulation in the room sufficient to secure a reasonably uniform temperature distribution, but do not cause a direct draft on the unit under test.

2.5 *Ambient room test conditions*

2.5.1 *Active mode ambient room air temperature.* During the active mode test for conventional cooking tops, maintain the ambient room air temperature and pressure specified in Section 5.1 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.5.2 *Standby mode and off mode ambient temperature.* For standby mode and off mode testing, maintain room ambient air temperature conditions as specified in Section 4, Paragraph 4.2 of IEC 62301 (Second Edition) (incorporated by reference; see § 430.3).

2.6 *Normal non-operating temperature.* All areas of the appliance to be tested must attain the normal non-operating temperature, as defined in section 1.16 of this appendix, before any testing begins. Measure the applicable normal non-operating temperature using the equipment specified in sections 2.8.3.1 and 2.8.3.2 of this appendix. For conventional cooking tops, forced cooling may be used to assist in reducing the temperature of the appliance, as specified in Section 5.5 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.7 *Conventional cooking top test vessels*

2.7.1 *Conventional electric cooking top test vessels.* The test vessels and water amounts required for the test of conventional electric cooking tops must meet the requirements specified in Section 7.1.Z2 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.7.2 *Conventional gas cooking top test vessels.* The test vessels for conventional gas cooking tops must be constructed according to Section 7.1.Z2 of EN 60350–2:2013 (incorporated by reference; see § 430.3). Use the following test vessel diameters and water amounts to test gas cooking zones having the burner input rates as specified:

Nominal gas burner input rate		Test vessel diameter inches (mm)	Water load mass lbs (kg)
Minimum Btu/h (kW)	Maximum Btu/h (kW)		
3,958 (1.16)	5,596 (1.64)	8.27 (210)	4.52 (2.05)
5,630 (1.65)	6,756 (1.98)	9.45 (240)	5.95 (2.70)
6,790 (1.99)	8,053 (2.36)	10.63 (270)	7.54 (3.42)

Nominal gas burner input rate		Test vessel diameter inches (mm)	Water load mass lbs (kg)
Minimum Btu/h (kW)	Maximum Btu/h (kW)		
8,087 (2.37)	14,331 (4.2)	10.63 (270)	7.54 (3.42)
>14,331 (4.2)		11.81 (300)	9.35 (4.24)

2.8 *Instrumentation.* Perform all test measurements using the following instruments, as appropriate:

2.8.1 *Electrical Measurements.*

2.8.1.1 *Watt-hour meter.* The watt-hour meter for measuring the electrical energy consumption of conventional cooking tops must have a resolution as specified in Table Z1 of Section 5.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3). The watt-hour meter for measuring the electrical energy consumption of microwave ovens must have a resolution of 0.1 watt-hour (0.36 kJ) or less and a maximum error no greater than 1.5 percent of the measured value.

2.8.1.2 *Standby mode and off mode watt meter.* The watt meter used to measure standby mode and off mode power must meet the requirements specified in Section 4, Paragraph 4.4 of IEC 62301 (Second Edition) (incorporated by reference; see § 430.3). For microwave oven standby mode and off mode testing, if the power measuring instrument used for testing is unable to measure and record the crest factor, power factor, or maximum current ratio during the test measurement period, measure the crest factor, power factor, and maximum current ratio immediately before and after the test measurement period to determine whether these characteristics meet the requirements specified in Section 4, Paragraph 4.4 of IEC 62301 (Second Edition).

2.8.2 *Gas Measurements.*

2.8.2.1 *Positive displacement meters.* The gas meter to be used for measuring the gas consumed by the gas burners of the conventional cooking top must have a resolution of 0.01 cubic foot (0.28 L) or less and a maximum error no greater than 1 percent of the measured valued for any demand greater than 2.2 cubic feet per hour (62.3 L/h).

2.8.3 *Temperature measurement equipment.*

2.8.3.1 *Room temperature indicating system.* For the test of microwave ovens, the room temperature indicating system must have an error no greater than ±1 °F (±0.6 °C) over the range 65° to 90 °F (18 °C to 32 °C). For conventional cooking tops, the room temperature indicating system must be as specified in Table Z1 of Section 5.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.8.3.2 *Temperature indicator system for measuring surface temperatures.* Measure the temperature of any surface of a conventional cooking top by means of a thermocouple in firm contact with the surface. The temperature indicating system must have an error no greater than ±1 °F (±0.6 °C) over the range 65° to 90 °F (18 °C to 32 °C).

2.8.3.3 *Water temperature indicating system.* For the test of conventional cooking tops, measure the test vessel water temperature by means of a thermocouple as specified in Table Z1 of Section 5.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.8.3.4 *Room air pressure indicating system.* For the test of conventional cooking tops, the room air pressure indicating system must be as specified in Table Z1 of Section 5.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

2.8.4 *Heating Value.* Measure the heating value of the natural gas or propane with an instrument and associated readout device that has a maximum error no greater than ±0.5% of the measured value and a resolution of ±0.2% or less of the full scale reading of the indicator instrument. Correct the heating value of natural gas or propane to standard pressure and temperature conditions in accordance with U.S. Bureau of Standards, circular C417, 1938.

2.8.5 *Scale.* The scale used to measure the mass of the water amount must be as specified in Table Z1 of Section 5.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3).

3. Test Methods and Measurements

3.1. *Test methods.*

3.1.1 *Conventional cooking top.* Establish the test conditions set forth in section 2, *Test Conditions,* of this appendix. Turn off the gas flow to the conventional oven(s), if so equipped. The temperature of the conventional cooking top must be its normal non-operating temperature as defined in section 1.16 and described in section 2.6 of this appendix. For conventional electric cooking tops, select the test vessel(s) and test position(s) according to Sections 6.2.Z1, 7.1.Z2, 7.1.Z3, 7.1.Z4, Annex ZA to ZD, and Annex ZF of EN 60350–2:2013 (incorporated by reference; see § 430.3). When measuring the surface unit cooking zone diameter, the outer diameter of the cooking zone printed marking shall be used for the measurement. For conventional gas cooking tops, select the appropriate test vessel(s) from the test vessels specified in section 2.7.2 of this appendix based on the burner input rate. Use the test methods set forth in Section 7.1.Z6 of EN 60350–2:2013 to measure the energy consumption of electric and gas cooking zones and electric cooking areas. The temperature overshoot, ΔT_0, calculated in Section 7.1.Z6.2.2 is the difference between the highest recorded temperature value and T_{70} as shown in Figure Z2. During the simmering energy consumption measurement specified in Section 7.1.Z6.3, the 20-minute simmering period starts when the water temperature first reaches 90 °C and does not drop below 90 °C for more than 20 seconds after initially reaching 90 °C. Do not test specialty cooking zones that are for use only with non-circular cookware, such as bridge zones, warming plates, grills, and griddles.

3.1.1.1 *Conventional cooking top standby mode and off mode power except for any conventional cooking top component of a combined cooking product.* Establish the standby mode and off mode testing conditions set forth in section 2, *Test Conditions,* of this appendix. For conventional cooking tops that take some time to enter a stable state from a higher 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 conventional cooking top 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 testing in each possible mode as described in sections 3.1.1.1.1 and 3.1.1.1.2 of this appendix. For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition), 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 +0/−2 sec after an additional stabilization period until the clock time reaches 3:33.

3.1.1.1.1 If the conventional cooking top has an inactive mode, as defined in section 1.14 of this appendix, measure and record the average inactive mode power of the conventional cooking top, P_{IA}, in watts.

3.1.1.1.2 If the conventional cooking top has an off mode, as defined in section 1.17 of this appendix, measure and record the average off mode power of the conventional cooking top, P_{OM}, in watts.

3.1.2 *Combined cooking product standby mode and off mode power.* Establish the standby mode and off mode testing conditions set forth in section 2, *Test Conditions,* of this appendix. For combined cooking products that take some time to enter a stable state from a higher 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 combined cooking product 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 testing in each possible mode as described in sections 3.1.2.1 and 3.1.2.2 of this appendix. For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition), 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 +0/−2 sec after an additional stabilization period until the clock time reaches 3:33.

3.1.2.1 If the combined cooking product has an inactive mode, as defined in section 1.14 of this appendix, measure and record the average inactive mode power of the combined cooking product, P_{IA}, in watts.

3.1.2.2 If the combined cooking product has an off mode, as defined in section 1.17 of this appendix, measure and record the average off mode power of the combined cooking product, P_{OM}, in watts.

3.1.3 *Microwave oven.*

3.1.3.1 *Microwave oven test standby mode and off mode power except for any microwave oven component of a combined cooking product.* 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 +0/−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 1.19 and 1.17 of this appendix, respectively, or both, test the microwave oven in each mode in which it can operate.

3.2 *Test measurements.*

3.2.1 *Conventional cooking top test energy consumption.*

3.2.1.1 *Conventional cooking area or cooking zone energy consumption.* Measure the energy consumption for each electric cooking zone and cooking area, in watt-hours (kJ) of electricity according to section 7.1.Z6.3 of EN 60350–2:2013 (incorporated by reference; see § 430.3). For the gas surface unit under test, measure the volume of gas consumption, V_{CT}, in standard cubic feet (L) of gas and any electrical energy, E_{IC}, consumed by an ignition device of a gas heating element or other electrical components required for the operation of the conventional gas cooking top in watt-hours (kJ).

3.2.1.2 *Conventional cooking top standby mode and off mode power except for any conventional cooking top component of a combined cooking product.* Make measurements as specified in section 3.1.1.1 of this appendix. If the conventional cooking top is capable of operating in inactive mode, as defined in section 1.15 of this appendix, measure the average inactive mode power of the conventional cooking top, $P_{IA,}$ in watts as specified in section 3.1.1.1.1 of this appendix. If the conventional cooking top is capable of operating in off mode, as defined in section 1.17 of this appendix, measure the average off mode power of the conventional cooking top, P_{OM}, in watts as specified in section 3.1.1.1.2 of this appendix.

3.2.2 *Combined cooking product standby mode and off mode power.* Make measurements as specified in section 3.1.2 of this appendix. If the combined cooking product is capable of operating in inactive mode, as defined in section 1.15 of this appendix, measure the average inactive mode power of the combined cooking product, $P_{IA,}$ in watts as specified in section 3.1.2.1 of this appendix. If the combined cooking product is capable of operating in off mode, as defined in section 1.17 of this appendix, measure the average off mode power of the combined cooking product, P_{OM}, in watts as specified in section 3.1.2.2 of this appendix.

3.2.3 *Microwave oven standby mode and off mode power except for any microwave oven component of a combined cooking product.* 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 1.19 of this appendix, measure the average standby mode power of the microwave oven, P_{SB}, in watts as specified in section 3.1.3.1 of this appendix. If the microwave oven is capable of operating in off mode, as defined in section 1.17 of this appendix, measure the average off mode power of the microwave oven, P_{OM}, as specified in section 3.1.3.1.

3.3 *Recorded values.*

3.3.1 Record the test room temperature, T_R, at the start and end of each conventional cooking top or combined cooking product test, as determined in section 2.5 of this appendix.

3.3.2 Record the relative air pressure at the start of the test and at the end of the test in hectopascals (hPa).

3.3.3 For conventional cooking tops and combined cooking products, record the standby mode and off mode test measurements P_{IA} and P_{OM}, if applicable.

3.3.4 For each test of an electric cooking area or cooking zone, record the values listed in 7.1.Z6.3 in EN 60350–2:2013 (incorporated by reference; see § 430.3) and the total test electric energy consumption, E_{TV}.

3.3.5 For each test of a conventional gas surface unit, record the gas volume consumption, V_{CT}; the time until the power setting is reduced, t_c; the time when the simmering period starts, t_{90}; the initial temperature of the water; the water temperature when the setting is reduced, T_c; the water temperature at the end of the test, T_s; and the electrical energy for ignition of the burners, E_{IC}.

3.3.6 Record the heating value, H_n, as determined in section 2.2.2.2 of this appendix for the natural gas supply.

3.3.7 Record the heating value, H_p, as determined in section 2.2.2.3 of this appendix for the propane supply.

3.3.8 Record the simmering setting selected in accordance with section 7.1.Z6.2.3.

3.3.9 For microwave ovens except for any microwave oven component of a combined cooking product, record the average standby mode power, P_{SB}, for the microwave oven standby mode, as determined in section 3.2.3 of this appendix 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 3.2.3 of this appendix for a microwave oven capable of operating in off mode.

4. Calculation of Derived Results From Test Measurements

4.1 *Conventional cooking top.*

4.1.1 *Conventional cooking top energy consumption.*

4.1.1.1 *Energy consumption for electric cooking tops.* Calculate the energy consumption of a conventional electric cooking top, $E_{CTE,}$ in Watt-hours (kJ), using the following equation:

$$E_{CTE} = \frac{2853g}{n_{tv}} \times \sum_{tv=1}^{n_{tv}} \frac{E_{tv}}{m_{tv}}$$

Where:

n_{tv} = the total number of tests conducted for the conventional electric cooking top

E_{tv} = the energy consumption measured for each test with a given test vessel, tv, in Wh

m_{tv} is the mass of water used for the test, in g

2853 = the representative water load mass, in g

4.1.1.2 *Gas energy consumption for conventional gas cooking tops.* Calculate the energy consumption of the conventional gas cooking top, $E_{CTG,}$ in Btus (kJ) using the following equation:

$$E_{CTG} = \frac{2853g}{n_{tv}} \times \sum_{tv=1}^{n_{tv}} \frac{E_{tvg}}{m_{tv}}$$

Where:

n_{tv} = the total number of tests conducted for the conventional gas cooking top

m_{tv} = the mass of the water used to test a given cooking zone or area

E_{tvg} = ($V_{CT} \times H$), the gas energy consumption measured for each test with a given test vessel, tv, in Btu (kJ)

Where:

V_{CT} = total gas consumption in standard cubic feet (L) for the gas surface unit test as measured in section 3.2.1.1 of this appendix.

H = either H_n or H_p, the heating value of the gas used in the test as specified in sections 2.2.2.2 and 2.2.2.3 of this appendix, expressed in Btus per standard cubic foot (kJ/L) of gas.

2853 = the representative water load mass, in g

4.1.1.3 *Electrical energy consumption for conventional gas cooking tops.* Calculate the energy consumption of the conventional gas cooking top, $E_{CTGE,}$ in Watt-hours (kJ) using the following equation:

$$E_{CTGE} = \frac{2853g}{n_{tv}} \times \sum_{tv=1}^{n_{tv}} \frac{E_{IC}}{m_{tv}}$$

Where:

n_{tv} = the total number of tests conducted for the conventional gas cooking top

m_{tv} = the mass of the water used to test a given cooking zone or area

E_{IC} = the electrical energy consumed in watt-hours (kJ) by a gas surface unit as measured in section 3.2.1.1 of this appendix.

2853 = the representative water load mass, in g

4.1.2 *Conventional cooking top annual energy consumption.*

4.1.2.1 *Conventional electric cooking top.*

4.1.2.1.1 *Annual energy consumption of a conventional electric cooking top.* Calculate the annual energy consumption of a conventional electric cooking top, E_{CA}, in kilowatt-hours (kJ) per year, defined as:

$$E_{CA} = E_{CTE} \times K \times N_{CE}$$

Where:

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

N_{CE} = 207.5 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for conventional electric cooking tops.

E_{CTE} = energy consumption of the conventional electric cooking top as defined in section 4.1.1.1 of this appendix.

4.1.2.1.2 *Integrated annual energy consumption of a conventional electric cooking top.* Calculate the integrated annual electrical energy consumption, E_{IAEC}, of a conventional electric cooking top, except for any conventional electric cooking top component of a combined cooking product, in kilowatt-hours (kJ) per year, defined as:

$$E_{IAEC} = E_{CA} + E_{CTLP}$$

Where:

E_{CA} = the annual energy consumption of the conventional electric cooking top as defined in section 4.1.2.1.1 of this appendix.

E_{CTLP} = conventional cooking top annual combined low-power mode energy consumption = $[(P_{IA} \times S_{IA}) + (P_{OM} \times S_{OM})] \times K$,

Where:

P_{IA} = conventional cooking top inactive mode power, in watts, as measured in section 3.1.1.1.1 of this appendix.

P_{OM} = conventional cooking top off mode power, in watts, as measured in section 3.1.1.1.2 of this appendix.

If the conventional cooking top has both inactive mode and off mode annual hours, S_{IA} and S_{OM} both equal 4273.4;

If the conventional cooking top has an inactive mode but no off mode, the inactive mode annual hours, S_{IA}, is equal to 8546.9, and the off mode annual hours, S_{OM}, is equal to 0;

If the conventional cooking top has an off mode but no inactive mode, S_{IA} is equal to 0, and S_{OM} is equal to 8546.9;

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

4.1.2.2 *Conventional gas cooking top*

4.1.2.2.1 *Annual gas energy consumption of a conventional gas cooking top.* Calculate the annual gas energy consumption, E_{CCG}, in kBtus (kJ) per year for a conventional gas cooking top, defined as:

$$E_{CCG} = E_{CTG} \times K \times N_{CG}$$

Where:

N_{CG} = 214.5 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for conventional gas cooking tops.

E_{CTG} = gas energy consumption of the conventional gas cooking top as defined in section 4.1.1.2 of this appendix.

K = 0.001 conversion factor for Btu to kBtu.

4.1.2.2.2 *Annual electrical energy consumption of a conventional gas cooking top.* Calculate the annual electrical energy consumption, E_{CCE}, in kilowatt-hours (kJ) per year for a conventional gas cooking top, defined as:

$$E_{CCE} = E_{CTGE} \times K \times N_{CG}$$

Where:

N_{CG} = 214.5 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for conventional gas cooking tops.

E_{CTGE} = secondary electrical energy consumption of the conventional gas cooking top as defined in section 4.1.1.3 of this appendix.

K = 0.001 conversion factor for Wh to kWh.

4.1.2.2.3 *Integrated annual energy consumption of a conventional gas cooking top.* Calculate the integrated annual energy consumption, E_{IAEC}, of a conventional gas cooking top, except for any conventional gas cooking top component of a combined cooking product, in kBtus (kJ) per year, defined as:

$$E_{IAEC} = E_{CC} + (E_{CTSO} \times K_e)$$

Where:

$E_{CC} = E_{CCG} + (E_{CCE} \times K_e)$ the total annual energy consumption of a conventional gas cooking top

Where:

E_{CCG} = the primary annual energy consumption of a conventional gas cooking top as determined in section 4.1.2.2.1 of this appendix.

E_{CCE} = the secondary annual energy consumption of a conventional gas cooking top as determined in section 4.1.2.2.2 of this appendix.

K_e = 3.412 Btu/Wh (3.6 kJ/Wh), conversion factor of watt-hours to Btus.

E_{CTSO} = conventional cooking top annual combined low-power mode energy consumption = $[(P_{IA} \times S_{IA}) + (P_{OM} \times S_{OM})] \times K$,

Where:

P_{IA} = conventional cooking top inactive mode power, in watts, as measured in section 3.1.1.1.1 of this appendix.

P_{OM} = conventional cooking top off mode power, in watts, as measured in section 3.1.1.1.2 of this appendix.

If the conventional cooking top has both inactive mode and off mode annual hours, S_{IA} and S_{OM} both equal 4273.4;

If the conventional cooking top has an inactive mode but no off mode, the inactive mode annual hours, S_{IA}, is equal to 8546.9, and the off mode annual hours, S_{OM}, is equal to 0;

If the conventional cooking top has an off mode but no inactive mode, S_{IA} is equal to 0, and S_{OM} is equal to 8546.9;

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

4.2 *Combined cooking products.*

4.2.1 Combined cooking product annual combined low-power mode energy consumption. Calculate the combined cooking product annual combined low-power mode energy consumption, E_{CCLP}, defined as:

$$E_{CCLP} = (P_{IA} \times S_{IA}) + (P_{OM} \times S_{OM})] \times K,$$

Where:

P_{IA} = combined cooking product inactive mode power, in watts, as measured in section 3.1.2.1 of this appendix.

P_{OM} = combined cooking product off mode power, in watts, as measured in section 3.1.2.2 of this appendix.

S_{TOT} equals the total number of inactive mode and off mode hours per year, 8,329.2;

If the combined cooking product has both inactive mode and off mode, S_{IA} and S_{OM} both equal $S_{TOT}/2$;

If the combined cooking product has an inactive mode but no off mode, the inactive mode annual hours, S_{IA}, is equal to S_{TOT}, and the off mode annual hours, S_{OM}, is equal to 0;

If the combined cooking product has an off mode but no inactive mode, S_{IA} is equal to 0, and S_{OM} is equal to S_{TOT};

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

4.2.2 *Integrated annual energy consumption of any conventional cooking top component of a combined cooking product.*

4.2.2.1 *Integrated annual energy consumption of any conventional electric cooking top component of a combined cooking product.* Calculate the integrated annual energy consumption of a conventional electric cooking top component of a combined cooking product, E_{IAEC}, in kilowatt-hours (kJ) per year and defined as:

$$E_{IAEC} = E_{CA} + E_{CCTLP}$$

Where,

E_{CA} = the annual energy consumption of the conventional electric cooking top as defined in section 4.1.2.1.1 of this appendix.

E_{CCTLP} = annual combined low-power mode energy consumption for the conventional cooking top component of a combined cooking product, in kWh (kJ) per year, calculated as:

$$E_{CCTLP} = E_{CCLP} \times \frac{H_{CT}}{H_T}$$

Where:

E_{CCLP} = combined cooking product annual combined low-power mode energy consumption, determined in section 4.2.1 of this appendix.

H_{CT} = 213.1 hours per year, the average number of cooking hours per year for a conventional cooking top.

$H_T = H_{OV} + H_{CT} + H_{MWO}$

Where:

H_{OV} = average number of cooking hours per year for a conventional oven, which

is equal to 219.9 hours per year. If the combined cooking product does not include a conventional oven, then H_{OV} = 0.

H_{MWO} = average number of cooking hours per year for a microwave oven, which is equal to 44.9 hours per year. If the combined cooking product does not include a microwave oven, then H_{MWO} = 0.

4.2.2.2 *Integrated annual energy consumption of any conventional gas cooking top component of a combined cooking product.* Calculate the integrated annual energy consumption of a conventional gas cooking top component of a combined cooking product, E_{IAEC}, in kBtus (kJ) per year and defined as:

$E_{IAEC} = E_{CC} + (E_{CCTLP} \times K_e)$

Where,

E_{CC} = $E_{CCG} + E_{CCE}$, the total annual energy consumption of a conventional gas cooking top,

Where:

E_{CCG} = the annual gas energy consumption of a conventional gas cooking top as determined in section 4.1.2.2.1 of this appendix.

E_{CCE} = the annual electrical energy consumption of a conventional gas cooking top as determined in section 4.1.2.2.2 of this appendix.

K_e = 3.412 kBtu/kWh (3,600 kJ/kWh), conversion factor for kilowatt-hours to kBtus.

E_{CCTLP} = annual combined low-power mode energy consumption for the conventional cooking top component of a combined cooking product, in kWh (kJ) per year, calculated as:

$$E_{CCTLP} = E_{CCLP} \times \frac{H_{CT}}{H_T}$$

Where:

E_{CCLP} = combined cooking product annual combined low-power mode energy consumption, determined in section 4.2.1 of this appendix.

H_{CT} = 213.1 hours per year, the average number of cooking hours per year for a conventional cooking top.

$H_T = H_{OV} + H_{CT} + H_{MWO}$

Where:

H_{OV} = average number of cooking hours per year for a conventional oven, which is equal to 219.9 hours per year. If the combined cooking product does not include a conventional oven, then H_{OV} = 0.

H_{MWO} = average number of cooking hours per year for a microwave oven, which is equal to 44.9 hours per year. If the combined cooking product does not include a microwave oven, then H_{MWO} = 0.

4.2.3 *Annual combined low-power mode energy consumption for any microwave oven component of a combined cooking product.* Calculate the annual combined low-power mode energy consumption of a microwave oven component of a combined cooking product, E_{CMWOLP}, in kWh (kJ) per year, and defined as:

$$E_{CMWOLP} = E_{CCLP} \times \frac{H_{MWO}}{H_T}$$

Where:

E_{CCLP} = combined cooking product annual combined low-power mode energy consumption, determined in section 4.2.1 of this appendix.

H_{MWO} = 44.9 hours per year, the average number of cooking hours per year for a microwave oven.

$H_T = H_{OV} + H_{CT} + H_{MWO}$

H_{OV} = average number of cooking hours per year for a conventional oven, which is equal to 219.9 hours per year. If the combined cooking product does not include a conventional oven, then H_{OV} = 0.

H_{CT} = average number of cooking hours per year for a conventional cooking top, which is equal to 213.1 hours per year. If the combined cooking product does not include a conventional cooking top, then H_{CT} = 0.

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