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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

EERE-2021-BT-TP-0023

RIN 1904-AF18

Energy Conservation Program: Test Procedure for Cooking Products

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

ACTION: Final rule; technical correction.

SUMMARY: The U.S. Department of Energy ("DOE") is establishing a test procedure for a category of cooking products, *i.e.*, conventional cooking tops, under a new appendix. The new test procedure adopts the latest version of the relevant industry standard for electric cooking tops with modifications. The modifications adapt the test method to gas cooking tops, normalize the energy use of each test cycle, include measurement of standby mode and off mode energy use, update certain test conditions, and clarify certain provisions. This final rule retitles the existing cooking products test procedure to specify that it is for microwave ovens only. This final rule also corrects the CFR following an incorrect amendatory instruction in a June 2022 final rule.

DATES: The effective date of this rule is **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. The final rule changes will be mandatory for representations of energy use or energy efficiency of a conventional cooking top on or after [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

The incorporation by reference of certain publications listed in this rule is approved by the Director of the Federal Register on [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***].

ADDRESSES: The docket, which includes *Federal Register* notices, webinar 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 *www.regulations.gov/docket/EERE-2021-BT-TP-0023*. The docket web page contains 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) 287-1445 or by e-mail: *ApplianceStandardsQuestions@ee.doe.gov*.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

DOE incorporates by reference the following industry standards into appendix I1 to subpart B of part 430:

International Electrotechnical Commission ("IEC") 62301, "Household electrical appliances—Measurement of standby power", first edition, June 2005 ("IEC 62301 First Edition").

IEC 62301, "Household electrical appliances—Measurement of standby power", Edition 2.0, 2011-01 ("IEC 62301 Second Edition").

IEC 60350–2, "Household electric cooking appliances Part 2: Hobs—Methods for measuring performance", Edition 2.1, 2021-05 ("IEC 60350–2:2021").

Copies of IEC 62301 First Edition, IEC 62301 Second Edition and IEC 60350–2:2021 can be obtained from the International Electrotechnical Commission at 25 W. 43rd Street, 4th Floor, New York, NY 10036, or by going to *webstore.ansi.org*.

See section IV.N of this document for further discussion of these standards.

Technical Correction

On June 1, 2022 DOE published the final rule "Test Procedures for Residential and Commercial Clothes Washers", effective on July 1, 2022 (87 FR 33316). One of the instructions was intended to update the IEC 62301 Second Edition entry in the centralized IBR section (10 CFR 430.3(p)(6)). However, the amendatory instruction referenced paragraph (o) instead of paragraph (p). (See 87 FR 33380.) This final rule, therefore, corrects that error.

Table of Contents

I. Authority and Background

Kitchen ranges and ovens are included in the list of "covered products" for which the 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 regulations at title 10 of the Code of Federal Regulations ("CFR") part 430 section 2 defines "cooking products,"[1] which cover cooking appliances that use gas, electricity, or microwave energy as the source of heat. The section also defines specific categories of cooking products: conventional cooking tops, conventional ovens, microwave ovens, and a term for products that do not fall into those categories: "other cooking products." DOE's energy conservation standards and test procedure for cooking products are currently prescribed at 10 CFR 430.32(j) and 10 CFR part 430 subpart B appendix I

[1] DOE established the regulatory term "cooking products" in lieu of the statutory term "kitchen ranges and ovens" (42 U.S.C. 6292(a)(10)) having determined that the latter is obsolete and does not accurately describe the products considered, which include microwave ovens, conventional ranges, cooking tops, and ovens. 63 FR 48038, 48052 (Sep. 8, 1998).

("appendix I"), respectively. Only microwave oven test procedures are currently specified in appendix I. DOE is creating a new test procedure at 10 CFR part 430 subpart B appendix I1 ("appendix I1") that establishes a test procedure for conventional cooking tops. The following sections discuss DOE's authority to establish test procedures for conventional cooking tops and relevant background information regarding DOE's consideration of test procedures for this product.

A. Authority

The Energy Policy and Conservation Act, as amended ("EPCA"),[2] authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part B[3] of EPCA established the Energy Conservation Program for Consumer Products Other Than Automobiles, which sets forth a variety of provisions designed to improve energy efficiency. These products include cooking products, and specifically conventional cooking tops, the subject of this document. (42 U.S.C. 6292(a)(10))

The energy conservation program under EPCA consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA specifically include definitions (42 U.S.C. 6291), test procedures (42 U.S.C. 6293), labeling provisions (42

[2] All references to EPCA in this document refer to the statute as amended through the Energy Act of 2020, Pub. L. 116-260 (Dec. 27, 2020), which reflect the last statutory amendments that impact Parts A and A-1 of EPCA.

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

U.S.C. 6294), energy conservation standards (42 U.S.C. 6295), and the authority to require information and reports from manufacturers (42 U.S.C. 6296).

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 (42 U.S.C. 6295(s)), and (2) making other representations about the efficiency of those products (42 U.S.C. 6293(c)). Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

Federal energy efficiency requirements for covered products established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297) DOE may, however, grant waivers of Federal preemption for particular State laws or regulations, in accordance with the procedures and other provisions of EPCA. (42 U.S.C. 6297(d))

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products. EPCA requires that any test procedures prescribed or amended under this section 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 (as determined by the Secretary) or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product, including cooking products, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(1)(A))

If the Secretary determines, on her own behalf or in response to a petition by any interested person, that a test procedure should be prescribed or amended, the Secretary shall promptly publish in the *Federal Register* proposed test procedures and afford interested persons an opportunity to present oral and written data, views, and arguments with respect to such procedures. The comment period on a proposed rule to amend a test procedure shall be at least 60 days and may not exceed 270 days. In prescribing or amending a test procedure, the Secretary shall take into account such information as the Secretary determines relevant to such procedure, including technological developments relating to energy use or energy efficiency of the type (or class) of covered products involved. (42 U.S.C. 6293(b)(2)). If DOE determines that test procedure revisions are not appropriate, DOE must publish its determination not to amend the test procedures.

In addition, EPCA requires that DOE amend its test procedures for all covered products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already incorporates the standby mode and off mode energy consumption, or if such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)(A)) If an integrated test procedure is technically infeasible, DOE must prescribe separate standby mode and off mode energy use test procedures for the covered product, if a separate test is technically feasible. (*Id.*) Any such amendment must consider the most current versions of IEC 62301[4] and IEC 62087[5] as applicable. (42 U.S.C. 6295(gg)(2)(A))

DOE is publishing this final rule in satisfaction of the statutory authority specified in EPCA. (42 U.S.C. 6293(b)(1)(A) and 42 U.S.C. 6292(a)(10))

B. Background

As stated, DOE's test procedure for cooking products appears at 10 CFR part 430, subpart B, appendix I ("Uniform Test Method for Measuring the Energy Consumption of Cooking Products"). The current Federal test procedure provides for the testing only of standby power of microwave ovens. There are no provisions for testing conventional cooking tops or conventional ovens. DOE is adopting testing provisions only for conventional cooking tops in this final rule.

DOE originally established test procedures for cooking products in a final rule published in the *Federal Register* on May 10, 1978 ("May 1978 Final Rule"). 43 FR 20108, 20120–20128. In the years following, DOE amended the test procedure for conventional cooking tops on several occasions. Those amendments included the

[4] IEC 62301, *Household electrical appliances—Measurement of standby power* (Edition 2.0, 2011-01).
[5] IEC 62087, *Audio, video and related equipment—Methods of measurement for power consumption* (Edition 1.0, Parts 1–6: 2015, Part 7: 2018).

adoption of standby and off mode provisions in a final rule published on October 31, 2012 (77 FR 65942, the "October 2012 Final Rule") that satisfied the EPCA requirement that DOE include measures of standby mode and off mode power in its test procedures for covered products, if technically feasible. (42 U.S.C. 6295(gg)(2)(A))

In a final rule published December 16, 2016 ("December 2016 Final Rule"), DOE amended 10 CFR part 430 to incorporate by reference, for use in the conventional cooking top test procedure, the relevant sections of the Committee for Electrotechnical Standardization ("CENELEC") Standard 60350–2:2013, "Household electric appliances—Part 2: Hobs—Method for measuring performance" ("EN 60350–2:2013"), which uses a water-heating test method to measure the energy consumption of electric cooking tops, and extended the water-heating test method specified in EN 60350–2:2013 to gas cooking tops. 81 FR 91418.

On August 18, 2020, DOE published a final rule ("August 2020 Final Rule") withdrawing the test procedure for conventional cooking tops. 85 FR 50757. DOE initiated the rulemaking for the August 2020 Final Rule in response to a petition for rulemaking submitted by the Association of Home Appliance Manufacturers ("AHAM") ("AHAM petition"). AHAM asserted that the then-current test procedure for gas cooking tops was not representative, and, for both gas and electric cooking tops, had such a high level of variation that it did not produce accurate results for certification and enforcement purposes and did not assist consumers in making purchasing decisions based on energy efficiency. 85 FR 50757, 50760; *see also* 80 FR 17944 (Apr. 25, 2018).

At the time of the AHAM petition, the Federal test procedure for cooking tops measured the integrated annual energy consumption of both gas and electric cooking tops based on EN 60350–2:2013.[6] *See*, appendix I of 10 CFR part 430 subpart B edition revised as of January 1, 2020.

DOE withdrew the test procedure for conventional cooking tops in the August 2020 Final Rule based on test data submitted by outside parties indicating that the test procedure for conventional cooking tops yielded inconsistent results.[7] 85 FR 50757, 50760. DOE's test data for electric cooking tops from testing conducted at a single laboratory showed small variations. *Id*. Lab-to-lab test results submitted by AHAM showed high levels of variation for gas and electric cooking tops. *Id*. at 85 FR 50763. DOE determined that the inconsistency in results of such testing showed the results to be unreliable, and that it was unduly burdensome to require cooking top tests be conducted using that test method without further study to resolve those inconsistencies. *Id*. at 85 FR 50760.

DOE conducted two sets of round robin testing and published a notice of proposed rulemaking ("NOPR") on November 4, 2021, ("November 2021 NOPR"), at which time one set had been completed. The November 2021 NOPR proposed to re-

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[6] The EN 60350–2:2013 test method was based on the same test methods in the draft version of IEC 60350–2 Second Edition, at the time of publication of the final rule adopting EN 60350–2:2013. Based on comments received during the development of the draft, DOE stated in the December 2016 Final Rule that it expected the IEC procedure, once finalized, would retain the same basic test method as contained in EN 60350–2:2013, and incorporated EN 60350–2:2013 by reference in appendix I. 81 FR 91418, 91421 (Dec. 16, 2016).

[7] DOE later stated in the notice of proposed rulemaking published on November 4, 2021, that not all of the test results submitted by outside parties were from testing that followed all requirements of the DOE test procedure. 86 FR 60974, 60976.

establish a conventional cooking top test procedure. 86 FR 60974. DOE proposed to adopt the latest version of the relevant industry standard published by the International Electrotechnical Commission ("IEC"), Standard 60350–2 (Edition 2.0 2017-08), "Household electric cooking appliances—Part 2: Hobs – Methods for measuring performance" ("IEC 60350–2:2017"), with modifications. The modifications would adapt the test method to gas cooking tops, offer an optional method for burden reduction, normalize the energy use of each test cycle, include measurement of standby mode and off mode energy use, update certain test conditions, and clarify certain provisions. *Id*. The November 2021 NOPR also presented the results of an initial round robin test program initiated in January 2020 ("2020 Round Robin") to investigate further the water-heating approach and the concerns raised in the AHAM petition.[8] *Id*. at 86 FR 60979–60980. The comment period for the November 2021 NOPR was initially set to close on January 3, 2022. *Id*. at 86 FR 60974.

DOE published a notice of data availability ("NODA") on December 16, 2021, ("December 2021 NODA") in which DOE announced that it had published the results of a second round robin test program initiated in May 2021 ("2021 Round Robin") and extended the comment period for the November 2021 NOPR until January 18, 2022. 86 FR 71406. In response to a stakeholder request,[9] on January 18, 2022, DOE published a notice further extending the comment period until February 17, 2022. 87 FR 2559.

[8] The 2020 Round Robin was ongoing as of the August 2020 Final Rule.
[9] Request from AHAM (EERE-2021-BT-TP-0023-0007) available at *www.regulations.gov/comment/EERE-2021-BT-TP-0023-0007*.

DOE received comments in response to the November 2021 NOPR and the December 2021 NODA from the interested parties listed in Table I.1.

Table I.1 List of Commenters with Written Submissions in Response to the November 2021 NOPR and December 2021 NODA

Commenter(s)	Reference in this Final Rule	Document No. in Docket	Commenter Type
Anonymous	Anonymous	3	Individual
Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, Consumer Federation of America, National Consumer Law Center, and Natural Resources Defense Council	Joint Commenters	11	Efficiency Organizations
Association of Home Appliance Manufacturers	AHAM	12	Trade Association
The American Gas Association and the American Public Gas Association	Joint Gas Associations	18	Utility and Trade Association
Northwest Energy Efficiency Alliance	NEEA	15	Efficiency Organization
New York State Energy Research and Development Authority	NYSERDA	10	State Agency
Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison; collectively, the California Investor-Owned Utilities	CA IOUs	14	Utilities
Samsung Electronics America	Samsung	16	Manufacturer
UL LLC	UL	17	Certification Laboratory
Whirlpool Corporation	Whirlpool	13	Manufacturer

A parenthetical reference at the end of a comment quotation or paraphrase provides the location of the item in the public record.[10]

[10] The parenthetical reference provides a reference for information located in the docket of DOE's rulemaking to develop test procedures for conventional cooking tops. (Docket No. EERE-2021-BT-TP-0023, which is maintained at *www.regulations.gov*). The references are arranged as follows: (commenter name, comment docket ID number, page of that document). Some comment references are from different dockets than the one listed here, in that case, the parenthetical reference will include the docket number as well as the document ID number.

II. Synopsis of the Final Rule

In this final rule, DOE establishes a new test procedure at 10 CFR part 430, subpart B, appendix I1, "Uniform Test Method for the Measuring the Energy Consumption of Conventional Cooking Products." For use in appendix I1, DOE also amends 10 CFR part 430 to incorporate by reference IEC 60350–2 (Edition 2.1, 2021-05), "Household electric cooking appliances—Part 2: Hobs – Methods for measuring performance", the current version of the applicable industry standard. Appendix I1:

(1) Reduces the test burden and improves the repeatability and reproducibility[11] of testing conducted to IEC 60350–2:2021 by:

(a) Simplifying the test vessel selection process for electrical cooking tops;

(b) Modifying the room temperature, product temperature, and initial water temperature requirements;

(c) Providing criteria for determining the simmering setting during energy testing; and

(d) Normalizing the per-cycle energy use to account for the water temperature at the end of the simmering period;

(2) Applies IEC 60350–2:2021 to the measurement of gas cooking tops by including:

(a) Specifications for gas supply instrumentation and test conditions;

[11] Repeatability refers to test-to-test variability within a single laboratory, on a given unit. Reproducibility, which measures the ability to replicate the findings of others, refers to lab-to-lab variability, on a given unit.

(b) Test vessel selection based on nominal heat input rate;

(c) Adjustment methods and specifications for the maximum heat input rate; and

(d) Target power density for the optional potential simmering setting pre-selection test;

(3) Provides additional specifications, including:

(a) Definitions for operating modes, product configurations, test settings, test parameters, and instrumentation;

(b) Test conditions, including electrical supply characteristics and water load mass tolerance;

(c) Instructions for product installation according to product configuration; and

(d) Instructions for determining power settings for multi-ring cooking zones and cooking zones with infinite power settings and rotating knobs;

(4) Provides means for measuring cooking top annual energy use in standby mode and off mode by:

(a) Applying certain provisions from IEC 62301, "Household electrical appliances—Measurement of standby power", First Edition, 2005-06, and IEC 62301, "Household electrical appliances—Measurement of standby power", Edition 2.0 2011-01;

(b) Defining the number of hours spent in combined low-power mode; and

(c) Defining the allocation of combined low-power mode hours to the conventional cooking top component of a combined cooking product; and

(5) Defines the integrated annual energy use metric by specifying the representative water load mass and the number of annual cooking top cycles.

DOE is also adding calculations of annual energy consumption and estimated annual operating cost to 10 CFR 430.23(i) and renaming the test procedure at 10 CFR part 430, subpart B, appendix I to "Uniform Test Method for Measuring the Energy Consumption of Microwave Ovens."

Table II.1 summarizes DOE's modifications to the cooking top test procedure compared to the current industry test procedure, as well as the reasons for the provisions in new appendix I1. DOE's reorganization of appendix I is summarized in Table II.2.

Table II.1 Summary of Changes in the Newly Established Test Procedure for Conventional Cooking Products Relative to the Industry Test Procedure Incorporated by Reference

IEC 60350–2:2021 Test Procedure	Appendix I1 Test Procedure	Attribution
Addresses only electric cooking tops.	Addresses both electric and gas cooking tops, including new provisions specific to gas test conditions, instrumentation, and test conduct.	Include all covered cooking tops
Includes an incomplete list of definitions.	Includes definitions of operating modes, product configurations, test settings, test parameters, and specialty cooking zone.	Improve readability of test procedure
Installation instructions specify only that the cooking product is to be installed in accordance with manufacturer instructions.	Provides additional detail for the installation instructions, by product configuration, as well as definitions of those configurations.	Improve readability of test procedure
Does not include provisions for measuring standby mode and off mode energy.	Incorporates provisions of IEC 62301 (first and second editions) to measure standby mode and off mode power and calculate annual combined low-power mode energy.	EPCA requirement
Specifies a room and starting product temperature of 23 ± 2 degrees Celsius ("°C").	Specifies a room and starting product temperature of 25 ± 5 °C. Specifies that the temperature must be stable, defines stable temperature, and specifies how to measure the product temperature.	Decrease test burden
Specifies an initial water temperature of 15 ± 0.5 °C.	Specifies an initial water temperature of 25 ± 0.5 °C.	Decrease test burden

IEC 60350–2:2021 Test Procedure	Appendix I1 Test Procedure	Attribution
Specifies complex requirements for determining test vessel sizes for cooking tops with 4 or more cooking zones, requiring that the set of vessels comprise at least 3 of 4 defined cookware size categories.	Requires the use of the cookware that is closest in size to the heating element size, without consideration of cookware size categories.	Improve readability of test procedure and decrease test burden
Does not include a tolerance on the mass of the water load.	Specifies a 0.5 gram ("g") tolerance on the mass of the water load.	Improve repeatability and reproducibility
The measured energy consumption of the simmering period is not normalized to account for a final water temperature above the nominal 90 °C.	The energy consumption of the simmering period is normalized to represent a final water temperature of exactly 90 °C.	Improve representativeness of test results
Uses a 1000 g water load to normalize energy consumption.	Uses a 2853 g water load to normalize energy consumption.	Improve representativeness of test results
Does not calculate annual energy use.	Calculates annual energy use based on 418 cooking cycles per year and 31 minutes per cycle.	Provide a representative measure of annual energy consumption

Table II.2 Summary of Changes in the Amended Test Procedure for Microwave Ovens Relative to Existing Test Procedure

Existing DOE Test Procedure	Amended Test Procedure	Attribution
Appendix I title refers to all cooking products, but includes test procedures only for microwave ovens.	Appendix I title refers only to microwave ovens.	Improve readability of test procedure

DOE has determined that the new test procedure described in section III of this document and adopted in this final rule will produce measurements of energy use that are representative of an average use cycle and are not unduly burdensome to conduct. Discussion of DOE's actions are addressed in detail in section III of this document. Additionally, DOE provides estimates of the cost of testing for industry in section III.N of this document. DOE notes that there are currently no performance-based energy conservation standards prescribed for conventional cooking tops.

The effective date for the new test procedure adopted in this final rule is 30 days after publication of this document in the *Federal Register*. Manufacturers will not be required to conduct the test procedure until compliance is required with any future applicable standards that are established, unless manufacturers voluntarily choose to make representations as to the energy use or energy efficiency of a conventional cooking top. To the extent manufacturers make voluntary representations as to the energy use or energy efficiency of a conventional cooking top, representations of energy use or energy efficiency must be based on testing in accordance with the new test procedure beginning 180 days after the publication of this final rule.

III. Discussion

In this final rule, DOE establishes a new test procedure for conventional cooking tops in a new appendix I1, "Uniform Test Method for Measuring the Energy Consumption of Conventional Cooking Products." The test procedure is based primarily on an industry standard for measuring the energy consumption of electric cooking tops, IEC 60350–2:2021, with certain adjustments and clarifications, as discussed in the following sections of this document. Although IEC 60350–2:2021 applies only to electric cooking tops, the methodology is extended to gas cooking tops by means of additional instrumentation and test setup provisions.

DOE is also renaming existing appendix I to "Uniform Test Method for Measuring the Energy Consumption of Microwave Ovens" to clarify that it applies only to microwave ovens.

A. General Comments

Whirlpool supported AHAM's comments on the November 2021 NOPR. (Whirlpool, No. 13 at p. 2) The Joint Gas Associations agreed with the amendments that AHAM recommended in response to the November 2021 NOPR. (Joint Gas Associations, No. 18 at p. 2)

An anonymous commenter expressed general support for a new test procedure that creates a standardized measure of energy consumption of cooking products. (Anonymous Commenter, No. 3 at p. 1)

Samsung supported DOE's establishing energy conservation standards and considering applicable tolerances for certification and compliance for electric cooking tops, based on the round robin test results. (Samsung, No. 16 at p. 2) Samsung also encouraged DOE to move forward in finalizing the test procedure for electric cooking tops, stating that this could help advance ENERGY STAR recognition of induction cooking tops in the near future, which would also be important for significant potential decarbonization and electrification through induction cooking. (Samsung, No. 16 at p. 3)

NYSERDA commented that DOE should re-institute a test procedure for electric and gas cooking tops as soon as possible. (NYSERDA, No. 10 at p. 1) According to NYSERDA, the test procedure withdrawal was unsupported by DOE's test results and data, and has left a void in the market for products introduced since October 2019 that have not been subjected to test procedures and have been sold to consumers. (*Id.*)

NEEA expressed general support for the proposed test procedure. (NEEA, No. 15 at p. 1)

The CA IOUs supported re-adoption of a test procedure for cooking products and encouraged DOE to swiftly finalize this rulemaking, commenting that the proposed modifications to the test procedure would mitigate the repeatability, reproducibility, and representativeness concerns of the withdrawn test procedure while also reducing the testing burden. (CA IOUs, No. 14 at p. 1)

The Joint Commenters supported the test methods proposed in the November 2021 NOPR. They urged DOE to finalize the test procedures for cooking tops as soon as possible to allow the Department to develop standards that can deliver large energy savings. (Joint Commenters, No. 11 at p. 1)

The Joint Commenters also encouraged DOE to initiate work to develop a test procedure for conventional ovens, noting that there are no test procedures or performance-based standards in place for conventional ovens. (Joint Commenters, No. 11 at p. 4) The Joint Commenters stated that developing a test procedure for conventional ovens would allow DOE to set performance-based standards for conventional ovens, which could lead to significant energy savings. (*Id.*)

DOE notes that the scope of this rulemaking and of this final rule is limited to test procedures for cooking tops. The development of any potential test procedure for conventional ovens would be considered in a separate rulemaking.

The Joint Gas Associations commented that the proposed DOE test procedures for cooking tops do not appear to produce reliable and repeatable results. (Joint Gas Associations, No. 18 at p. 2) To remedy this, the Joint Gas Associations support the changes recommended by AHAM. (*Id.*)

AHAM commented that the proposed rule does not comply with the EPCA requirements at 42 U.S.C. 6293(b)(3) that new and amended test procedures produce accurate results that measure energy efficiency during a representative average use cycle or period of use and are not unduly burdensome to conduct. (AHAM, No. 12 at p. 2) AHAM also stated that the proposed rule does not comply with the Administrative Procedure Act requirement that a rule not be arbitrary and capricious. (*Id.*) AHAM further commented that the November 2021 NOPR lacks supporting data on the record other than in summary form and is not the detailed data necessary to assess DOE's proposal and support its conclusion that the proposed test procedure sufficiently addresses repeatability and reproducibility. (AHAM, No. 12 at pp. 5–6)

In evaluating whether the adopted test procedure is reasonably designed to produce test results which measure energy efficiency and energy use of conventional cooking tops, DOE relied, in part, on the data presented in the November 2021 NOPR and the December 2021 NODA. This final rule is supported by rigorous and substantive testing conducted over 6 months at four different testing laboratories that included both round robin testing and additional investigative testing. As discussed in the following sections, DOE has determined that the evaluated test data demonstrate that the test procedure is repeatable and reproducible for both electric and gas cooking tops (see discussion in section III.D.1 of this document). In this final rule, DOE determines that this test procedure is accurate and measures energy use during a representative average use cycle (see discussions in sections III.E.1, III.F.3, III.G.2, and III.K.1 of this document). DOE further determines in this final rule that the test procedure is not unduly burdensome (see section III.N of this document).

AHAM requested that DOE provide 180 days between the publication of the final test procedure and the end of the comment period on proposed energy conservation standards for conventional cooking products. (AHAM, No. 12 at p. 8) AHAM further requested that DOE not issue a proposed rule on standards until after publishing a notice of data availability or other subsequent document subject to notice and comment that provides updated test data from DOE's own testing, preferably including data from AHAM members' testing as well. (*Id*.)

AHAM commented that DOE could satisfy its commitment to rectify its missed statutory deadline by finalizing a rule not amending energy conservation standards for cooking products due to the lack of a test procedure, stating that doing so would allow DOE to separately finalize a test procedure and consider whether further amended standards are justified. (AHAM, No. 12 at p. 6) AHAM commented that EPCA requires DOE to review determinations not to amend energy conservation standards "not later than 3 years after" the determination, stating that 3 years at most would pass before DOE would revisit possible amended standards if it published a final rule not amending cooking product energy conservation standards. (*Id*.) AHAM commented that DOE could review standards at any time before that, should a test procedure be completed sooner, which AHAM asserted was likely. (*Id.*)

AHAM commented that it has convened a task force ("Task Force")[12] that has worked to develop an industry test method that would improve the repeatability and reproducibility of the test and to decrease what AHAM characterized as significant test burden. (AHAM, No. 12 at pp. 4–5) AHAM commented that its Task Force has worked to develop a test method that meets DOE's requirements under EPCA. (AHAM, No. 12 at p. 4) AHAM acknowledged that there are some improvements in the test procedure as proposed in the November 2021 NOPR, but stated that there are potential sources of variation that need to be resolved before DOE finalizes a cooking top test procedure. (AHAM, No. 12 at p. 5) AHAM noted that the determination to withdraw the cooking top test procedure was one of the rulemakings specified for review by December 31, 2021, under Executive Order 13990, "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." (*Id.*) AHAM requested that DOE allow AHAM to complete its data collection efforts and then proceed with this rulemaking according to the data, rather than continue to work in parallel to the Task Force. (*Id.*)

DOE based the test procedure proposed in the November 2021 NOPR on the then-current version of the Task Force draft procedure. In particular, DOE notes that the test procedure proposed in the November 2021 NOPR includes several revisions to IEC

[12] The AHAM cooking product task force includes AHAM member manufacturers, a representative of the Appliance Standard Awareness Project, and DOE staff and contractors. The first meeting of the Task Force was in January 2021. The Task Force has been developing test procedures for both electric and gas cooking tops.

60350–2 methodology suggested by Task Force members. One is the simplification of the test vessel selection for electric cooking tops (see section III.E.1 of this document). A second is the expanded ambient room temperature range (see section III.E.2.a of this document). A third is the updated initial water temperature (see section III.E.2.c of this document). A fourth is the use of a flow chart to determine the simmering setting (see section III.E.3 of this document). A fifth is the normalization of the per-cycle energy use based on the final water temperature (see section III.E.4 of this document). Generally, DOE has addressed concerns that AHAM has raised. These include the repeatability and reproducibility of the test procedure (see section III.D.1 of this document), the potential effects of test vessel warpage (see section III.H.3 of this document), and the test burden (see sections III.K.1 and III.N of this document).

DOE is finalizing this test procedure having determined that it meets the EPCA criteria that a test procedure be reasonably designed to produce test results which measure the energy use of a covered product during a representative average use cycle, without being unduly burdensome to conduct. DOE discusses in detail the adopted test procedure and addresses specific comments in the following sections.

B. Scope of Applicability

This rulemaking applies to conventional cooking tops, a category of cooking products which are household cooking appliances consisting of a horizontal surface containing one or more surface units that utilize a gas flame, electric resistance heating, or electric inductive heating. 10 CFR 430.2. A conventional cooking top includes any conventional cooking top component of a combined cooking product. *Id*.

As discussed in section I.A of this document, EPCA authorizes DOE to establish and amend test procedures for covered products (42 U.S.C. 6293(b)) and 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 replace 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. Cooking products 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. 10 CFR 430.2.

Certain 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. A combined cooking product that consists of multiple classes of cooking products is subject to multiple standards. Any established energy conservation standard applies to each individual component of such a combined cooking product. As determined in the December 2016 Final Rule, the cooking top test procedure applies to the individual conventional cooking top portion of a combined cooking product. *See* 81 FR 91418, 91423.

As discussed in the December 2016 Final Rule, DOE observed that for combined cooking products, the annual combined low-power mode energy consumption can be measured only for the combined cooking product, not for the individual components. 81 FR 91418, 91423. As discussed in section III.J.3 of this document, DOE is establishing similar methods to those adopted in the December 2016 Final Rule to calculate the integrated annual energy consumption of the conventional cooking top component separately. DOE's approach involves 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 of the combined cooking product.

C. Round Robin Test Results

In January 2020, DOE initiated the 2020 Round Robin test program to investigate further the repeatability and reproducibility of the water-heating approach in the then-current version of appendix I and to evaluate issues raised in the AHAM petition. DOE presented the results of the 2020 Round Robin in the November 2021 NOPR. 86 FR 60974, 60979. Four laboratories with experience testing cooking products tested a total of ten cooking tops—five electric units[13] and five gas units—according to the then-current version of appendix I. *Id*. Except as noted in the November 2021 NOPR, for

[13] Among the five electric cooking tops, two were induction technology, two were radiant technology, and one was electric resistance coil technology.

each unit tested, each laboratory conducted three complete tests (*i.e.*, three replications of the DOE test procedure)[14] to determine the annual energy consumption (excluding combined low-power mode energy), yielding a coefficient of variation ("COV")[15] that can be used to assess the repeatability[16] of results. *Id*. The averages between the laboratories were also compared to determine a COV of reproducibility.[17] *Id*.

The results from the 2020 Round Robin are summarized as follows. For electric cooking tops, the test results showed repeatability COVs ranging from 0.1 to 1.5 percent and reproducibility COVs ranging from 1.5 to 2.7 percent.[18] 86 FR 60974, 60980. For gas cooking tops, the test results showed repeatability COVs ranging from 0.3 to 3.7 percent and reproducibility COVs ranging from 4.0 to 8.9 percent. *Id*.

Following the August 2020 Final Rule, DOE initiated another round robin test program in response to changes to electric cooking tops on the market[19] and to evaluate variability in testing gas cooking tops. DOE presented the results of this 2021 Round

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[14] As detailed in the November 2021 NOPR, not all ten units were tested at all four participating laboratories. Table III.1 of the November 2021 NOPR details which units were tested at which laboratories. Further details regarding testing can be found in section III.K.3 of this document.

[15] COV is a statistical measure of the dispersion of data points around the mean. A lower COV indicates less variation in results.

[16] Repeatability refers to test-to-test variability within a single lab, on a given unit.

[17] Reproducibility refers to lab-to-lab variability, on a given unit.

[18] Among test laboratories identified in the November 2021 NOPR as "certified," reproducibility COVs ranged from 0.4 percent to 1.9 percent.

[19] On June 18, 2015, UL issued a revision to its safety standard for electric ranges—UL 858 "Household Electric Ranges Standard for Safety" ("UL 858")—that added a new performance requirement for electric-coil cooking tops intended to address unattended cooking. This revision had an effective date of April 4, 2019. Because the electric-coil cooking top in the 2020 Round Robin was purchased prior to that effective date, DOE could not be certain whether that test unit contained design features that would meet the performance specifications in revised version of UL 858. To address the lack of test data on electric-coil cooking tops that comply with the revised UL 858 safety standard, DOE included one electric-coil cooking top meeting the 2015 revision of UL 858 in the 2021 Round Robin. 86 FR 71406, 71407.

Robin in the December 2021 NODA. 86 FR 71406, 71407. Four laboratories[20] with recognized experience testing cooking products tested a total of five cooking top units—four gas cooking tops and one electric (resistance coil-type) cooking top that meets the most recent version of the relevant industry safety standard (*i.e.*, UL 858)—according to the test procedure proposed in the November 2021 NOPR.[21] For each unit tested, each laboratory conducted two complete tests (*i.e.*, two replications of the proposed test procedure) to determine the annual energy consumption (excluding combined low-power mode energy).

The results from the 2021 Round Robin are as follows. For the electric-coil cooking top, the results showed repeatability COVs ranging from 0.3 to 0.5 percent (compared to a range of 0.4 to 0.7 percent from the 2020 Round Robin) and a reproducibility COV of 2.4 percent (compared to 2.7 percent from the 2020 Round Robin). 86 FR 60974, 60980 and 86 FR 71406, 71407.[22] For the gas cooking tops, the test results showed repeatability COVs ranging from 0.004 to 1.7 percent (compared to a range of 0.3 to 3.7 percent from the 2020 Round Robin) and reproducibility COVs ranging from 3.3 to 5.3 percent (compared to a range of 4.0 to 8.9 percent from the 2020 Round Robin). *Id*. at 86 FR 71407–71408.

[20] Three of the test laboratories which participated in the 2020 Round Robin also participated in the 2021 Round Robin.
[21] As detailed in the December 2021 NODA, not all five units were tested at all four participating laboratories. The data tables accompanying the December 2021 NODA detail which units were tested at which laboratories.
[22] See also the table of results for the 2021 Round Robin available at *www.regulations.gov/document/EERE-2021-BT-TP-0023-0004*.

In response to the November 2021 NOPR and December 2021 NODA, AHAM commented that DOE had not provided sufficient data. In particular, AHAM asserted the data DOE provided was insufficient to support its analysis or to allow commenters to fully understand, interpret, or analyze the proposed test procedure and provide meaningful comment. (AHAM, No. 12 at p. 6) AHAM commented that DOE's failure to fully disclose its data in this rulemaking would be a mistake and urged DOE to provide complete disclosure and time for comment. (*Id.*) AHAM requested that DOE provide its full, raw data on the record for stakeholder review, not just high-level results. (AHAM, No. 12 at p. 7) AHAM stated that the data summaries provided by DOE were helpful but do not provide the ability to understand what occurred during testing or to conduct an independent review of the data. (*Id.*) AHAM commented that without second-by-second data from DOE, it is unable to fully evaluate DOE's results and provide meaningful comments. (*Id.*) AHAM commented that it is collecting data to evaluate DOE's proposed test procedure and hopes to provide the investigative test data in detail to supplement comments on the test procedure. (*Id.*)

The CA IOUs commented that they also plan to test electric and gas cooking tops to further evaluate the proposed test procedure's repeatability, reproducibility, and representativeness. (CA IOUs, No. 14 at p. 9) The CA IOUs commented that they will share the results of this testing as it is completed. (*Id.*)

The CA IOUs commented that the 2021 Round Robin results highlight the efficacy of the amendments proposed by DOE in the November 2021 NOPR in improving repeatability and reproducibility of the cooking top test procedure. (CA IOUs, No. 14 at p. 2) The CA IOUs commented that in comparison to the 10-percent uncertainty allowance for repeatability in other test methodologies such as the American Society for Testing and Materials ("ASTM") test methods used in the ENERGY STAR program, the revised DOE test methodology has shown exceptional repeatability and reproducibility results. (*Id*.) The CA IOUs supported the improvements made to the test method, stating that the test procedure constitutes a reasonable, repeatable and reproducible method. (*Id*.)

NYSERDA commented that DOE's proposal effectively addresses any concerns with the prior procedure, stating that the modifications proposed in the November 2021 NOPR reduce the variability in repeatability and reproducibility as compared to the previous test procedure. (NYSERDA, No. 10 at p. 2)

Samsung supported DOE's efforts after the previously withdrawn test procedure to further develop the test procedure for conventional cooking tops to address concerns expressed by stakeholders to improve repeatability and reproducibility and to reduce test burden. (Samsung, No. 16 at p. 2) Samsung commented that the repeatability and reproducibility COV values for electric and gas cooking tops based on the 2021 Round Robin significantly mitigate the repeatability and reproducibility concerns raised previously. (*Id*.)

AHAM expressed its long-held position that any COV greater than 2 percent for the reproducibility of testing cooking top energy use from laboratory to laboratory is unacceptable. (AHAM, No. 12 at p. 8) AHAM asserted that, while it appreciates DOE's efforts to reduce variation, those efforts have not reduced variation enough and that the reproducibility COVs presented in DOE's data are still too high. (*Id*.) AHAM commented that DOE's data show that the variation in gas cooking top testing is not similar to the variation in electric cooking top testing, and asserted that more work is necessary before DOE can proceed with the test procedure. (AHAM, No. 12 at pp. 8–9) According to AHAM, the industry insists on more narrow reproducibility than was measured during the 2021 Round Robin, stating that a higher COV is likely to increase the risk of potential non-compliance (*e.g.*, where a certifying body finds a unit's performance to be acceptable, but verification testing identifies potential non-compliance). (*Id*.) AHAM urged DOE to allow the Task Force to complete its test plan and to consider its test results in this rulemaking. (AHAM, No. 12 at p. 9) AHAM commented that it hopes the testing will be completed by September 2022. (AHAM, No. 12 at p. 10).

DOE notes that in addition to the extensive test data made public as part of the November 2021 NOPR and the December 2021 NODA, DOE has also posted to the rulemaking docket the detailed test reports upon which the summary tables presented in the December 2021 NODA were based, in response to AHAM's request that DOE provide its full, raw data.[23] These data and test reports represent testing of cooking tops from multiple manufacturers, across all available technologies, at multiple testing laboratories. The breadth of products represented in DOE's data set, together with the data and test reports published to the rulemaking docket, provide the foundation for the

[23] Available at *www.regulations.gov/docket/EERE-2021-BT-TP-0023/document*, items number 19, 20, 21, and 22.

conclusions presented in the discussion that follows. DOE welcomes any additional data that AHAM, the CA IOUs, or any other stakeholder is able to share, and DOE will consider any such data as part of the ongoing energy conservation standards rulemaking.

DOE is required to establish test procedures that are reasonably designed to produce test results which measure energy efficiency and energy use of covered products, including conventional cooking tops, during a representative average use cycle or period of use, as determined by the Secretary, and that are not unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) DOE seeks improved repeatability and reproducibility of a test procedure (as measured by a decrease in the COVs), which has two potential benefits related to this obligation. First, representativeness potentially improves because there is more certainty that the measured results reflect representative use of the product under test. Second, test burden potentially decreases, because fewer test replications may be necessary to obtain certainty in the results.

Regarding AHAM's comment that the results of the gas cooking top testing do not demonstrate similar variation to the electric cooking top testing, DOE acknowledges the generally higher reproducibility COVs for gas cooking tops as compared to electric cooking tops and that in the 2021 Round Robin the reproducibility COV of 5.3 percent for one of the gas cooking tops was higher than the reproducibility COVs of the three other gas cooking tops (3.3, 3.6, and 3.6 percent). However, these differences reflect the inherent differences between electric and gas cooking tops. In particular, a gas cooking top's performance variability is greater than that of an electric cooking top due to inherent factors that do not affect electric products. These include variation in the gas composition, air flow mix, or other components of the combustion system. In effect, a certain amount of variation in test results for a gas cooking top is expected; this variation reflects actual variation in performance of the product. The test procedure is capturing variation in the product's actual performance, not demonstrating a lack of repeatability and reproducibility in the test procedure.

DOE has determined that the 2021 Round Robin test results demonstrate that the representativeness of the test procedure proposed in the November 2021 NOPR and finalized in this final rule for gas cooking tops (see discussion of gas-specific provisions in section III.F of this document) is not negatively impacted by repeatability and reproducibility concerns. In particular, the test procedure proposed in the November 2021 NOPR demonstrates significantly improved repeatability and reproducibility compared to the testing methodology used for the 2020 Round Robin. As discussed, the repeatability COVs for the 2021 Round Robin for gas cooking tops ranged from 0.004 to 1.7 percent (compared to a range of 0.3 to 3.7 percent from the 2020 Round Robin) and reproducibility COVs ranged from 3.3 to 5.3 percent (compared to a range of 4.0 to 8.9 percent from the 2020 Round Robin).

DOE has also determined that the 2020 Round Robin and 2021 Round Robin test results demonstrate that the representativeness of DOE's test procedure for electric cooking tops is not negatively impacted by repeatability and reproducibility concerns. The 2021 Round Robin test results demonstrate specifically that these findings hold true for electric coil-type products that meet the revised UL 858 safety standard. As discussed, the repeatability COVs for coil-type electric cooking tops ranged from 0.3 to 0.5 percent and the reproducibility COV was 2.4 percent.

There are changes that potentially could further improve repeatability and reproducibility. These include narrower tolerances on testing conditions and greater accuracy on instrumentation. However, such increased stringencies would likely increase the testing burden and could make it more difficult to conduct a valid test.

For gas cooking tops, tighter tolerances on gas specifications than those proposed in the November 2021 NOPR[24] could decrease variability. 86 FR 60974, 60987. However, as explained below, this would not be feasible because test laboratories may not have control over the higher heating value of their gas supply if they do not choose to use bottled gas with a certified gross heating value.

DOE research suggests that third-party laboratories use either municipal line natural gas or bottled natural gas for their natural-gas-fired combustion testing. Either source may have a higher heating value that varies from the nominal 1,025 Btu per standard cubic foot for natural gas specified in the November 2021 NOPR. The Environmental Protection Agency suggests the typical range is 950–1,050 Btu per standard cubic foot.[25] The higher heating value will depend on the specific mix of gases in the natural gas line, which is a function of the origin of the natural gas. Because test

[24] The gas specifications proposed in the November 2021 NOPR only required an approximate higher heating value of 1,025 British thermal units ("Btu") per standard cubic foot when testing with natural gas or an approximate higher heating value of 2,500 Btu per standard cubic foot when testing with propane.
[25] *www.epa.gov/sites/default/files/2020-09/documents/1.4_natural_gas_combustion.pdf.*

laboratories do not have control over the line gas's heating value, specifying a tolerance on the natural gas heating value would not be feasible.

One way to minimize higher heating value variability from test-to-test and from lab-to-lab is to specify reference gases to be very pure (*i.e.*, over 99% methane). However, requiring the use of methane would impose burdens on test laboratories. Methane is substantially more costly per cubic foot than natural gas[26] and would require a dedicated bottled gas supply. Test laboratories currently using municipal line gas would need to make significant investments, such as purchasing gas bottle storage cabinets and controllers for flammable gases. For test laboratories currently using bottled natural gas for other gas-fired appliances (*e.g.*, clothes dryers, water heaters, furnaces), requiring the use of methane for testing cooking tops would create additional logistical burden, because they would need to keep track of multiple kinds of gas bottles.

In summary, DOE has determined that any potential improvement in repeatability and reproducibility of the test procedure that could be achieved by requiring the use of pure methane would be outweighed by the additional cost and burden that would be imposed on test laboratories, and therefore requiring the use of pure methane would be unduly burdensome.

[26] DOE research found typical prices of bottled methane with purity of 99.0 percent or greater, intended for laboratory usage, ranging from approximately $0.50 to $1.50 per cubic foot of methane, depending on cylinder size and purity. Methane, with a gross heating value of 1,011 Btu/ft^3, is the primary constituent of natural gas and is thus typically used for testing products designed to operate with natural gas. In contrast, the U.S. Energy Information Administration's U.S. monthly commercial price of natural gas for January 2022 was $9.76 per thousand cubic feet, or $0.00976 per cubic foot. (See *www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm.*) Therefore, the cost of bottled methane for a testing laboratory would be roughly 50–150 times that of natural gas from a municipal line.

Other alternatives suggested by AHAM would significantly affect the test procedure's representativeness (as discussed in section III.K.1 of this document).

In this final rule, DOE determines that the test procedure established in this final rule is reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a cooking top during a representative average use cycle and is not unduly burdensome to conduct.

D. Incorporation by Reference of IEC 60350–2:2021 for Measuring Energy Consumption

1. Water-Heating Test Methodology

In the November 2021 NOPR, DOE proposed to create a new appendix I1 that would generally adopt the test procedure in IEC 60350–2:2017, which is an industry test procedure that measures the energy consumption of a cooking top using a water-heating method. 86 FR 60974, 60979. In the IEC 60350–2:2017 test method (and the updated IEC 60350–2:2021 test method), each heating element is tested individually by heating a specified water load in a standardized test vessel at the maximum power setting until the temperature of the water, including any overshoot after reducing the input power, reaches 90 °C (*i.e.*, the "heat-up period").[27] At that time, the power is reduced to a lower setting so that the water temperature remains as close to 90 °C as possible, without dropping below that temperature threshold, for a 20-minute period (*i.e.*, the "simmering period").[28] Energy consumption is measured over the entire duration of the initial heat-up period and 20-minute simmering period, which together comprise the Energy Test Cycle for that

[27] See discussion of the turndown temperature in sections III.D.2.a and III.G.5 of this document.
[28] See discussion of the simmering period in section III.E.3 of this document.

heating element. The energy consumption for each heating element is normalized by the weight of the tested water load and averaged among all tested heating elements to obtain an average energy consumption value for the cooking top, as discussed in section III.J.1 of this document.

The approach DOE proposed in the November 2021 NOPR for new appendix I1, IEC 60350–2:2017 (on which the November 2021 NOPR was based), and IEC 60350–2:2021 (on which this final rule is based) are all similar to the approach used in the earlier DOE test procedure as established in the December 2016 Final Rule, which incorporated certain provisions from EN 60350–2:2013. *Id*. A more detailed comparison of IEC 60350–2:2021, IEC 60350–2:2017 and EN 60350–2:2013 is provided in section III.D.2 of this document.

In the November 2021 NOPR, DOE proposed to use a water-heating method, based primarily on IEC 60350–2:2017, to measure cooking top energy consumption, but with modifications to extend the test methodology to gas cooking tops and to reduce the variability of test results, as discussed in sections III.D.2.d through III.G of this document. 86 FR 60974, 60980.

UL supported DOE's efforts to review and update the test procedure for cooking products and of DOE leveraging existing procedures such as IEC 60350–2:2017. (UL, No. 17 at p. 1)

Samsung supported the proposed test procedure for cooking tops based on the IEC water-heating test methodology. (Samsung, No. 16 at p. 2)

AHAM generally agreed with DOE's proposed determination to rely on a water boiling test. (AHAM, No. 12 at p. 3)

For the reasons discussed in November 2021 NOPR, DOE is finalizing its proposal to use a water-heating method, based primarily on the most recent IEC test procedure, to measure cooking top energy consumption.

2. Differences between IEC 60350–2:2021 and Previous Versions

After the publication of the December 2016 Final Rule, which was based on EN 60350–2:2013, IEC issued IEC 60350–2:2017. In comparison to EN 60350–2:2013, IEC 60350–2:2017 included additional informative methodology for significantly reducing testing burden during the determination of the simmering setting.

As mentioned previously, since the publication of the November 2021 NOPR, IEC has issued an updated test standard, IEC 60350–2:2021. This updated version retains substantively the same provisions for the water-heating methodology evaluated in the November 2021 NOPR, except as addressed in the following sections.

In this final rule, DOE incorporates certain provisions of IEC 60350–2:2021 for measuring the energy consumption of cooking tops. DOE further adopts certain modifications and clarifications to the referenced sections of IEC 60350–2:2021, as discussed in sections III.D.2.d, 0, III.G, III.H, and III.I of this document.

a. Temperature-Averaging

DOE proposed in the November 2021 NOPR to add a definition of "smoothened water temperature" to section 1 of new appendix I1, which would specify that the averaged values be rounded to the nearest 0.1 °C, in accordance with the resolution requirements of IEC 60350–2:2017. 86 FR 60974, 60982. DOE also proposed to define smoothened water temperature as "the 40-second moving-average temperature as calculated in Section 7.5.4.1 of IEC 60350–2:2017, rounded to the nearest 0.1 degree Celsius." *Id*.

DOE requested comment on its proposed definition of smoothened water temperature as well as its proposal to require the smoothened water temperature be rounded to the nearest 0.1 °C. *Id*.

The CA IOUs commented that using a 40-second moving average for determining temperatures is a key change proposed in the November 2021 NOPR to increase repeatability of the test procedure. (CA IOUs, No. 14 at pp. 1–2)

NEEA agreed with implementing a 40-second moving average to smoothen the temperature curve, stating that this addresses natural temperature oscillation. (NEEA, No. 15 at p. 2)

For the reasons discussed, DOE is finalizing a definition for smoothened water temperature consistent with the November 2021 NOPR, changing the referenced test procedure to IEC 60350–2:2021.

In the December 2016 Final Rule, DOE discussed that the water temperature may occasionally oscillate slightly above and below 90 °C due to minor fluctuations (*i.e.*, "noise") in the temperature measurement. 81 FR 91418, 91430. As DOE further discussed in the November 2021 NOPR, these temperature oscillations may cause difficulty in determining when the 20-minute simmering period starts after the water temperature first reaches 90 °C. 86 FR 60974, 60981. EN 60350–2:2013 did not contain provisions that addressed temperature oscillations. In contrast, IEC 60350–2:2017 introduced (and IEC 60350–2:2021 maintained) the use of "smoothened" temperature measurements to minimize the effect of minor temperature oscillations in determining the water temperature.

In the November 2021 NOPR, DOE evaluated the impact of implementing "smoothened" water temperature averaging on two aspects of the test procedure: (1) validating that the water temperature at which the power setting is reduced during the simmering test[29] (*i.e.*, the "turndown temperature")[30] was within a certain defined

[29] DOE uses the term "simmering test" to refer to the test cycle that includes a heat-up period and a simmering period. DOE uses this term to distinguish it from the "overshoot test" which refers to the test used to calculate the turndown temperature (see section III.G.5 of this document).
[30] See section III.G.5 of this document for a definition and further discussion of turndown temperature.

tolerance; and (2) the determination of the start of the 20-minute simmering period. 86 FR 60974, 60981.

Regarding validation of the turndown temperature, Section 7.5.2.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 provides a methodology for conducting a preliminary test (the "overshoot test") to determine the water temperature at which the power setting will be reduced to the "simmering setting" during the subsequent simmering test (*i.e.*, the "target" turndown temperature).[31] Section 7.5.3 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies that while conducting the simmering test, the water temperature when the power setting is reduced (*i.e.*, the "measured" turndown temperature) must be recorded. Section 7.5.4.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 provides a methodology for validating that the measured turndown temperature was within a tolerance of + 1 °C/ – 0.5 °C of the target turndown temperature. Section 7.5.4.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 requires that this validation be performed based on the smoothened water temperature (as described previously) rather than using the instantaneous measured water temperature.

In the November 2021 NOPR, DOE presented test data suggesting that using the smoothened water temperature measurement, rather than the instantaneous water temperature measurement, to validate the measured turndown temperature could introduce unnecessary test burden. That test burden resulted from invalidating test cycles that otherwise would have been valid if the instantaneous water temperature

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[31] See section III.G.5 of this document for a definition and further discussion of target turndown temperature.

measurement had been used instead (as was previously required by EN 60350–2:2013). 86 FR 60974, 60981. The potential for this to occur is highest for cooking top types that have particularly fast water temperature response times to changes in input power; *e.g.*, electric-smooth radiant and induction types. *Id*. On such products, the rate at which the water temperature rises begins to quickly decrease (*i.e.*, the temperature rise "flattens" out) within a few seconds after the power setting is turned down to the simmering setting. *Id*. For such products, the smoothened turndown temperature can be a few degrees lower than the instantaneous turndown temperature because the smoothened water temperature calculation incorporates 20 seconds of forward-looking data into the average, during which time the temperature curve is flattening out. *Id*. This can result in a measured turndown temperature that is within the allowable tolerance of the target turndown temperature based on the instantaneous water temperature, but below the allowable tolerance when determined based on the smoothened average method (and thus invalid according to Section 7.5.4.1 of both IEC 60350–2:2017 and IEC 60350–2:2021). *Id*. On such products, using the instantaneous water temperature, rather than the smoothened water temperature, would provide a more accurate and representative validation that the measured turndown temperature was within the specified tolerance of the target turndown temperature. *Id*.

In the November 2021 NOPR, DOE tentatively determined that the requirement in IEC 60350–2:2017[32] to use the smoothened water temperature measurement, rather than the instantaneous water temperature measurement, to validate the measured

[32] IEC 60350–2:2021 contains the same requirement.

turndown temperature may be unduly burdensome, particularly for electric-smooth radiant and induction cooking tops. *Id*. at 86 FR 60982. Therefore, in the November 2021 NOPR, DOE proposed that new appendix I1require using the instantaneous water temperature measurement (rather than the smoothened water temperature measurement) to validate that the measured turndown temperature was within + 1 °C/ – 0.5 °C of the target turndown temperature. *Id*.

DOE requested comment on its proposal to require that the instantaneous, rather than the smoothened, turndown[33] temperature be within +1 °C/ –0.5 °C of the target turndown temperature. *Id*. DOE did not receive any comments regarding this proposal.

For the reasons discussed, DOE determines that the provision to use the smoothened water temperature measurement to validate the measured turndown temperature may be unduly burdensome, particularly for electric-smooth radiant and induction cooking tops. Therefore, DOE finalizes its proposal, consistent with the November 2021 NOPR, to require that the instantaneous turndown temperature be within +1 °C/ –0.5 °C of the target turndown temperature.

Regarding the determination of the start of the 20-minute simmering period,[34] in the November 2021 NOPR, DOE analyzed approaches for determining the start of the simmering period that account for water temperature fluctuations. 86 FR 60974, 60982. Section 7.5.3 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies that the start of

[33] See section III.G.5 of this document for comments pertaining to the definition of turndown temperature.
[34] As discussed in section III.E.3 of this document, the start of the 20-minute simmering period is when the smoothened water temperature is greater than or equal to 90 °C.

the 20-minute simmering period is when the water temperature first meets or exceeds 90 °C. By contrast, the version of appendix I as finalized in the December 2016 Final Rule, which used instantaneous water temperatures, allowed for a brief "grace period" after the water temperature initially reached 90 °C. In that grace period, temperature fluctuations below 90 °C for up to 20 seconds were permitted without changing the determination of whether the power setting under test met the requirements for a simmering setting. As part of the November 2021 NOPR analysis, DOE analyzed test data from the 2020 Round Robin. DOE observed that for each simmering setting under test, the smoothened water temperature did not drop below 90 °C after the initial time it reached that temperature. In other words, when using the smoothened water temperature approach described in Section 7.5.4.1 of IEC 60350–2:2017, none of the test cycles that had required a "grace period" when evaluated according to the test procedure finalized in the December 2016 Final Rule had smoothened water temperatures below 90 °C after the start of the simmering period. *Id*. Accordingly, in the November 2021 NOPR, DOE proposed to determine the start of the simmering period as defined in Sections 7.5.3 and 7.5.4.1 of IEC 60350–2:2017, using the smoothened water temperature and without any "grace period." *Id*. DOE tentatively concluded in the November 2021 NOPR that a grace period is unnecessary when relying on smoothened water temperature. DOE also tentatively concluded such a provision could cause confusion regarding the start time of the 20-minute simmering period, which in turn could reduce repeatability and reproducibility of the test procedure. *Id*.

DOE requested comment on its proposal to include the requirement to evaluate the start of the simmering period as the time that the 40-second "smoothened" average water temperature first meets or exceeds 90 °C. *Id*. DOE did not receive any comments regarding this proposal.

For the reasons discussed, DOE is finalizing, consistent with the November 2021 NOPR, the requirement to evaluate the start of the simmering period as the time that the 40-second "smoothened" average water temperature first meets or exceeds 90 °C.

b. Water Hardness

Section 7.1.Z6.1 of EN 60350–2:2013, and Section 7.6 of both IEC 60350–2:2017 and IEC 60350–2:2021, specify that the test water shall be potable. Section 7.5.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 further state that distilled water may be used to avoid lime sediment. DOE tentatively determined in the November 2021 NOPR that the use of distilled water would not significantly affect the energy use of the cooking top in comparison to test results that would be obtained using water with a hardness within potable limits.[35] 86 FR 60974, 60982. This was based on DOE's 2020 Round Robin test results that showed high reproducibility among the test laboratories with different water supplies that were not subject to specific tolerances on water hardness. *Id*. DOE also tentatively determined in the November 2021 NOPR that a reduction in lime sediment

[35] While the U.S. Environmental Protection Agency ("EPA") does not regulate the water hardness of drinking water, EPA has established non-mandatory Secondary Drinking Water Standards that provide limits on contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. These secondary standards specify a maximum limit of 500 milligrams/liter of total dissolved solids. The table of secondary standards is available at: *www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals#table*.

could extend the lifetime of the test vessels. *Id*. Therefore, DOE proposed in the November 2021 NOPR to allow the use of distilled water in new appendix I1. *Id*.

DOE requested comment on its proposal to allow the use of distilled water for testing in the new appendix I1. *Id*. DOE did not receive any comments regarding this proposal.

For the reasons discussed, DOE determines that the use of distilled water would not significantly affect the measured energy use of a cooking top in comparison to test results that would be obtained using water with a hardness within potable limits. DOE therefore finalizes its proposal, consistent with the November 2021 NOPR, to allow the use of distilled water for testing in new appendix I1.

c. Cooking Top Preparation

Section 7.1.Z6.1 of EN 60350–2:2013 specifies that before the energy consumption measurement is conducted, the cooking top must be operated for at least 10 minutes to ensure that residual water in the components is vaporized. (Residual water may accumulate in the components during the manufacturing process, shipping, or storage of a unit.) In the past, DOE received questions from test laboratories on how frequently this cooking top pre-test preparation should be conducted. 86 FR 60974, 60982. Section 7.5.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 include a similar requirement and clarify that this vaporization process need only be run once per tested unit. In the November 2021 NOPR, DOE proposed to require that the vaporization process need only be run once per tested unit by adopting the provision in IEC 60350–

2:2017 in new appendix I1. This was based on DOE's preliminary determination that conducting the vaporization process once would be sufficient to eliminate residual water. *Id*.

DOE requested comment on its proposal to include the cooking top preparation requirements for water vaporization from IEC 60350–2:2017[36] in its new appendix I1. *Id*. DOE did not receive any comments regarding this proposal.

For the reasons discussed, DOE has determined that conducting the vaporization process once is sufficient to eliminate residual water. Therefore, consistent with the November 2021 NOPR, DOE is including the cooking top preparation requirements for water vaporization in new appendix I1, changing the referenced test procedure to IEC 60350–2:2021.

d. Optional Potential Simmering Setting Pre-Selection Test

As discussed, DOE is adopting the water-heating methodology in IEC 60350–2:2021. This method requires the evaluation of an Energy Test Cycle, which consists of measuring energy consumption during an initial heat-up period and a subsequent 20-minute simmering period. Conducting the IEC 60350–2:2021 test method requires determining the simmering setting through repeated test cycles, each with a successively higher input power setting after turndown, starting with the lowest input setting. This

[36] IEC 60350–2:2021 contains an identical provision.

methodology can require a laboratory to conduct numerous test cycles before identifying the one in which the simmering period criteria are met.

A draft version of IEC 60350–2:2021 included a new Annex H ("draft Annex H"), which provided an informative and optional test method for determining the potential simmering setting (*i.e.*, the first setting used to conduct a simmering test in order to determine the simmering setting). Draft Annex H, available at the time of the November 2021 NOPR, stated that, for electric cooking tops, empirical test data show that the power density of the minimum-above-threshold power setting (*i.e.*, simmering setting) is close to 0.8 watts per square centimeter ("W/cm^2").[37] The method in draft Annex H provided a means to determine which power setting is closest to the target power density, and thus to more easily identify the first power setting that may be used for determining which power setting will be used for the Energy Test Cycle.

In response to manufacturer concerns regarding the test burden of IEC 60350–2:2017, DOE proposed in the November 2021 NOPR to include provisions in its new appendix I1 that mirrored the language of draft Annex H, with certain modifications to further reduce test burden. 86 FR 60974, 60985. DOE stated that in its testing experience, using this "pre-selection test" can significantly reduce the test burden of determining the simmering setting for the Energy Test Cycle. *Id*. Although this would represent an additional procedure, DOE stated that the overall testing time for a cooking top may be substantially shorter because performing the potential simmering setting pre-

[37] The power density is defined as the average wattage of the power setting over a 10-minute period divided by the area of the cookware bottom.

selection test can reduce the number of simmering test cycles necessary to determine the Energy Test Cycle from as many as 12 to as few as two.[38] *Id*.

In the November 2021 NOPR DOE proposed an approach consistent with that of draft Annex H. During the potential simmering setting pre-selection test, the power density measurement would need to be repeated for each successively higher power setting until the measured power density exceeds the specified threshold power density. *Id*. The potential simmering setting would be one of the last two power settings tested (*i.e.*, the last one that results in a power density below the threshold and the first one that results in a power density above the threshold. Whichever setting produces a power density closest to the threshold value would be the potential simmering setting. *Id*. The closest power density may be higher or lower than the applicable threshold value. *Id*.

In the November 2021 NOPR, DOE also proposed a modification from draft Annex H to further reduce test burden while achieving the same end result as the procedure specified in draft Annex H. *Id*. at 86 FR 61008. As discussed, the objective of the pre-selection test is to determine which power setting is closest to providing the target power density of 0.8 W/cm^2. Draft Annex H specified a starting water temperature of 20 ± 5 °C for the optional pre-selection test; however, the temperature of the water does not affect the power density of a particular power setting. The two parameters used to determine the power density are a measurement of the surface area of the bottom of the

[38] The potential simmering setting pre-selection tests takes 10 minutes per power setting tested (with no cooldown required between each test), whereas testing each setting as described in IEC 60350–2:2017 takes between 1 and 1.5 hours per power setting tested (including cooldown time between each test).

test vessel and the electrical energy consumption during the 10-minute test. The temperature of the water in the test vessel does not affect either of these measured values. Therefore, to reduce the test burden of the simmer setting pre-selection test, as part of its proposal DOE did not specify a water temperature condition for the start of the pre-selection test[39] *Id*.

In the November 2021 NOPR, DOE further proposed to make the potential simmering setting pre-selection test optional. *Id*. at 86 FR 60985. DOE proposed that if the tester has prior knowledge of the unit's operation and has previously determined through a different method which power setting is the potential simmering setting, the tester may use that setting as the initial power setting for the test cycles. *Id*. Irrespective of the method used for determining the potential simmering setting, a valid test confirms whether the power setting under test meets the requirements of an Energy Test Cycle (see section III.E.3 of this document). *Id*. If a tester decides to use a different method to select the potential simmering setting, and chooses an incorrect power setting, the tester may then be required to conduct additional simmering tests to find the power setting that meets the requirements of an Energy Test Cycle. *Id*.

DOE requested comment on its proposal to include the optional potential simmering setting pre-selection test in new appendix I1. *Id*. DOE also requested comment on its proposal, if a tester has prior knowledge of the unit's operation and has

[39] See section III.F.5 of this document for a discussion of how this provision was extended to apply to gas cooking tops.

previously determined a potential simmering setting through a different method, to allow the tester to use that as the initial power setting for the test cycles. *Id*.

The Joint Commenters supported DOE's proposal to include an optional simmering setting pre-selection test for both electric and gas cooking top test procedures. (Joint Commenters, No. 11 at p. 3)

The CA IOUs noted that the simmer setting preselection method and test modifications that reduce the need for possible retests will decrease test duration. (CA IOUs, No. 14 at p. 2) The CA IOUs supported DOE's efforts to reduce testing burden by shortening test duration from 36 to 17.5 hours while still maintaining a representative test procedure. (*Id*.)

For the reasons discussed, DOE finalizes its proposal from the November 2021 NOPR to include an optional potential simmering setting pre-selection test in new appendix I1 that mirrors the methodology specified in Annex H of IEC 60350–2:2021,[40] with modifications as proposed and discussed above to further reduce test burden. DOE also finalizes its proposal from the November 2021 NOPR that if the tester has prior knowledge of the unit's operation and has previously determined through a different method which power setting is the potential simmering setting, the tester may use that setting as the initial power setting for the test cycles.

[40] The methodology specified in Annex H of IEC 60350–2:2021 is the same as the methodology specified in draft Annex H.

E. Modifications to IEC 60350–2:2021 Methodology to Reduce Testing Burden

1. Test Vessel Selection for Electric Cooking Tops

Section 5.6.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies a set of standardized cylindrical test vessels and respective lids of varying diameters, measured in millimeters ("mm"), that must be used for conducting the cooking top energy consumption tests. Table 3 in Section 5.6.1.5 of both IEC 60350–2:2017 and IEC 60350–2:2021 defines four "standardized cookware categories"[41] that are used to group test vessels by diameter range.

Sections 6.3 and 7.3 of IEC 60350–2:2017 and IEC 60350–2:2021 specify a procedure to select the set of test vessels necessary to test an electric cooking top, based on if a cooking zone[42] or a cooking area[43] is being tested. The process requires determining the number of cooking zones based on the number of controls that can be operated independently at the same time. For cooking zones, a tester selects the test vessel based on the cooking zone dimension. To find the cooking zone dimension, the tester measures the marked area on the surface of the cooking top, irrespective of the size of the heating element. For circular cooking zones, the outermost diameter is used; for non-circular cooking zones, the shorter side or the minor axis is used. The tester then

[41] The four categories are defined as A, B, C, and D. The vessel diameters associated with each category are as follows: Category A: 120 mm and 150 mm; Category B: 180 mm; Category C: 210 mm and 240 mm; and Category D: 270 mm, 300 mm, and 330 mm.

[42] DOE defines a cooking zone in section 1 of new appendix I1 as a part of a conventional cooking top surface that is either a single electric resistance heating element, 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.

[43] DOE defines a cooking area in section 1 of new appendix I1 as 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 may or may not include limitative markings.

matches the cooking zone dimension to the outer diameter of a corresponding test vessel, using Table 3 in Section 5.6.1.5 of both IEC 60350–2:2017 and IEC 60350–2:2021, and makes an initial selection of the corresponding test vessel. For cooking areas, Annex A of both IEC 60350–2:2017 and IEC 60350–2:2021 defines the set of test vessels to use for testing all of the cooking zones on the cooking top, based on the number of cooking zones (*i.e.*, the number of independent controls) within the cooking area.

There are additional requirements for selecting the set of test vessels used for testing a cooking top. Both IEC 60350–2:2017 and IEC 60350–2:2021 specify in Table 4 of Section 7.3 that for electric cooking tops with four or more controls, the set of test vessels used to test the cooking top must comprise at least three of the standardized cookware categories. If the initially selected test vessel set does not meet this criterion, a substitution must be made using the next best-fitting test vessel from one of the other standardized cookware categories. If a selected test vessel size is out of the range of the sizes allowed by the user manual, the closest compatible diameter is to be used.

In the November 2021 NOPR, DOE tentatively determined through a market survey of electric cooking tops that the typical difference in diameter between the initial test vessel selection and the substituted test vessel is less than 30 mm. This suggests that the energy consumption will not substantially differ compared to using the test vessel whose diameter is closest to the heating element diameter. In addition, any corresponding difference in measured energy consumption for the entire cooking top will be even more minimal. 86 FR 60974, 60983. Through testing conducted in support of the December 2016 Final Rule, DOE also observed that in some tests, electric cooking tops were tested with the wrong set of test vessels. *Id*. DOE attributes this to the complex test vessel selection process.

In the November 2021 NOPR, DOE proposed to require much simpler test vessel selection criteria for new appendix I1 to reduce the burden of implementing the test vessel selection procedure and thereby improve test procedure reproducibility. *Id*. Specifically, DOE proposed to require that for electric cooking tops with limitative markings, each cooking zone be tested with the test vessel that most closely matches the outer diameter of the marking, from among the test vessels defined in Table 3 in Section 5.6.1.5 of IEC 60350–2:2017. *Id*. For electric cooking tops without limitative markings, DOE proposed to use Table A.1 in Annex A of IEC 60350–2:2017 to determine the set of test vessels required, because without those markings, it is not possible to match the test vessel diameter to the marking's diameter. *Id*. DOE also proposed to exclude the provisions from Section 7.3 of IEC 60350–2:2017 in new appendix I1 to ensure that these approaches are properly implemented. *Id*. If a selected test vessel cannot be centered on the cooking zone due to interference with a structural component of the cooking top (for example, a raised outer border), DOE proposed to require using the test vessel with the largest diameter that can be centered on the cooking zone. *Id*. This process of vessel selection would reflect the expected consumer practice of matching cookware to the size of a heating element (*i.e.*, cookware is placed on the heating element that is the closest in size to the cookware). *Id*.

DOE requested comment on its proposal to update the test vessel selection procedure. Again, for electric cooking tops with limitative markings, the proposal excludes the provisions from Section 7.3 of IEC 60350–2:2017 and instead requires that each cooking zone be tested with the test vessel that most closely matches the outer diameter of the marking. For electric cooking tops without limitative markings, DOE proposed that Table A.1 of Annex A of IEC 60350–2:2017 be used to define the test vessels. *Id*. DOE also requested comment on its proposal for when a structural component of the cooking top interferes with the test vessel to substitute the largest test vessel that can be centered on the cooking zone. *Id*.

NYSERDA supported DOE's effort to simplify the test vessel selection process to ensure repeatability and reproducibility. (NYSERDA, No. 10 at p. 2)

The Joint Commenters agreed with the proposed test vessels and test vessel selection method for electric cooking tops. (Joint Commenters, No. 11 at p. 2) The Joint Commenters asserted that DOE's proposal to exclude the provisions from Section 7.3 of IEC 60350–2:2017 and to simplify the test vessel selection criteria for electric cooking tops are reasonable methods for selecting test vessels. (*Id*.) The Joint Commenters stated that these proposals would improve reproducibility while simplifying the test vessel selection process for manufacturers. (*Id*.) The Joint Commenters encouraged DOE to investigate methods for testing non-circular cooking zones to fully encapsulate the energy consumption of all cooking zones in the test procedure.[44] (*Id*.)

[44] See further discussion of the definition of specialty cooking zones in section III.G.4 of this document.

The CA IOUs commented on differences between the vessel selection methods depending on the fuel type of the cooktop. They noted that the electric cooking top test vessel selection criteria contain upper and lower bounds, but the gas cooking top test vessel criteria do not.[45] (CA IOUs, No. 14 at p. 4) The CA IOUs stated that while they are unaware of existing electric cooking tops with heating elements outside of the included scope of diameters (*i.e.*, between 100 – 330 mm), they do not see any reason that heating elements less than 100 mm or larger than 330 mm should be excluded. (*Id.*) The CA IOUs urged DOE to eliminate the lower and upper bounds of the electric test vessel selection criteria, stating that this would keep the electric and gas cooking top scopes consistent in terms of not excluding products purely based on their size or power rating. (*Id.*)

In response to the CA IOUs' comment comparing the scope of electric and gas cooking tops, DOE notes that in general, gas burners are able to be effectively used with a wider range of pot sizes than electric heating elements. An electric resistance heating element, can only provide effective heat transfer to the area of a pot in direct contact or line of sight with the element because the primary mechanism of heat transfer to the pot is through conduction (*i.e.*, surface contact) or radiation. As such, the range of pot diameters that can be effectively used on an electric resistive heating element is limited by the diameter of the element. Conversely, for a gas burner, the flames are able to provide effective heat transfer to a wide range of pot sizes (and in particular, pots with a diameter substantially larger than the burner) because the primary mechanism of heat

[45] See further comments from the CA IOUs regarding gas cooking top test vessel selection criteria in section III.F.3 of this document.

transfer to the pot is through convection (*i.e.*, the movement of hot air around the base of the pot). As such, the diameter of a gas burner does not limit the range of pot diameters that can be effectively used. For these reasons, DOE has determined that it is appropriate for the test vessel selection table to define an upper bound for electric heating elements but not for gas burners.

Regarding the lower bound defined for electric cooking tops, DOE notes that a heating element on an electric cooking top with a diameter smaller than 100 mm (3.9 inches) would likely not be able to heat water to 90 °C. As such, it would likely be excluded from testing because it would be a specialty cooking zone (*e.g.*, a warming plate or zone).

For the reasons discussed, DOE finalizes its test vessel selection proposal from the November 2021 NOPR. Again, on an electric cooking top, tests must use the test vessels according to Table 3 of Section 5.6.1.5 of IEC 60350–2:2021 and, if a structural component of the cooking top interferes with the test vessel, substitute the largest test vessel that can be centered on the cooking zone. DOE further specifies that if a structural component of the cooking top interferes with the test vessel such that a test vessel's *lid* cannot be centered on the test vessel due to interference with a structural component of the cooking top, the instruction to substitute the largest test vessel that can be centered on the cooking zone applies.

In the November 2021 NOPR, DOE proposed different instructions for determining test vessel selection in the preamble and regulatory text for cooking areas with limitative markings that differed from the instructions for cooking areas without limitative markings. The preamble was correct; the proposed regulatory text was incorrect. As discussed previously in this section, for cooking areas (regardless of limitative markings), Annex A of both IEC 60350–2:2017 and IEC 60350–2:2021 defines the set of test vessels to be used for testing based on the number of cooking zones (*i.e.*, the number of independent controls) within the cooking area. As indicated by the discussion in section III.C.1 of the preamble to the November 2021 NOPR, DOE intended to propose the same test vessel selection requirements as specified in IEC 60350–2:2017; *i.e.*, to use Annex A of IEC 60350–2:2017 to determine the correct test vessel for testing cooking areas with or without limitative markings.[46] 86 FR 60974, 60983. Although the preamble stated Annex A, the regulatory text for cooking areas with limitative markings incorrectly proposed to use Table 3 in Section 5.6.1.5 of IEC 60350–2:2017. That section corresponds instead to the instructions for circular "cooking zones." *Id*. at 86 FR 61009. In this final rule, DOE corrects this error and specifies that for all cooking areas, the test vessel section is based on the number of cooking zones and as specified in Annex A of IEC 60350–2:2021.

There was another error in the regulatory text as proposed in the November 2021 NOPR. It incorrectly implied that all cooking zones are circular, by requiring measuring their diameter. *Id*. For a non-circular cooking zone, measuring a "diameter" would not be appropriate, since "diameter" is a dimension limited to a circle. In this final rule, DOE

[46] The only intended difference between the proposed appendix I1 and IEC 60350–2:2017 was the removal of the "categories" requirement in Section 7.3 of IEC 60350–2:2017.

provides instructions for measuring the size of a non-circular cooking zone[47] and selecting the appropriate test vessel, consistent with the language in Section 7.3 of IEC 60350–2:2021. DOE also specifies how to determine the cooking zone size. For circular cooking zones, use the outer diameter of the printed marking, and for non-circular cooking zones, use the measurement of the shorter (*i.e.*, minor) axis.

As part of the 2021 Round Robin, DOE learned that some technicians are uncertain about how to measure the size of an open coil heating element, because open coils are not perfect circles.[48] Indeed, the approach to measure the size of a heating element depends on whether a technician considers the open coil heating elements as circular. If so, the largest diameter would be used to determine the appropriate test vessel, according to Section 6.3.2 of IEC 60350–2:2021. If not, a technician uses the short axis of the ellipse ("the minor dimension") to determine the appropriate test vessel, according to Sections 6.3.2 and 7.3 of IEC 60350–2:2021. DOE understands that industry practice is to use the largest diameter of an open coil heating element, as presented in Figure 60A.2 of UL 858. In this final rule, DOE clarifies that open coil heating elements are to be treated as circular, and that the largest diameter is used to

[47] DOE makes a distinction between non-circular cooking zones designed for use with any type of cookware (which are discussed in this section), and cooking zones designed for use only with non-circular cookware (which are considered specialty cooking zones, as discussed in section III.G.4 of this document).
[48] As an example of this lack of clarity, one of the test laboratories in the 2021 Round Robin measured a diameter 3mm smaller than the other two laboratories on one heating element size of one cooking top. As a result, the test laboratories used different test vessel sizes. DOE cannot confirm the source of this difference. However, based on an inspection of the coil heating element in question, it is DOE's understanding that one laboratory measured the diameter as the smallest width of the coil, and the other two laboratories measured the diameter as the largest width of the coil, perpendicular to the first laboratory's measurement.

determine the appropriate test vessel and incorporates an illustration similar to Figure 60A.2 of UL 858.

2. Temperature Specifications

a. Room Temperature

Section 5.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies an ambient room temperature of 23 ± 2 °C for testing. DOE stated in the November 2021 NOPR that it was aware that conducting energy testing on cooking tops in the same conditioned space that safety testing is conducted could significantly reduce testing burden, based on discussions with cooking top manufacturers as part of the Task Force. 86 FR 60974, 60983. Section 40 of UL 858, a relevant safety standard for cooking tops, requires a room temperature of 25 ± 5 °C for certain safety testing that manufacturers are likely conducting.

The IEC ambient room temperature specifications (23 ± 2 °C) are within the range allowed by UL 858 (25 ± 5 °C). DOE stated in the November 2021 NOPR that it did not expect that the slightly different nominal value and larger tolerance on the ambient room temperature (corresponding to the range allowed by UL 858) would significantly impact the measured cooking top energy consumption. *Id*. This was based on DOE's understanding of the primary heat transfer mechanisms to the water load. Those mechanisms are conduction to the test vessel for electric-coil cooking tops; radiation for electric-smooth cooking tops other than induction type; joule heating in the test vessel itself by induced eddy currents for electric-smooth induction cooking tops; and convective heat transfer from the flames and conduction from the grates for gas cooking tops. DOE tentatively determined in the November 2021 NOPR that expanding the ambient temperature tolerance to match that used for safety testing (*i.e.*, 25 ± 5 °C) would be warranted and would not impact repeatability or reproducibility of the test procedure, due to this relatively minimal impact on testing results and the potential for significant reduction in test burden on manufacturers. *Id*. Manufacturers in the Task Force raised concerns that test laboratories could consistently test at the extremes of the temperature tolerances. To address those concerns, DOE proposed in the November 2021 NOPR to specify that the target ambient room temperature is the nominal midpoint of the temperature range. *Id*. DOE proposed to specify in new appendix I1 an ambient room temperature of 25 ± 5 °C, with a target temperature of 25 °C. *Id*.

DOE requested comment on its proposal to specify an ambient room temperature of 25 ± 5 °C. *Id*.

The Joint Commenters supported a target ambient room temperature specification of 25 °C, but expressed concern that it may not prevent test laboratories from testing at extremes of the ± 5 °C tolerance, which they stated could potentially affect reproducibility. (Joint Commenters, No. 11 at p. 2) The Joint Commenters encouraged DOE to consider providing instructions on how to best reach the target temperature or more specificity around what it means to target the midpoint of the temperature range. (*Id*.)

NEEA commented that DOE should set a more rigorous ambient temperature specification during the active mode test, stating that an ambient temperature specification of 25 ± 5 °C is too wide to ensure repeatability. (NEEA, No. 15 at p. 1) NEEA commented that specifying a target ambient temperature of 25 °C may not prevent tests from being conducted at the extremes of that range, and that it is unclear whether the differences in applying the current methodology at 20 °C and 30 °C are insignificant. (*Id*.) According to NEEA, an ambient temperature tolerance such as ± 3 °C should not prove overly burdensome for testing, stating that ASTM food service standards typically have a ± 5 degrees Fahrenheit ("°F") tolerance on ambient temperature. (*Id*.)

The CA IOUs commented that there is no requirement to maintain the ambient temperature close to the "target" value of 25 °C. (CA IOUs, No. 14 at p. 7) The CA IOUs suggested that DOE include an additional requirement that the average ambient temperature throughout the test remain within 25 ± 2 °C to provide consistency with the target temperature and to improve repeatability and reproducibility. (*Id*.) The CA IOUs commented that this specification would be in addition to the 25 ± 5 °C maximum and minimum ambient temperature requirements. (*Id*.)

AHAM agreed with DOE's proposal to maintain an ambient room air temperature of 25 ± 5 °C with a target temperature of 25 °C AHAM stated that it is consistent with the U.S. safety standard for electric cooking tops, UL 858, and that this provision would reduce test burden and allow manufacturers to use existing laboratories for testing to the DOE test procedure. (AHAM, No. 12 at p. 12)

DOE's 2021 Round Robin testing was conducted in accordance with the ambient room air temperature specification of 25 ± 5 °C, as proposed in the November 2021

NOPR. As discussed, it produced repeatable and reproducible results. DOE further notes that testing for the 2021 Round Robin was conducted in facilities that also perform safety testing requiring ambient room air temperatures of 25 ± 5 °C, such as the UL 858 standard. Reducing the allowable range for the ambient room air temperature or adding a secondary tolerance to the average ambient room air temperature would add undue burden to the cooking top test procedure depending on the laboratory's equipment. Based on the foregoing discussion, DOE determines that an ambient room temperature specification of 25 ± 5 °C provides repeatable and reproducible results without being unduly burdensome.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to specify an ambient room temperature of 25 ± 5 °C in new appendix I1.

b. Product Starting Temperature

Section 5.5 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies that the conventional cooking top unit under test must be at the laboratory's ambient temperature at the beginning of each test. To assist in reducing the temperature from a prior test, forced cooling may be used. This provision ensures a repeatable starting temperature of the cooking top before testing. If a cooking top is warmer or colder than the ambient temperature, it would consume a different amount of energy during testing than one that is at the ambient temperature. Section 5.5 of both IEC 60350–2:2017 and IEC 60350–2:2021, however, does not specify how to measure the temperature of the product before each test.

In the November 2021 NOPR, DOE proposed to require that the product temperature must be stable, DOE also proposed to define that as "a temperature that does not vary by more than 1 °C over a 5-minute period." 86 FR 60974, 60984. DOE also proposed to bar using forced cooling during the period of time used to assess temperature stability. *Id*.

DOE further proposed to specify where to measure the temperature of the product. *Id*. Before any active mode testing, the product temperature would be measured at the center of the cooking zone under test. Before the standby mode and off mode power test,[49] the product temperature would be measured as the average of the temperature measured at the center of each cooking zone. *Id*.

DOE requested comments on its proposal to require that the product temperature be stable, its proposed definition of a stable temperature, and its proposed methods for measuring the product temperature for active mode testing as well as standby mode and off mode power testing. *Id*.

The CA IOUs commented that specifying the initial starting temperature of the cooking zone is a key change that would increase repeatability of the test procedure. (CA IOUs, No. 14 at pp. 1–2)

[49] See section III.I of this document for discussion of the standby mode and off mode power test.

The Joint Commenters supported DOE's proposal to require that the product temperature not vary by more than 1 °C over a 5-minute period. (Joint Commenters, No. 11 at p. 2)

For the reasons discussed, DOE finalizes its proposal to require that the product temperature be stable, its proposed definition of a stable temperature, and its proposed methods for measuring the product temperature for active mode testing as well as standby mode and off mode power testing.

c. Initial Water Temperature

Section 7.5.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies an initial water temperature of 15 ± 0.5 °C, and that the test vessel must not be stored in a refrigerator to avoid the rims getting "too cold." As part of conversations within the Task Force in which DOE has participated, manufacturers expressed concerns regarding the test burden of maintaining a supply of water for test loads that is colder than the ambient temperature, especially when the test vessels cannot be placed in a refrigerator before testing. 86 FR 60974, 60984.

As discussed, DOE is specifying an ambient room temperature of 25 ± 5 °C. In the November 2021 NOPR, DOE stated that it expects that using an initial nominal water temperature of 25 °C, rather than the IEC-specified 15 °C, would not impact the repeatability and reproducibility of the test procedure. *Id*. Furthermore, DOE stated that it expects that an initial nominal water temperature of 25 °C may more accurately represent an average temperature of food or water loads with which consumers would fill their cookware before starting to cook. *Id*. DOE surmised that consumers would be expected to fill cookware not only with refrigerated foods or water from the cold water supply (*i.e.*, food and water loads at 15 °C or lower), but also with water from the hot water supply and food items at room temperature (*i.e.*, food and water loads at 25 °C or higher). *Id*.

DOE also tentatively determined in the November 2021 NOPR that, although a different initial nominal water temperature would be appropriate, it is critical to maintain the tolerance of ± 0.5 °C on the initial water temperature as specified by IEC 60350–2:2017 so that the energy consumption during the initial heat-up phase to 90 °C is repeatable and reproducible. *Id*.

In summary, in the November 2021 NOPR, DOE proposed to specify in new appendix I1 that the water must have an initial temperature of 25 ± 0.5 °C. *Id*. DOE requested comment on this proposal. *Id*.

The CA IOUs and Joint Comments supported the proposed initial water temperature specifications to minimize variability when testing. (CA IOUs, No. 14 at pp. 1–2; Joint Commenters, No. 11 at p. 2)

AHAM commented that it tentatively believes that the proposed initial water temperature of 25 ± 0.5 °C tolerance is too small and creates excessive test burden. (AHAM, No. 12 at p. 12) AHAM is collecting data on potentially expanding the water temperature tolerance to ±1 °C, and stated that DOE should consider its results before publishing a final rule. (*Id.*) AHAM asserted that it is not feasible for a tester to maintain the proposed tolerance, as water temperature can rise above the tolerance between the time when the water is brought to the appliance and when the test is started. (*Id.*)

While DOE has not yet received any data from AHAM on this issue, DOE encourages AHAM to send any data when it becomes available. DOE notes that the 2021 Round Robin, which DOE has concluded resulted in repeatable and reproducible results, used a ± 0.5 °C tolerance on the initial water temperature, as proposed in the November 2021 NOPR. DOE is not aware of any of the test laboratories that participated in the 2021 Round Robin having had any difficulty maintaining the ± 0.5 °C tolerance on the initial water temperature. In DOE's experience, the alignment of the nominal ambient temperature and of the nominal initial water temperature at 25 °C, has reduced the burden associated with the ± 0.5 °C tolerance on the initial water temperature, as compared to the specification in both IEC 60350–2:2017 and IEC 60350–2:2021. For example, in DOE's experience, if the ambient temperature is maintained at the nominal value of 25 °C and the test vessel is kept in the test room and not placed on a cooking zone that is turned on, the water in the test vessel will remain within the required 25 ± 0.5 °C for 10–30 minutes. For these reasons, DOE determines that maintaining a tolerance of ± 0.5 °C on the initial water temperature is not unduly burdensome.

Furthermore, DOE confirms its tentative determination from the November 2021 NOPR that it is critical to maintain the tolerance of ± 0.5 °C on the initial water temperature as specified by IEC 60350-2:2017 so that the energy consumption during the initial heat-up phase to 90 °C is repeatable and reproducible. DOE also confirms its tentative determination from the November 2021 NOPR that it would not be feasible to normalize the measured energy consumption to reflect different starting water temperatures due to the non-linearity of the water temperature curve during the initial portion of the test. A wider initial water temperature tolerance of ±1 °C, as suggested by AHAM, would reduce the repeatability and reproducibility of the test procedure and would seemingly contradict AHAM's comment that DOE's efforts to reduce variation have not reduced variation enough for certain parts of the test procedure (see section III.C of this document).

For the reasons discussed, DOE finalizes its proposal from the November 2021 NOPR to specify an initial water temperature of 25 ± 0.5 °C.

3. Determination of the Simmering Setting

IEC 60350–2:2021 adds a clause to Section 7.5.4.1 of IEC 60350–2:2017 stating that if the smoothened water temperature is below 90 °C during the simmering period, the energy consumption measurement shall be repeated with an increased power setting. The new clause also adds that if the smoothened water temperature is above 91 °C during the simmering period, the test cycle is repeated using the next lower power setting and checked to ensure that the lowest possible power setting that remains above 90 °C is identified for the Energy Test Cycle. In the November 2021 NOPR, DOE stated that it infers from this new clause that if the smoothened water temperature does not drop below 90 °C or rise above 91 °C during the simmering period, no additional testing is needed. 86 FR 60974, 60985. This new clause provides clarity as to what setting is "as close to

90 °C as possible," as required in Section 7.5.2.2 of IEC 60350–2:2017, and therefore improves the reproducibility of the simmering setting determination.

In the November 2021 NOPR, DOE proposed two power setting definitions. First, the "maximum-below-threshold power setting" would be "the power setting on a conventional cooking top that is the highest power setting that results in smoothened water temperature data that does not meet the evaluation criteria specified in Section 7.5.4.1 of IEC 60350–2:2017." Second, the "minimum-above-threshold power setting" would be "the power setting on a conventional cooking top that is the lowest power setting that results in smoothened water temperature data that meet the evaluation criteria specified in Section 7.5.4.1 of IEC 60350–2:2017. This power setting is also referred to as the simmering setting." *Id*.

DOE also proposed to include a flow chart (see Figure III.1) in new appendix I1 that would require identifying the maximum-below-threshold power setting and the minimum-above-threshold power setting (or the simmering setting) from any valid[50] simmering test conducted according to Section 7.5.2 of IEC 60350–2:2017, as follows:

1) If the smoothened temperature does not exceed 91 °C or drop below 90 °C at any time in the 20-minute period following t_{90},[51] the power setting

[50] DOE defines a valid simmering test as one for which the test conditions in section 2 of appendix I1 are met and the measured turndown temperature, Tc, is within – 0.5 °C and + 1 °C of the target turndown temperature. 86 FR 60974, 60985. See section III.G.5 of this document for definitions of turndown temperature and target turndown temperature.

[51] In the November 2021 NOPR, DOE defined t_{90} in this context as the start of the simmering period and as the time at which the smoothened water temperature first meets or exceeds 90 °C. *Id*. at 86 FR 60986.

under test is considered to be the simmering setting, and no further evaluation or testing is required. The test is considered the Energy Test Cycle.

2) If the smoothened temperature exceeds 91 °C and does not drop below 90 °C at any time in the 20-minute period following t_{90}, the power setting under test is considered to be above the threshold power setting. The simmering test is repeated using the next lower power setting, after allowing the product temperature to return to ambient conditions, until two consecutive power settings have been determined to be above the threshold power setting and below the threshold power setting, respectively. These power settings are considered to be the minimum-above-threshold power setting and the maximum-below-threshold power setting, respectively. The energy consumption representative of an Energy Test Cycle is calculated based on an interpolation of the energy use of both of these cycles, as discussed in section III.E.4 of this document.

3) If the smoothened temperature drops below 90 °C at any time in the 20-minute period following t_{90}, the power setting under test is considered to be below the threshold power setting. The simmering test is repeated using the next higher power setting, after allowing the product temperature to return to ambient conditions, until two consecutive power settings have been determined to be above the threshold power setting and below the threshold power setting, respectively. These power settings are considered

to be the minimum-above-threshold power setting and the maximum-below-threshold power setting, respectively. The energy consumption representative of an Energy Test Cycle is calculated based on an interpolation of the energy use of both of these cycles, as discussed in section III.E.4 of this document. 86 FR 60974, 60985–60986.

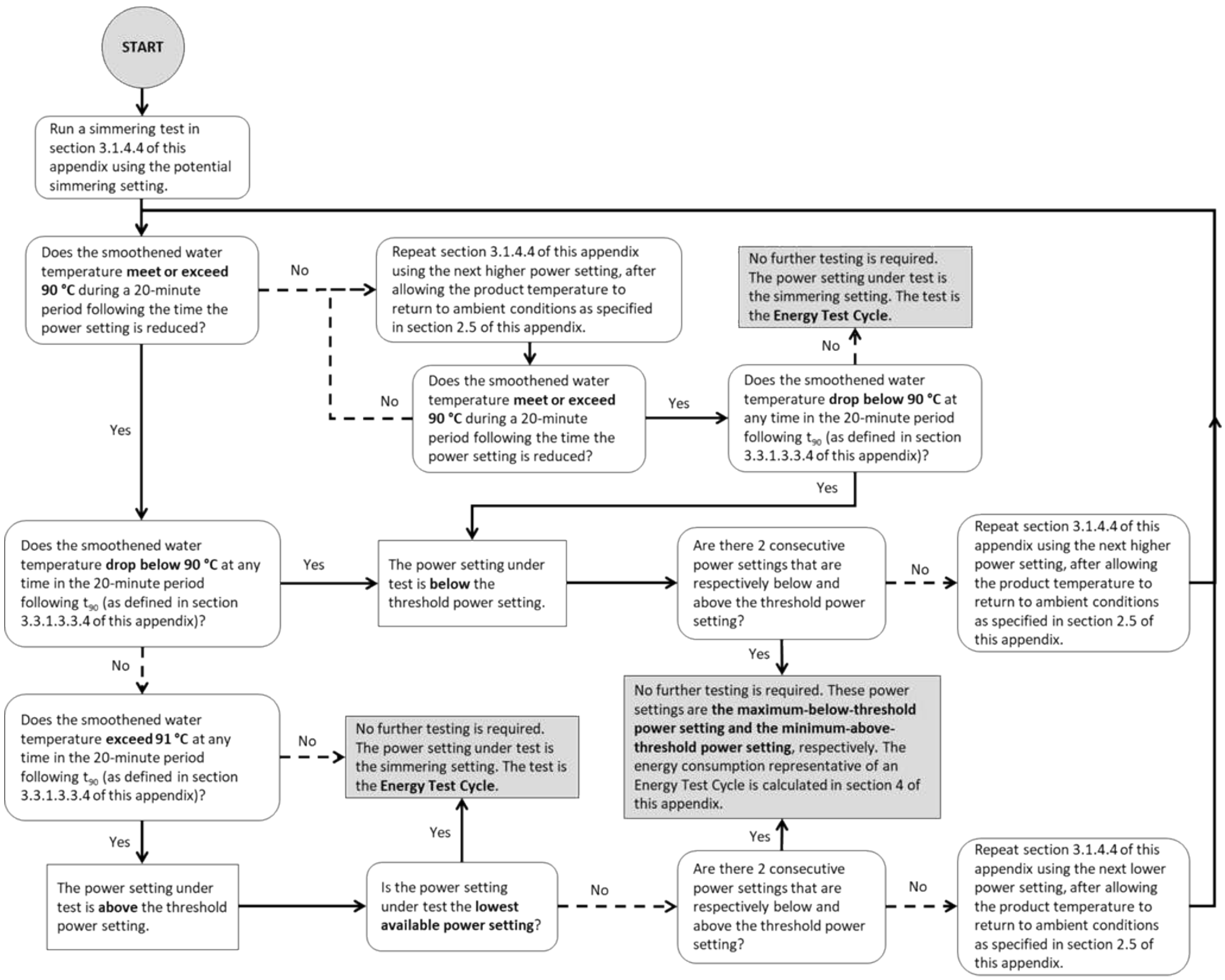

Figure III.1 Flow Chart Proposed in the November 2021 NOPR on Evaluating the Simmering Test

DOE requested comment on its proposed definitions of the minimum-above-threshold power setting and the maximum-below-threshold power setting, and on its proposed methodology for determining the simmering setting. *Id*. at 86 FR 60986.

NYSERDA supported the proposal to clarify which setting is as close to 90 °C as possible for the simmering period to ensure repeatability and reproducibility. (NYSERDA, No. 10 at p. 2)

The CA IOUs appreciated the flow chart in Figure 3.1.4.5 of the November 2021 NOPR that specifies the simmering test process. (CA IOUs, No. 14 at p. 8)

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed definitions of the minimum-above-threshold power setting and maximum-below-threshold power setting.[52] Within these finalized definitions, DOE references IEC 60350–2:2021 rather than IEC 60350–2:2017, noting that the definitions are the same in each version. DOE also finalizes, consistent with the November 2021 NOPR, its proposed methodology for determining the simmering setting.

To provide additional clarity to the test procedure, in this final rule DOE is moving the definitions of certain terms from section 3 of appendix I1 (as proposed in the November 2021 NOPR) to section 1 of appendix I1. These terms include: the turndown temperature (Tc), the target turndown temperature (Tc_{target}), the simmering period, and

[52] In the finalized definition of maximum-below-power threshold power setting, the phrase “data that does not meet” is changed to “data that do not meet” to mirror the phrasing used in the definition of minimum-above-threshold power setting.

the time t_{90} (the start of the simmering period).[53] In appendix I1, DOE is defining the time t_{90} as "the first instant during the simmering test for each cooking zone where the smoothened water temperature is greater than or equal to 90 °C," consistent with the definition in section 3.3.1.3.3.4, as proposed in the November 2021 NOPR. In appendix I1, DOE is also defining the simmering period for each cooking zone as "the 20-minute period during the simmering test starting at time t_{90}," consistent with the definition in section 3.3.1.3.3.5, as proposed in the November 2021 NOPR. DOE is also simplifying the language of sections 3.1.4.5, 3.3.1.3.3, 3.3.1.3.3.3, 3.3.1.3.3.4, and 3.3.1.3.3.5 of appendix I1, to reflect the inclusion of these definitions in section 1 of appendix I1, by removing redundant phrases.

DOE also finalizes the use of a flow chart in Figure 3.1.4.5 of appendix I1 that describes how to evaluate the simmering setting, similar to the one proposed in the November 2021 NOPR. The flow chart in Figure 3.1.4.5 of appendix I1 in this final rule uses updated formatting to standardize the shape of the boxes, to provide additional arrows where clarity on the sequence of actions was needed, and to replace the gray background of certain text boxes with a bolded border to increase legibility. The new flow chart in Figure 3.1.4.5 of appendix I1 also uses streamlined language to reflect the new definition of simmering period and of turndown temperature, and to use more direct questions. For example, the text "Does the smoothened water temperature drop below 90 °C at any time in the 20-minute period following t_{90} (as defined in section 3.3.1.3.3.4 of this appendix)?" is replaced with simpler text that conveys the same question using the

[53] See section III.G.5 of this document for the definitions of the turndown temperature (T_c) and the target turndown temperature (Tc_{target}).

wording "Is the smoothened water temperature ≤ 90 °C at any time during the simmering period?"

4. Normalizing Per-Cycle Energy Use for the Final Water Temperature

As discussed in section III.E.3 of this document, the test conduct can conclude with either one or two cycles. A single Energy Test Cycle in which the smoothened water temperature during the simmering period remains between 90 °C and 91 °C is one possibility. Otherwise, a pair of cycles designated as the minimum-above-threshold cycle and the maximum-below-threshold cycle is identified. In the minimum-above-threshold cycle, as defined above, the smoothened water temperature remains at or above 90 °C for the entire 20-minute simmering period, and the smoothened water temperature exceeds 91 °C for at least one second of the simmering period. Conversely, in the maximum-below-threshold cycle, as defined above, the smoothened water temperature does not remain at or above 90 °C during the entire 20-minute simmering period, and the smoothened water temperature drops below 90 °C for at least one second of the simmering period. In both IEC 60350–2:2017 and IEC 60350–2:2021, the energy use of a cooking zone is calculated based on such a minimum-above-threshold cycle, regardless of the amount by which the smoothened water temperature exceeds 90 °C during the simmering period.

In conversations as part of the Task Force in which DOE has participated, some manufacturers expressed concerns that a test cycle with a water temperature at the end of the simmering period (*i.e.*, a "final water temperature") that is above 91 °C may not be comparable to a test cycle with a final water temperature that is closer to 90 °C. The higher the final temperatures, the greater the risk; there is no limit on how far above 91 °C the final water temperature may be (as long as the setting is the minimum-above-threshold cycle). 86 FR 60974, 60986. In addition, this concern is particularly relevant to cooking tops with a small number of discrete power settings that result in relatively large differences in final water temperature between each setting. *Id*. In addition, for cooking tops with continuous (*i.e.*, infinite) power settings, repeatably identifying the minimum-above-threshold cycle is particularly challenging.[54] *Id*.

To reduce test burden for cooking tops with infinite power settings, and to provide comparable energy use for all cooking tops including those with discrete power settings, in the November 2021 NOPR, DOE proposed to normalize the energy use of the minimum-above-threshold cycle to represent an Energy Test Cycle with a final water temperature of exactly 90 °C. DOE proposed using an interpolation of the energy use of the maximum-below-threshold cycle and the respective final smoothened water temperatures. *Id*. For test cycles for which the smoothened water temperature during the simmering period does not exceed 91 °C, DOE also proposed not to perform this normalization for two reasons. First, IEC 60350–2:2017 does not require the next lowest power setting to be tested under these circumstances. Second, DOE had tentatively determined the extra test burden would not be warranted by the resulting small adjustment to the energy use. *Id*.

[54] See section III.G.3 of this document for further discussion of the methodology for cooking tops with infinite power settings.

In the November 2021 NOPR, DOE further posited that the normalization calculation would not be possible under two scenarios. One scenario is the minimum-above-threshold power setting is the lowest available power setting on the cooking zone under test. A second is the smoothened water temperature during the maximum-below-threshold power setting does not meet or exceed 90 °C during a 20-minute period following the time the power setting is reduced. *Id.* Under either of these circumstances, DOE proposed that the minimum-above-threshold power setting test be the Energy Test Cycle. *Id.*

DOE requested comment on its proposal to normalize the energy use of the tested cycle if the smoothened water temperature exceeds 91 °C during the simmering period, to represent an Energy Test Cycle with a final water temperature of 90 °C. *Id.* DOE specifically requested comment on its proposal to use the smoothened final water temperature to perform this normalization and on whether a different normalization method would be more appropriate. *Id.* DOE also requested comment on its proposal not to require the normalization under any of three circumstances: when the smoothened water temperature remains between 90 °C and 91 °C during the simmering period, when the minimum-above-threshold power setting is the lowest available power setting on the cooking zone under test, or when the smoothened water temperature during the maximum-below-threshold power setting does not meet or exceed 90 °C during a 20-minute period following the time the power setting is reduced. *Id.*

NEEA supported normalizing the calculated energy of the Energy Test Cycle to maintain comparable temperatures. (NEEA, No. 15 at p. 2)

The CA IOUs commented that the normalizing methodology would increase repeatability of the simmering test. (CA IOUs, No. 14 at pp. 1–2) The CA IOUs commented that it appears that one pathway[55] on the flow chart in proposed Figure 3.1.4.5 does not align with the requirement for a simmering test to maintain a temperature between 90 and 91 °C throughout the simmering test, or, if that is not possible, for the two dial/knob positions that bound[56] this temperature condition to be tested. (CA IOUs, No. 14 at p. 8) The CA IOUs recommended that the flow chart be fixed to match the verbiage within the test methodology. (*Id*.)

In response to the CA IOUs' concern, DOE confirms that the flowchart pathway highlighted by the CA IOUs correctly reflects the intent of the test procedure as proposed in the November 2021 NOPR and as finalized in this final rule. In performing the complete test procedure, there are three circumstances which will cause the test to conclude with only a single Energy Test Cycle, as opposed to a pair of cycles designated as the minimum-above-threshold cycle and the maximum-below-threshold cycle. First, if the smoothened water temperature does not drop below 90 °C or rise above 91 °C during the simmering period, then no normalization is required. Second, if the lowest power setting available on the cooking zone under test is determined to be the minimum-above-threshold power setting, then no lower setting is available to be considered the maximum-below-threshold power setting. Third, if the maximum-below-threshold power setting is unable to achieve a smoothened water temperature of 90 °C (*i.e.*, does not have a

[55] The pathway highlighted visually by the CA IOUs as part of this comment is the pathway wherein the smoothened water temperature during the maximum-below-threshold power setting does not meet or exceed 90 °C during a 20-minute period following the time the power setting is reduced.
[56] The CA IOUs' comment used the word "bind." DOE understands the CA IOUs' comment to have meant to use the word "bound" instead of "bind."

definable simmer period), then no normalization can be performed and the Energy Test Cycle consists only of the minimum-above-threshold power setting. The pathway highlighted by the CA IOUs reflects the second pathway.

In summary, DOE finalizes its November 2021 proposals related to normalizing the energy use of the tested cycle. First, if the smoothened water temperature exceeds 91 °C during the simmering period, the tested cycle's energy consumption is normalized to represent an Energy Test Cycle with a final water temperature of 90 °C. Second, testers must use the smoothened final water temperature to perform this normalization. Third, under any of the following three conditions, normalization is not required: (A) the smoothened water temperature remains between 90 °C and 91 °C during the simmering period, (B) the minimum-above-threshold power setting is the lowest available power setting on the cooking zone under test, or (C) the smoothened water temperature during the maximum-below-threshold power setting does not meet or exceed 90 °C.

In this final rule, DOE also clarifies the language in the flow chart in Figure 3.1.4.5 of new appendix I1 to address the situation in which tests occur in a different order. If the first simmering test is conducted with a power setting above the threshold power setting and the second simmering test is one in which the smoothened water temperature does not equal or exceed 90 °C during the simmering phase, it is not necessary to perform the first test again. Instead, a tester evaluates the subsequent flow chart questions using the previously conducted test cycle.

DOE further updates the flow chart language to align the language in all three boxes that state that no further testing is necessary. This will clarify the next steps (*i.e.*, calculations) to perform after testing is complete. For flow chart paths ending with a determination that the test is the Energy Test Cycle, the last sentence of the text box is updated to read "the test is the Energy Test Cycle, for use in section 4 of this appendix." For flow chart paths ending with a determination of a maximum-below-threshold power setting and a minimum-above-threshold power setting, the last sentence of the text box is updated to read "these power settings are the maximum-below-threshold power setting and the minimum-above-threshold power setting, respectively, for use in section 4 of this appendix." DOE has removed all mention of normalization from the flow chart itself, and instead addresses normalization only within section 4 of appendix I1 ("*Calculation of Derived Results from Test Measurements*").

Finally, since publishing the November 2021 NOPR, DOE is aware that the Task Force has identified a means for reducing test burden when conducting a test cycle on a power setting for which the water temperature does not reach 90 °C. In the September 2021 NOPR, DOE proposed that the determination of whether the smoothened water temperature meets or exceeds 90 °C would be made after a 20-minute time period following the time the power setting is reduced (*i.e.*, "turndown"). Two of the question boxes in the proposed flowchart in Figure 3.1.4.5 of appendix I1 reflect this. As considered by the Task Force, and consistent with DOE's internal testing experience, a 10-minute period following turndown would be sufficient to confirm test settings that will not reach 90 °C. On such settings, the temperature continues to rise only for a few minutes following turndown, after which the temperature either stabilizes or starts to decrease. On such settings, if the smoothened water temperature has not reached 90 °C by the time it stabilizes or starts to decrease (which occurs a few minutes after turndown), the cycle will not meet or exceed 90 °C. DOE understands that for this reason, the Task Force has updated AHAM's draft test procedure to require only a 10-minute period to determine whether a simmering test meets or exceeds 90 °C following turndown. DOE's testing experience confirms that a 10-minute period is more than sufficient to determine whether the water temperature will meet or exceed 90 °C following turndown. Since this change would reduce test burden while maintaining the same end result of the test, DOE incorporates this change into this final rule, as reflected in updated langue to the flowchart in Figure 3.1.4.5.

F. Extension of Methodology to Gas Cooking Tops

DOE implemented a methodology for testing gas cooking tops in the December 2016 Final Rule, which was based on test provisions in the European Standard EN 30–2–1:1998, "Domestic cooking appliances burning gas—Part 2–1: Rational use of energy—General" ("EN 30–2–1") and EN 60350–2:2013 (extended to testing gas cooking tops). 81 FR 91418, 91422. In the November 2021 NOPR, DOE proposed a test procedure for testing gas cooking tops based on EN 30–2–1 and IEC 60350–2:2017 (extended to testing gas cooking tops), but with additional provisions to clarify testing requirements and improve the reproducibility of test results for gas cooking tops. 86 FR 60974, 60987. In the November 2021 NOPR, DOE stated that round robin testing of gas cooking tops suggests that a test procedure based on IEC 60350–2:2017 and EN 30–2–1, with modification as proposed in the November 2021 NOPR, would provide test results with acceptable repeatability and reproducibility for gas cooking tops. *Id*.

As discussed, in the December 2021 NODA, DOE presented test data from the 2021 Round Robin showing that the repeatability COV for gas cooking tops testing according to the procedure proposed in the November 2021 NOPR was under 2 percent, and the reproducibility COV for gas cooking tops was largely under 4 percent, with a maximum of 5.3 percent. 86 FR 71406, 71407–71408.

Samsung generally supported unifying the cooking top test procedure as much as possible across fuel types, including both gas and electric, to allow comparison of efficiency across the fuel types. (Samsung, No. 16 at p. 2) Samsung suggested that due to the higher COVs measured for gas cooking tops than for electric cooking tops, DOE should establish a wider certification and compliance tolerance for gas cooking tops than electric cooking tops when establishing energy conservation standards. (Samsung, No. 16 at p. 3) Samsung commented that DOE should alternatively continue to improve on the gas test procedure and move forward in finalizing the proposed test procedure for electric cooking tops. (*Id.*) Samsung stated that a finalized test procedure for electric cooking tops could help advance ENERGY STAR recognition of induction cooking tops in the near future, which could lead to significant potential decarbonization and electrification through induction cooking. (*Id.*)

AHAM asserted that manufacturers do not believe it is appropriate to use the same test procedure for gas and electric cooking tops, stating that the technologies and components are different between the two product types and that the use of the same test method is unlikely to reduce variation. (AHAM, No. 12 at p. 17) AHAM stated that it cannot comment on whether or not DOE's gas cooking top test results are representative of factory shipments and sales. (*Id*.) AHAM noted that different constructions will yield a variety of different results, especially considering different burner ratings and thicknesses of the grate. (AHAM, No. 12 at p. 9)

In response to Samsung's comment, in lieu of establishing certification tolerances, DOE regulations instead specify methods for statistically evaluating a sample plan to ensure that products meet the relevant standard. Any represented value of a basic model for which consumers would favor lower values (such as annual energy use) must be greater than or equal to the higher of the mean of the sample or the upper 97.5 percent confidence limit of the true mean divided by 1.05 (see section III.L.1 of this document).

In response to AHAM's comments, DOE has acknowledged the need to include unique provisions in the test procedure to account for whether the unit being tested is a gas or electric cooking top. Notably, DOE has specified a procedure for adjusting the burner heat input rate for gas cooking tops, as discussed in section III.F.4 of this document. As illustrated by the 2021 Round Robin test results, these specifications have resulted in a cooking top test procedure that has significantly reduced variability as compared to the test procedure finalized in the December 2016 Final Rule. DOE also notes that units used in the round robin testing were not intended to be reflective of any particular shipment or sales distribution except to the extent that a broad range of manufacturers were represented. DOE will address the market distribution of cooking top efficiencies as part of its ongoing energy conservation standards analysis.

1. Gas Test Conditions

In the November 2021 NOPR, DOE proposed that the supply pressure immediately ahead of all controls of the gas cooking top under test must be between 7 and 10 inches of water column for testing with natural gas, and between 11 and 13 inches of water column for testing with propane. 86 FR 60974, 60987. DOE further proposed that the higher heating value of natural gas be approximately 1,025 Btu per standard cubic foot, and that the higher heating value of propane be approximately 2,500 Btu per standard cubic foot. *Id*. These values are consistent with industry standards, and other DOE test procedures for gas-fired appliances.

DOE also proposed to define a standard cubic foot of gas as "the quantity of gas that occupies 1 cubic foot when saturated with water vapor at a temperature of 60 °F and a pressure of 14.73 pounds per square inch (101.6 kPa)." *Id*. Standard cubic feet are used to measure the energy use of a gas appliance in a repeatable manner by correcting for potential variation in the gas line conditions.

DOE requested comment on its proposed test conditions for gas cooking tops, and its proposed definition of a standard cubic foot of gas. *Id*.

AHAM agreed with the proposed natural gas and propane heating value definitions. (AHAM, No. 12 at p. 12)

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed test conditions for gas cooking tops, and its proposed definition of a standard cubic foot of gas.

2. Gas Supply Instrumentation

a. Gas Meter

In the November 2021 NOPR, DOE proposed to specify in new appendix I1 a gas meter for testing gas cooking tops. The proposal was identical to the provision in the version of appendix I as finalized in the December 2016 Final Rule. That provision read as follows: the gas meter used for measuring gas consumption must have a resolution of 0.01 cubic foot 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. 86 FR 60974, 60987.

DOE requested comment on its proposed instrumentation specifications for gas cooking tops, including the gas meter, and any cost burden for manufacturers who may not already have the required instrumentation. *Id*.

DOE did not receive any comments regarding the proposed specifications for the gas meter used in new appendix I1.

For the reasons presented in the November 2021 NOPR, DOE finalizes its proposed specifications for the gas meter used in new appendix I1.

b. Correction Factor

In the November 2021 NOPR, DOE proposed to include in section 4.1.1.2.1 of new appendix I1 the formula for the correction factor to standard temperature and pressure conditions. This was a change from the version of appendix I as finalized in the December 2016 Final Rule, which referenced the U.S. Bureau of Standards Circular C417, 1938, ("C417"). 86 FR 60974, 60987. DOE stated in the November 2021 NOPR that by providing this explicit formula, it expects to reduce the potential for confusion or miscalculations. *Id*.

Measuring the gas temperature and line pressure[57] are required to calculate the correction factor to standard temperature and pressure conditions. In the November 2021 NOPR, DOE proposed to specify the instrumentation to do so. *Id*. DOE proposed to require that the instrument for measuring the gas line temperature have a maximum error no greater than ± 2 °F over the operating range and that the instrument for measuring the gas line pressure have a maximum error no greater than 0.1 inches of water column. *Id*. These requirements are consistent with the gas temperature and line pressure requirements from the test procedures at 10 CFR part 430, subpart B, appendices N and E, for gas-fired furnaces and for gas-fired water heaters, respectively.

[57] If line pressure is measured as gauge pressure, the absolute pressure is the sum of that value and the barometric pressure.

DOE requested comment on its proposed instrumentation specifications for gas cooking tops, including for measuring gas temperature and pressure, and any cost burden for manufacturers who may not already have the required instrumentation. *Id*.

UL observed that the accuracy of the gas line pressure meter is specified in the proposed test procedure but that the accuracy of the barometric pressure reading is not specified. (UL, No. 17 at p. 2) UL commented that the barometric pressure reading is not necessary if the gas pressure is measured as absolute pressure. (*Id*.) UL recommended that DOE specify an accuracy for the sum of the barometric pressure and gas pressure measurements and for the barometric pressure measurement. (*Id*.) UL commented that if an accuracy requirement is specified only for the barometric pressure, then DOE should provide guidance for how to combine the two accuracies. (*Id*.)

UL also commented that any pressure measurements that reference a height of liquid should specify the temperature of the liquid, or whether it is "conventional." (UL, No. 17 at pp. 2–3) UL commented that the National Institute of Standards and Technology ("NIST") provides three possible conversion factors when working with inches of mercury or inches of water, depending on the condition of the liquid. (UL, No. 17 at p. 2) UL commented that the value of P_{base}, the standard sea level air pressure, specified in section 4.1.1.2.1 of proposed appendix I1 (408.13 inches of water) is different than in the gas calorimeter tables in C417 and does not seem to match any typical standard pressure conditions. (*Id*.) UL commented that C417 specifies a pressure of 30 inches of mercury at a temperature of 32 °F, which UL converted according to NIST conversion factors into 101,591.4 Pascals or 407.852 inches of water (using the "conventional liquid" conversion factor). (UL, No. 17 at pp. 2–3) UL recommended that the value for P_{base} be updated to match the value derived using C417 and that the pressure be specified in units that do not involve the height of a fluid to avoid confusion. (UL, No. 17 at p. 3)

In response to UL's comment that the accuracy of the barometric pressure reading is not specified in the November 2021 NOPR, DOE notes that the 2021 Round Robin produced repeatable test results even though the barometric pressure reading accuracy was not specified. DOE has determined that the laboratories that conducted the 2021 Round Robin used barometric pressure measuring devices with accuracies ranging from 0.1 to 4 millibars. DOE has observed that typical accuracies for barometric pressure reading devices currently on the market are less than 8 millibars. In this final rule, DOE is not specifying an accuracy for the barometric pressure reading in appendix I1, noting that it is unlikely that an instrument used by a test laboratory to measure barometric pressure would produce significantly more variability than was observed in the 2021 Round Robin.

For the reasons discussed, DOE finalizes its proposed gas pressure and temperature specifications for gas cooking tops.

In response to UL's comments regarding the gas correction factor formula, DOE is updating the units of measurement specified in the formula for the correction factor to standard temperature and pressure conditions used in section 4.1.1.2.1 of new appendix I1 to be more representative of the units of measurement used by test laboratories. These changes do not affect any of the resulting calculations. Specifically, DOE notes that C417 specifies a P_{base} value of 30 inches of mercury at a temperature of 32 °F, which is equal to 101,591.4 Pascals,[58] or 14.73 pounds per square inch ("psi").[59] In the November 2021 NOPR, DOE proposed pressure values in the correction factor formula in inches of water column, which is the unit of measurement most commonly used by industry for measuring gas line pressure. By contrast, in DOE's experience, to measure barometric pressure, psi is a more commonly used unit. In this final rule, DOE updates the specified units for P_{base} and P_{atm} used in the correction factor formula in section 4.1.1.2.1 of appendix I1 to be recorded in psi, and maintains gas line pressure to be measured in inches of water column, as proposed in the November 2021 NOPR. DOE is also including a corresponding conversion factor of 0.0361[60] in appendix I1 to convert P_{gas} from inches of water column to psi.

DOE is also updating the units for gas temperature used in the correction factor formula to be measured in °F or °C, rather than degrees Rankine or Kelvin. To accommodate this change, DOE is including an adder, T_k, to the correction factor formula for converting the gas temperature from °F to Rankine or °C to Kelvin, as applicable.

[58] 30 inches of mercury at 32 °F x 3,386.38 Pascals per inch of mercury (conversion factor defined by NIST) = 101,591.4 Pascals.

[59] 101,591.4 Pascals ÷ 6,894.757 Pascals per pound per square inch (conversion factor defined by NIST) = 14.73 pounds per square inch.

[60] DOE notes that the conversion from inches of water column to psi, as defined by NIST, is equal to 0.0361, regardless of the temperature of the water defined in the inches of water column unit.

In summary, DOE believes these changes to the units of measurement better align with the units of measurement most commonly used by test laboratories.

c. Gas Calorimeter

The version of appendix I as finalized in the December 2016 Final Rule required that the heating value be measured with an unspecified instrument with a maximum error of 0.5 percent of the measured value and a resolution of 0.2 percent of the full-scale reading. The heating value was then required to be corrected to standard temperature and pressure. 81 FR 91418, 91440.

In the November 2021 NOPR, DOE proposed to require the use of a standard continuous flow calorimeter to measure the higher heating value of the gas. DOE proposed four requirements: an operating range of 750 to 3,500 Btu per cubic foot, a maximum error no greater than 0.2 percent of the actual heating value of the gas used in the test, an indicator readout maximum error no greater than 0.5 percent of the measured value within the operating range, and a resolution of 0.2 percent of the full-scale reading of the indicator instrument. 86 FR 60974, 60987. These requirements are consistent with the calorimeter requirements from the test procedure at 10 CFR part 430, subpart B, appendix D2, for gas clothes dryers.

As discussed in the November 2021 NOPR, DOE proposed a different approach for determining the heating value because, after discussions with test laboratories and manufacturers, applying the gas correction factor to the heating value does not reflect common practice in the industry. 86 FR 60974, 60987. Instead, DOE proposed to calculate gas energy use as the product of three factors: the measured gas volume consumed (in cubic feet), a correction factor converting measured cubic feet of gas to standard cubic feet of gas as discussed previously, and the heating value of the gas (in Btu per standard cubic foot) in new appendix I1. *Id.* DOE proposed to specify further that the heating value would be the higher heating value on a dry-basis of gas. *Id.* In the November 2021 NOPR, DOE stated that it is DOE's understanding that this is the typical heating value used by the industry and third-party test laboratories. *Id.*

DOE requested comment on its proposed instrumentation specifications for gas cooking tops, including the gas calorimeter, and any cost burden for manufacturers who may not already have the required instrumentation. *Id.*

AHAM commented that it does not oppose DOE's proposal to require the use of a standard continuous flow calorimeter for gas cooking top testing, stating that these devices are standard laboratory equipment. (AHAM, No. 12 at p. 12)

UL commented that the requirements for standard continuous flow calorimeter accuracy separating the meter accuracy (error) from the readout (error) seem to be based on older Cutler Hammer calorimeters and are not applicable to modern equipment or other techniques such as a gas chromatograph or bottled gases. (UL, No. 17 at p. 1) UL commented that it recommends that the regulation combines the meter accuracy with the readout accuracy to have an accuracy requirement for the measurement of heat content. (*Id.*)

UL further commented that the specification for operating range given in section 2.7.2.2 of proposed appendix I1 also seems to be based on older Cutler Hammer calorimeters and stated that, in general, operating ranges are not required for other instruments such as flow meters, volt meters, ammeters, *etc.* (UL, No. 17 at p. 2) UL recommended that section 2.7.2.2 of appendix I1 eliminate the requirement for an operating range, claiming that specifying a broad range tends to reduce accuracy. (*Id*.)

In response to UL's comment regarding the gas meter accuracy, DOE notes that these requirements would not apply if a test laboratory were to use bottled gas to conduct the cooking top test procedure. Modifying the accuracy requirements as suggested by UL could prevent some older testing equipment from being able to be used to perform the DOE test procedure, thus requiring laboratories that use such equipment to purchase newer equipment. DOE has no indications to suggest that such older equipment is any less accurate or any less appropriate for use in the DOE test procedure. Thus, requiring the purchase of newer equipment would represent undue test burden. DOE further notes that the requirements as proposed in the November 2021 NOPR do not preclude the use of more modern equipment. In this final rule, DOE finalizes the requirements for the accuracy of the standard continuous flow calorimeter as proposed in the November 2021 NOPR.

In response to UL's comment stating that specifying a broad operating range tends to reduce accuracy, DOE notes that the equipment used for testing must meet the accuracy specifications defined by the test procedure, regardless of whether a broad or narrow operating range is specified (*i.e.*, in combination with specifying an accuracy range, the specification of a broad operating range has no impact on the accuracy of the measured value). DOE recognizes, however, that specifying a particular operating range could prevent certain equipment from being used that may have a different specified operating range but provides an equivalent level of accuracy for the values being measured for the DOE test procedure. As such, specifying an accuracy range could increase test burden (by requiring the purchase of new equipment) without providing any benefit in the form of improved accuracy. For this reason, DOE determines that specifying an operating range for the gas calorimeter could introduce undue test burden. In this final rule, DOE specifies the required accuracy of the standard continuous flow calorimeter without specifying an allowable operating range.

For the reasons discussed, DOE finalizes its proposed instrumentation specifications for gas calorimeters for gas cooking tops, with the elimination of the 750 to 3,500 Btu per cubic foot operating range requirement proposed in the November 2021 NOPR.

3. Test Vessel Selection for Gas Cooking Tops

In applying the test method in IEC 60350–2:2021 to gas cooking tops, DOE must define test vessels that are appropriate for each type of burner. The test vessels specified in Section 5.6.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 are constructed from a 1-mm thick stainless steel sidewall welded to a 5-mm thick circular stainless steel base, with additional heat-resistant sealant applied.

The EN 30–2–1 test method, which is designed for use with gas cooking tops, specifies test vessels that differ in dimensions, material, and construction from those in IEC 60350–2. Further, Table 1 of EN 30–2–1 defines the test vessel selection based on the nominal heat input rate (specified in kilowatts ("kW") of each burner under test, as shown in Table III.1). These test vessels are fabricated from a single piece of aluminum, with a wall thickness between 1.5 and 1.8 mm.

Table III.1 Test Vessel Selection for Gas Cooking Tops in EN 30–2–1

Nominal Heat Input Range *(kW)*	**Test Vessel Diameter** *(mm)*	**Notes**
between 1.16 and 1.64 inclusive	220	
between 1.65 and 1.98 inclusive	240*	
between 1.99 and 2.36 inclusive	260*	
between 2.37 and 4.2 inclusive	260*	Adjust the heat input rate of the burner to 2.36 kW ±2%
greater than 4.2	300*	Adjust the heat input rate of the burner to 4.2 kW ±2%

* If the indicated diameter is greater than the maximum diameter given in the instructions, conduct the test using the next lower diameter and adjust the heat input rate to the highest heat input of the allowable range for that test vessel size, ±2%.

Because they are not made of a ferromagnetic material (such as stainless steel), the EN 30–2–1 test vessels could not be used for electric-smooth induction cooking tops. To use a consistent set of test vessels for all types of gas and electric cooking tops, DOE proposed in the November 2021 NOPR to specify in new appendix I1 the IEC 60350–2:2017 test vessel to be used for each gas burner,[61] based on heat input rate ranges equivalent to those in Table 1 of EN 30–2–1, although expressed in Btu per hour ("Btu/h"). 86 FR 60974, 60988. The test vessel diameters in EN 30–2–1 do not exactly match those of the test vessels in IEC 60350–2, but DOE selected the closest match

[61] As described previously, both IEC 60350–2:2017 and IEC 60350–2:2021 specify test vessels in the following diameters: 120 mmm 150 mm, 180 mm, 210 mm, 240 mm, 270 mm, 300 mm, and 330 mm.

possible, as shown in Table III.2. DOE also proposed to adjust the lower limit of one of the burner heat input rate ranges corresponding to the EN 260 mm test vessel (1.99–2.36 kW, equivalent to 6,800–8,050 Btu/h) and to allocate some of its range to the IEC 240 mm vessel for two reasons. First, it would provide more evenly balanced ranges. Second, it would avoid a significant mismatch between the heat input rate and test vessel sizes at the lower end of the heat input range. *Id*. DOE did not propose to include the notes included in EN 30–2–1, which require burners with nominal heat input rates greater than 8,050 Btu/h to be tested at heat input rates lower than their maximum rated value. DOE preliminarily determined these would not be representative of consumer use of such burners. *Id*.

Table III.2 Test Vessel Selection for Gas Cooking Tops Proposed in the November 2021 NOPR

Nominal Gas Burner Input Rate *(Btu/h)*		**EN 30–2–1 Test Vessel Diameter** *(mm)*	**IEC 60350–2 Test Vessel Diameter** *(mm)*	**Water Load Mass** *(g)*
Minimum (>)	Maximum (≤)			
--	5,600	220	210	2,050
5,600	8,050	240 and 260	240	2,700
8,050	14,300	260	270	3,420
14,300	--	300	300	4,240

Similar to electric cooking tops, DOE also proposed in new appendix I1 that if a selected test vessel cannot be centered on the cooking zone due to interference with a structural component of the cooking top, the test vessel with the largest diameter that can be centered on the cooking zone be used.[62] *Id*.

DOE requested comment on its proposal to require the use of IEC test vessels for gas cooking tops and on its proposed method for selecting the test vessel size to use based on the gas burner's heat input rate. *Id*.

The Joint Commenters agreed with the proposed test vessels and test vessel selection method for gas cooking tops. (Joint Commenters, No. 11 at p. 2) The Joint Commenters supported aligning the test methods for gas and electric cooking tops to the extent possible. (*Id*.) The Joint Commenters stated that using a consistent set of test vessels across all cooking tops can provide more accurate comparisons between cooking top models across different product types. (*Id*.)

Samsung supported the use of the same test vessels for both electric and gas cooking tops, stating that minimizing the variety of test vessels required reduces testing burden. (Samsung, No. 16 at p. 2)

The CA IOUs requested that DOE amend the gas and/or electric cooking top test vessel and water load selection criteria to mitigate what they claimed were discrepancies in comparability between cooking tops with different fuel types. (CA IOUs, No. 14 at p. 2) The CA IOUs commented that, while IEC 60350–2 and EN 30–2–1 are both reliable

[62] See section III.E.1 of this document for a discussion of the clarifying edits to this provision for electric cooking tops, which is extended to gas cooking tops, requiring that if a test vessel lid cannot be centered on the test vessel due to interference from a structural component, the substitution also occurs.

test procedure sources for their respective cooking top fuels, the use of two different sources for developing the test vessel and water load selection criteria may result in significant differences that limit performance comparisons between electric and gas cooking tops. (*Id.*) The CA IOUs commented that IEC 60350–2 and EN 30–2–1 were not developed to be directly comparable to one another, and stated that as such, DOE should make amendments to ensure comparability. (*Id.*) The CA IOUs recommended that to create a more comparable test procedure, the electric and gas cooking tops should have the same granularity of test vessel and water load selection criteria. (*Id.*) They stated that the gas cooking top test vessel selection table includes only half of the eight test vessels in the electric cooking top test vessel selection table. (*Id.*)

According to the CA IOUs, the relationship between input power and water load is not equivalent between cooking top fuel types because of the difference in granularity between electric and gas cooking top test vessel selection criteria in the November 2021 NOPR. (*Id.*) The CA IOUs commented that they have developed a crosswalk between the test vessel selection criteria for electric cooking tops based on cooking zone diameter, and for gas cooking tops based on evaluating the nominal burner input rating, using the cooking zone diameters and associated power ratings of a representative electric range. (CA IOUs, No. 14 at p. 3) The CA IOUs asserted that the resulting analysis shows the inconsistent test vessel and water load granularity between electric and gas. (*Id.*) The CA IOUs stated that by their calculation, the narrowest range defined for a gas cooking top test vessel (5,600 to 8,050 Btu/h, for use with the 240 mm test vessel) corresponds to three different vessel sizes for electric cooking tops within that equivalent range. (*Id.*) The CA IOUs further stated that the rate of change in water load to input power ratios is inconsistent between electric and gas cooking tops. (CA IOUs, No. 14 at p. 4) The CA IOUs commented that it is understandable that an electric heating element and gas burner designed for the same consumer purpose (*e.g.*, primary large or secondary simmering cooking zone) have different power ratings. (*Id.*) They stated that, according to a 2019 study conducted by Frontier Energy, they transfer heat to the pan or pot at different efficiencies dictated by their fuel type.[63] (*Id.*) The CA IOUs asserted that once that inherent difference has been established, the rate of change to the next test vessel selection should be consistent for both electric and gas cooking tops with the change in water load. (*Id.*) However, they noted that as proposed in the November 2021 NOPR, when moving from the 2,700 g water load to the 3,420 g water load, the electric heating element power increases by 13 percent, while the gas burner power increases by 64 percent. (*Id.*)

The CA IOUs claimed that the inconsistencies in the test vessel selection criteria create a test procedure that does not allow for an accurate comparison between gas and electric product performance and thus limits a consumer's ability to accurately compare products. (CA IOUs, No. 14 at p. 5) The CA IOUs requested that DOE align the gas cooking top test vessel and water load selection criteria with the electric cooking top criteria more closely by specifying an equal number of test vessel and water load increments for gas and electric cooking tops. (*Id.*) The CA IOUs also requested that

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[63] As described in a 2019 study by Frontier Energy, gas cooking tops "have the highest thermal losses because the gas flame heats up the air around the pot or pan, which in turn heats up the kitchen" while electric cooking tops, either "heat up the pot or pan directly and not the surrounding air", as is the case with induction cooking, or "heat the air indirectly" due to heating of the cooking top itself such as with electric resistance cooking tops. Residential Cooktop Performance and Energy Comparison Study by Frontier Energy. July 2019. *cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf.* Last accessed March 31, 2022.

DOE amend the gas and/or electric cooking top test vessel and water load selection criteria rate of changes to more closely align with one another. (*Id*.)

AHAM commented that DOE has not conducted testing to understand the wear and degradation effects from gas units on the IEC cookware, stating that the long-term durability of stainless pots for gas testing is unknown. (AHAM, No. 12 at p. 13) AHAM commented that it is conducting investigative testing to assess the difference in results between IEC and EN test vessels. (*Id*.) AHAM stated that DOE should wait for its test results before proceeding and should include its results in a supplemental NOPR ("SNOPR") or NODA as needed. (*Id*.) AHAM commented that it acknowledges the potential to reduce burden associated with using the same pots but stated that the impact of doing so on test results needs to be studied. (*Id*.)

In response to the CA IOUs' comments regarding the differences in granularity of the defined heat input ranges corresponding to each test vessel size for gas and electric cooking tops, DOE notes that gas and electric cooking tops are not directly comparable in terms of the variety of element and burner sizes generally offered on individual models. On a single unit, electric cooking tops generally offer a greater range of heating element sizes and maximum input rates among the different heating elements than gas cooking tops offer in terms of burner input rates.

As discussed in section III.E.1 of this document, gas burners are able to be effectively used with a much wider range of pot sizes than electric heating elements. An electric heating element can only provide effective heat transfer to the area of a pot in direct contact or in line of sight with the element, such that the range of pot diameters that can be effectively used on an electric heating element is limited by the diameter of the heating element. Conversely, gas burners are able to provide effective heat transfer to a wider range of pot sizes (and in particular, pots with a diameter larger than the burner). Thus, the range of pot diameters that can be effectively used on a gas burner is not limited by the diameter of the burner to the same extent that it is for an electric heating element. For these reasons, DOE has determined that it is appropriate that the test procedure specify smaller test vessel increments (*i.e.*, more granularity) for electric cooking tops than for gas cooking tops.

Furthermore, DOE is unaware of any existing electric cooking tops with heating element diameters smaller than 130 mm (5.1 inches) or larger than 310 mm (12.2 inches), which would use the 120 mm and 330 mm test vessels, respectively. Therefore, effectively only six test vessel sizes (as opposed to eight included for consideration) are used for electric cooking tops as compared to the four test vessel sizes used for gas cooking tops.

In response to AHAM's comment on the use of the IEC test vessels for gas cooking top testing, DOE has determined that there is no evidence to suggest that consumers use different cookware for gas and electric cooking tops. Therefore, DOE proposed to use the same cookware for testing gas cooking tops as is used for electric cooking tops. DOE selected the IEC test vessels because they are compatible with all cooking technologies, unlike the EN test vessels.[64] As discussed, DOE has conducted a rigorous round robin testing program over multiple months using the IEC test vessels on both gas and electric cooking tops, and DOE has not encountered any problems with their use during this testing. Further, DOE observed no discernable difference in the condition of the test vessels after electric or gas cooking top testing. See section III.H.3 of this document for further discussion regarding test vessel flatness. DOE has not yet received any data from AHAM on this issue and encourages AHAM to send any data when it becomes available.

For the reasons discussed, DOE finalizes its proposal in the November 2021 NOPR to require the use of IEC test vessels for gas cooking tops, and its proposed method for selecting the test vessel size based on the gas burner's heat input rate.

4. Burner Heat Input Rate Adjustment

In the November 2021 NOPR, DOE recognized that the version of appendix I as finalized in the December 2016 Final Rule did not include requirements related to gas outlet pressure, in particular a tolerance on the regulator outlet pressure or specifications for the nominal heat input rate for burners on gas cooking tops. 86 FR 60974, 60988. From a review of the test results from the 2020 Round Robin, DOE tentatively concluded in the November 2021 NOPR that the lack of such provisions was likely a significant contributor to the greater reproducibility COV values observed for gas cooking tops in relation to those for electric cooking tops. *Id*. To improve test procedure reproducibility,

[64] Because the EN cookware are made of aluminum, they would not be usable on electric cooking tops using induction heating technologies.

DOE proposed in the November 2021 NOPR to incorporate gas supply pressure and regulator outlet pressure (which affects heat input rate) requirements into new appendix I1, as described further in the following discussion. *Id*.

Industry procedures for gas cooking tops include specifications for the heat input rate. For example, EN 30–2–1 specifies that before testing, each burner is adjusted to within 2 percent of its nominal heat input rate. Section 5.3.5 of the American National Standards Institute ("ANSI") Standard Z21.1–2016, "Household cooking gas appliances" ("ANSI Z21.1") has a two-step heat input rate requirement. First, individual burners must be adjusted to their Btu rating at normal inlet test pressure. Next, the heat input rate of the burners must be measured after 5 minutes of operation, at which time it must be within ± 5 percent of the nameplate value.

Based on a review of its test data, DOE tentatively determined in the November 2021 NOPR that specifying a tolerance of ± 5 percent from the nominal heat input rate may not produce repeatable and reproducible test results. *Id*. at 86 FR 60989. Therefore, DOE proposed to specify in new appendix I1 that the measured heat input rate be within 2 percent the nominal heat input rate as specified by the manufacturer. *Id*.

In the November 2021 NOPR, DOE proposed that the heat input rate be measured and adjusted for each burner of the cooking top before conducting testing on that burner. *Id*. The measurement would be taken at the maximum heat input rate, with the properly sized test vessel and water load centered above the burner to be measured, starting 5 minutes after ignition. *Id*. If the measured average heat input rate of the burner is within

2 percent of the nominal heat input rate of the burner as specified by the manufacturer, no adjustment of the heat input rate would be made for any testing of that burner. *Id*.

DOE also proposed to require adjusting the average heat input rate if the measured average heat input rate of the burner is not within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. *Id*. For gas cooking tops with an adjustable internal pressure regulator, the pressure regulator would be adjusted such that the average heat input rate of the burner under test is within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. *Id*. For gas cooking tops with a non-adjustable internal pressure regulator or without an internal pressure regulator, the regulator would be removed or blocked in the open position, and the gas pressure ahead of all controls would be maintained at the nominal manifold pressure specified by the manufacturer. *Id*. These proposed instructions are in accordance with provisions for burner adjustment in Section 5.3.3 of ANSI Z21.1. The gas supply pressure would then be adjusted until the average heat input rate of the burner under test is within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. *Id*. In either case, the burner would be adjusted such that the air flow is sufficient to prevent a yellow flame or flame with yellow tips. *Id*. Once the heat input rate has been set for a burner, it would not be adjusted during testing of that burner. *Id*.

DOE requested comment on its proposal for adjusting the burner heat input rate to the nominal heat input rate as specified by the manufacturer, and to include a 2-percent tolerance on the heat input rate of each burner on a gas cooking top. *Id*. Below are summaries of comments received.

NYSERDA agreed with including gas supply pressure and regulatory outlet pressure requirements to ensure repeatability and reproducibility. (NYSERDA, No. 10 at p. 2)

The Joint Commenters supported the proposal for adjusting the burner heat input rate for gas cooking tops, the inclusion of specifications for the heat input rate, and the 2-percent tolerance on the heat input rate to ensure reproducibility of test results. (Joint Commenters, No. 11 at p. 3)

NEEA supported the proposed methodology for input rate verification and the proposed 2-percent tolerance on input rate, stating that these proposals align with the methodology of ASTM food service standards and should be rigorous enough to ensure repeatable testing. (NEEA, No. 15 at p. 2)

The CA IOUs supported the proposed input rate and incoming gas pressure specifications to ensure that units tested at different laboratories are tested under comparable conditions. (CA IOUs, No. 14 at p. 2)

AHAM commented that the third-party test laboratory it used for its testing had problems controlling gas pressure and flow, especially on smaller burners rated at 5,000 to 6,000 Btu/h. (AHAM, No. 12 at p. 11) AHAM stated that depending on unit construction, damage could occur from blocking open a built-in gas regulator, internal to the unit, to achieve the required gas tolerance. (*Id.*) AHAM also stated this could generate inaccurate results. (*Id.*)

AHAM asserted that the proposed tolerance of the average heat input rate of the burner under test being within 2 percent of the nominal heat input rate of the burner is too small. (AHAM, No. 12 at p. 13) AHAM stated that it is conducting investigative testing using both a 2-percent and 5-percent tolerance, and that DOE should wait for the results rather than using a calculated assessment of how results change based on burner adjustment. (*Id.*) AHAM recommended that DOE use the 5-percent tolerance if it decides to move forward without test data to support its proposal, stating that a 5-percent tolerance is used in well-established industry standards. (*Id.*) AHAM claimed that DOE's data do not demonstrate that variation in the test itself has been reduced. (*Id.*) AHAM stated that other factors, such as improved test technician understanding of the test, likely contributed to the reduction in variation. (*Id.*) Additionally, AHAM commented that the tighter tolerance on burner heat input rate adds undue burden. AHAM further stated that changing barometric pressure conditions must be considered within a wider tolerance. (*Id.*) AHAM commented that the smaller tolerance window is more problematic for smaller burners (5,000–6,000 Btu/h) than for higher-input-rate burners. (*Id.*)

UL commented that the procedure for gas burner adjustment defines only when to start measuring heat input and not for how long. (UL, No. 17 at p. 2) UL stated that the duration of the input rate measurement should be defined since heat input decreases over time. (*Id.*) UL asserted, for example, that if one laboratory measures heat input for 10 seconds and another measures it over a time period of 2 minutes, the numbers will be different because the heat input is changing while it is being measured. (*Id.*) UL suggested that some laboratories may object to a specific time period and stated that a range may be a good compromise to accommodate different measurement methods. (*Id*.) According to UL, some laboratories may rely on a stopwatch to measure the time of a specified number of rotations of the needle on a wet drum meter, and that the amount of time for those rotations depends on the size of the meter and the rating for the burner. (*Id*.) UL commented that other laboratories may have equipment to measure instantaneous heat input, in which case a time for measurement can align with alternative methods. (*Id*.)

DOE has not yet received any data from AHAM on this issue and encourages AHAM to send any data when it becomes available. AHAM's concern regarding the potential damage to the unit from blocking a built-in regulator in the open position to achieve the required burner heat input rate is not supported by DOE's testing experience. When blocking a gas regulator in the open position, to obtain the required heat input, the test laboratory would use the laboratory regulator on the gas supply line, upstream of the unit, to control the gas supply pressure. This external regulation would reduce the pressure and mitigate any gas flow fluctuations from the supply line that could cause potential damage. DOE also notes that this approach leads to more repeatable and reproducible results.

DOE's 2021 Round Robin test data shows improved repeatability and reproducibility in comparison to the 2020 Round Robin. Specifying a 2-percent tolerance on the burner heat input rate was one of the key differences between the two test programs. All of the data DOE has presented for both the 2020 Round Robin and the 2021 Round Robin was collected by experienced technicians and validated for compliance with the appropriate test method. DOE notes that none of the three test laboratories that participated in gas testing for the 2021 Round Robin reported any difficulty in meeting the 2-percent specification even on smaller burners.

DOE reiterates that the proposed 2-percent tolerance mirrors the tolerance specified in the EN 30–2–1 industry test procedure. DOE further notes that it did not propose any provisions that would require changing barometric conditions. Furthermore, DOE notes that AHAM's request for a 5-percent tolerance on the nominal burner heat input rate would seemingly contradict AHAM's comment that DOE's efforts to reduce variation have not reduced variation enough for certain parts of the test procedure (see section III.C of this document).

DOE disagrees with UL's suggestion to define the duration over which the burner heat input rate should be measured. As suggested by UL, the appropriate length of time over which the burner heat input rate should be measured is based on the type of meter being used and test laboratory best practices will depend on the type of meter being used. DOE testing suggests that the rate of change of the burner heat input rate within a few minutes after 5 minutes of operation is small enough that the average burner heat input rate measurement would not vary significantly for different measurement periods within that time frame. DOE expects that laboratories complete this measurement within a few minutes after the end of the 5-minute operating period, regardless of the type of meter being used. Therefore, DOE is not specifying a period of time over which the average burner heat input rate must be measured.

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposal for adjusting the burner heat input rate to the nominal heat input rate as specified by the manufacturer, and to include a 2-percent tolerance on the heat input rate of each burner on a gas cooking top.

For clarity, DOE is removing the word "average" from section 3.1.3 of appendix I1 to avoid implying that the measurement must be made over a specific length of time and, in particular, to accommodate the option to measure instantaneous burner heat input rate after the specified 5 minutes of operation.

5. Target Power Density for Optional Potential Simmering Setting Pre-Selection Test

As discussed in section III.D.2.d of this document, Annex H of IEC 60350–2:2021 specifies a target power density of 0.8 W/cm^2 for the potential simmering setting pre-selection test for electric cooking tops. In the November 2021 NOPR, DOE proposed for gas cooking tops to specify a separate target power density, which would be measured in Btu per hour divided by the area of the cookware bottom in square centimeters ("$Btu/h{\cdot}cm^2$"). 86 FR 60974, 60989.

To evaluate possible values for this target power density, in the November 2021 NOPR, DOE investigated test data from five gas cooking tops, each tested three times as part of the 2020 Round Robin,[65] at a single test laboratory. *Id*. The range of power

[65] This test data was not measured according to the test procedure proposed in the November 2021 NOPR. DOE preliminarily determined that it was still useful to evaluate potential target power densities because a cooking top setting's power density is inherent and does not vary with test procedure protocol. However, due to the lack of burner heat input rate tolerance in the testing, some of these tested values may not

densities measured for test cycles of minimum-above-threshold settings was 3.8 – 11.6 Btu/h·cm^2. *Id*. at 86 FR 60990. The range of power densities measured for test cycles of maximum-below-threshold settings was 2.6 – 5.9 Btu/h·cm^2. *Id*. In the November 2021 NOPR, DOE preliminarily estimated that a target power density of 4.0 Btu/h·cm^2 would be appropriate. *Id*. DOE noted that it could consider specifying a different target power density for the potential simmering setting pre-selection test if additional data were to suggest that a different value would be more representative than the proposed value of 4.0 Btu/h·cm^2. *Id*.

In the December 2021 NODA, DOE presented data from the 2021 Round Robin. The additional data DOE collected were on the measured power density of the minimum-above-threshold input setting and the maximum-below-threshold input setting for four gas cooking tops.[66] 86 FR 71406, 71408. The range of power densities measured for test cycles of minimum-above-threshold settings was 3.2 – 9.5 Btu/h·cm^2. The range of power densities measured for test cycles of maximum-below-threshold settings was 2.5 – 6.4 Btu/h·cm^2.

In the November 2021 NOPR, DOE requested comment on its proposed target power density for gas cooking tops of 4.0 Btu/h·cm^2. 86 FR 60974, 60990.

accurately reflect the expected power densities when the heat input rate is within 2 percent of the nominal value.

[66] The test data are available in the docket for this rulemaking at: *www.regulations.gov/document/EERE-2021-BT-TP-0023-0004*. Unlike the data presented in the November 2021 NOPR, these test data were measured according to the test procedure proposed in the November 2021 NOPR. However, DOE believes the two data sets present comparable data.

DOE did not receive any comments regarding its proposed target power density for gas cooking tops of 4.0 Btu/h·cm^2.

DOE finalizes, consistent with the November 2021 NOPR, its proposed target power density for the optional potential simmering setting pre-selection test for gas cooking tops of 4.0 Btu/h·cm^2.

6. Product Temperature Measurement for Gas Cooking Tops

As discussed in section III.E.2.b of this document, DOE is specifying in new appendix I1 that the temperature of the product must be measured at the center of the cooking zone under test before any active mode testing. In the November 2021 NOPR, DOE proposed to specify that this requirement would also apply to gas burner adjustments described in section 3.1.3 of new appendix I1. 86 FR 60974, 60990. DOE further proposed to specify that for a conventional gas cooking top, the product temperature would be measured inside the burner body of the cooking zone under test, after temporarily removing the burner cap. *Id*. Before the standby mode and off mode power test, the product temperature would be measured as the average of the temperature measured at the center of each cooking zone. *Id*.

DOE requested comment on its proposal to require measuring a gas cooking top's temperature inside the burner body of the cooking zone under test, after temporarily removing the burner cap. *Id*.

AHAM objected to DOE's proposal to require measuring the product temperature inside the burner body of the cooking zone under test, after temporarily removing the burner cap. (AHAM, No. 12 at p. 13) AHAM gave several reasons: DOE had not presented data to show that burner cap removal is necessary, and this requirement would be impractical, invasive, unnecessary, and not in accordance with common practices for testing gas cooking appliances. AHAM commented that burners have an increased risk of damage if they are tampered with and stated that burner disassembly compromises proper and safe performance and is not appropriate for gas products. (AHAM, No. 12 at pp. 13–14) AHAM urged DOE not to require any appliance disassembly in the test procedure. (AHAM, No. 12 at p. 14)

The CA IOUs suggested that DOE clarify where to measure the product temperature for products without burner caps. (CA IOUs, No. 14 at p. 7)

In response to AHAM's concern regarding the removal of the gas burner cap to measure the product temperature of a gas cooking top, DOE notes that to its knowledge and through its testing experience, removing the burner cap is generally not difficult and does not risk damage to the unit. A test laboratory that participated in the 2021 Round Robin confirmed with DOE that the removal of the gas burner cap is not a complicated or time-consuming requirement. DOE further notes that removing the gas burner cap is a common practice among consumers as part of the regular cleaning process for gas cooking tops, and instructions for doing so are typically included in manufacturer instructions. DOE considered not requiring the removal of the gas burner cap to measure the product temperature but has determined that the method proposed in the November

2021 NOPR is the approach that best confirms whether a cooking top's internal components have returned to ambient conditions. This confirmation is especially important for gas cooking tops because the temperature of the internal components can affect critical dimensions, and thus the amount of gas flow and entrained air. If the cooking top is not properly tested starting at ambient temperature, this factor could lead to unrepeatable results. DOE notes that throughout both the 2020 Round Robin and the 2021 Round Robin, three test laboratories followed the requirement to measure the product temperature inside the burner body of the cooking zone under test, after temporarily removing the burner cap without issue.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to require measuring a gas cooking top's temperature inside the burner body of the cooking zone under test, after temporarily removing the burner cap. In response to the comment from the CA IOUs, DOE clarifies that the burner cap need only be removed if one exists.

G. Definitions and Clarifications

As part of this final rule, DOE is adding certain definitions and clarifications to new appendix I1 in addition to those already described.

1. Operating Modes

To clarify provisions relating to the various operating modes, in the November 2021 NOPR, DOE proposed to add definitions of "active mode," "off mode," "standby mode," "inactive mode," and "combined low-power mode" to new appendix I1. 86 FR

60974, 60990. These definitions are identical to those that had been established in the version of appendix I as finalized in the December 2016 Final Rule.

DOE proposed to define active mode as "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, or electric inductive heating." *Id*.

DOE proposed to define off mode as "any mode in which a 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." *Id*.

DOE proposed to define standby mode as "any mode in which a 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." *Id*. at 86 FR 60990–60991.

DOE proposed to define inactive mode as "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." *Id*. at 86 FR 60991.

DOE proposed to define combined low-power mode as "the aggregate of available modes other than active mode, but including the delay start mode portion of active mode." *Id*.

DOE requested comment on its proposed definitions of "active mode," "off mode," "standby mode," "inactive mode," and "combined low-power mode." *Id*.

The CA IOUs commented that DOE's proposal to define both "standby" and "inactive" mode may cause confusion. (CA IOUs, No. 14 at p. 5) The CA IOUs suggested that DOE remove references to "inactive" mode from the test procedure and stated that the standby mode definition would then be used in low-power mode calculations. (*Id*.) The CA IOUs commented that it is their understanding that when DOE originally defined inactive mode as a subset of standby mode in the final rule pertaining to test procedures for clothes dryers and room air conditioners, published on January 6, 2011, it did not intend for the terms "inactive" and "standby" to be defined as separate modes for a single product, as has been done in the November 2021 NOPR.

(CA IOUs, No. 14 at p. 6) The CA IOUs commented that it is their understanding that the inactive mode was intended to be referenced partly in lieu of standby mode, when the statutory standby definition in the Energy Independence and Security Act of 2007[67] ("EISA 2007") did not apply. (CA IOUs, No. 14 at pp. 5–6) The CA IOUs recommended that the references to inactive mode be removed from the rulemaking unless DOE has identified a strong rationale for using a standby definition other than that provided by Congress. (CA IOUs, No. 14 at pp. 5–6)

In response to the CA IOUs' concern that DOE's proposal to define both "standby" and "inactive" mode may cause confusion, DOE notes that inactive mode was defined in the November 2021 NOPR as a subset of standby mode. It was in section 1.14 of the version of appendix I as finalized in the December 2016 Final Rule, on which the definitions used in the November 2021 NOPR were based. 86 FR 60974, 60991. EPCA, as amended by EISA 2007, requires DOE to integrate measures of standby mode and off mode energy consumption in any energy consumption metric, if technically feasible. (See 42 U.S.C. 6295(gg)(2)(A)) Inactive mode is the subset of standby mode measured as part of the energy consumption metric. DOE further notes that this terminology is consistent with other products such as clothes dryers, room air conditioners, and dishwashers. *See* 10 CFR part 430, subpart B, appendices D2, F, and C1.

[67] Pub. L. 110–140 (enacted Dec. 19, 2007).

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed definitions of "active mode," "off mode," "standby mode," "inactive mode," and "combined low-power mode."

2. Product Configuration and Installation Requirements

For additional clarity, in the November 2021 NOPR, DOE proposed to add definitions of "combined cooking product," "freestanding," "built-in," and "drop-in" to new appendix I1 that were included in the version of appendix I as finalized in the December 2016 Final Rule, and installation instructions for each of these configurations. 86 FR 60974, 60991.

DOE proposed to define combined cooking product as "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." *Id*.

DOE proposed to specify that a conventional cooking top or combined cooking product be installed in accordance with the manufacturer's instructions. *Id*. If the manufacturer's instructions specify that the product may be used in multiple installation conditions, the product would be installed according to the built-in configuration. *Id*. DOE proposed to require complete assembly of the product with all handles, knobs, guards, and similar components mounted in place, and that any electric resistance heaters, gas burners, and baffles be positioned in accordance with the manufacturer's instructions. *Id*.

DOE proposed that if the product can communicate through a network (*e.g.*, Bluetooth® or internet connection), the network function be disabled, if it is possible to disable it by means provided in the manufacturer's user manual, for the duration of testing. *Id*. If the network function cannot be disabled, or if means for disabling the function are not provided in the manufacturer's user manual, the product would be tested in the factory default setting or in the as-shipped condition. *Id*. These proposals are consistent with comparable provisions in final rule that DOE published for its microwave oven test procedure on March 30, 2022. 87 FR 18261, 18268.

DOE proposed to define "freestanding" as applying when "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." 86 FR 60974, 60991. DOE proposed that a freestanding combined cooking product be installed with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above the product and 1 foot beyond both sides of the product, and with no side walls. *Id*.

DOE proposed to define "built-in" as applying when "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." *Id*. DOE proposed to define "drop-in" as applying when "the product is supported by horizontal surface cabinetry." *Id*. DOE proposed that a drop-in or built-in combined cooking product be installed in a test enclosure in accordance with manufacturer's instructions. *Id*.

DOE proposed that a conventional cooking top be installed with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above the product and 1 foot beyond both sides of the product. *Id*.

DOE requested comment on its proposed definitions of product configurations and installation requirements. *Id*.

AHAM agreed with the proposed definitions for product configuration and installation requirements, stating that they align with existing industry standards. (AHAM, No. 12 at p. 14) AHAM commented that it is its understanding that DOE's proposal does not require additional installation requirements such as aesthetic or safety components (*e.g.*, anti-tipping brackets) that do not affect energy test performance, and stated that if this is not DOE's intent, then DOE should clarify its proposal and provide justification about why aesthetic or safety components should be installed, despite the added burden to install. (*Id*.)

NYSERDA urged DOE to amend the proposed procedure to account for network-connected energy usage during testing by requiring products be tested in the "as-shipped" condition to best represent typical use conditions. (NYSERDA, No. 10 at p. 2) According to NYSERDA, testing the product in the as-shipped condition is the best way to garner test results that are representative of real-world conditions, stating that it is unlikely the average consumer will read the manufacturer's instructions and disable network connectivity. (*Id.*)

The CA IOUs commented that DOE provides no information indicating that consumers will disable network functionality if they have a cooking top with this feature. (CA IOUs, No. 14 at p. 6) The CA IOUs asserted that testing the product in the "as-shipped" condition would be most representative of real-world conditions. (*Id.*) The CA IOUs stated that in the context of various DOE rulemakings, including the recently published microwave oven test procedure SNOPR, the CA IOUs have consistently commented that leaving networking functions in their as-shipped condition is most representative of real-world energy use in the absence of data indicating how consumers use connected functionality on the product under consideration. (*Id.*) The CA IOUs claimed, in particular, that given the limited user interface of many cooking products, granular control of networking capability (including on/off functionality) is seldom offered. (*Id.*) The CA IOUs commented that even if granular control of networking capability was offered, consumers would likely be unaware of the option to adjust such functions, or unable to determine how to do so. (*Id.*) The CA IOUs commented that they are fully supportive of innovation that enhances consumer utility but stated that this innovation ideally does not come at the expense of efficiency. (*Id.*) The CA IOUs commented that they understand the potential benefits of networked cooking products but stated that the implementation must be optimized properly. (*Id.*) The CA IOUs suggested that DOE's instruction to turn off networking as proposed in the test procedure provides an incentive for manufacturers to add a method for disabling connected functionality as cheaply as possible in a manner that may not be reasonably accessible to a consumer. (CA IOUs, No. 14 at pp. 6–7) The CA IOUs commented that this leaves consumers who do not take the active steps to disable their network functionality with unregulated energy consuming operations. (CA IOUs, No. 14 at p. 7) The CA IOUs commented that if DOE moves forward with its proposal to test with network functionality turned off when possible, DOE should provide market data illustrating that consumers do indeed take the active step to disable networking functionality. (*Id.*)

In response to AHAM's comment regarding installation requirements, DOE proposed to require complete assembly of the product with all handles, knobs, guards, and similar components mounted in place, and that any electric resistance heaters, gas burners, and baffles be positioned in accordance with the manufacturer's instructions. To the extent that an aesthetic or safety component does not correspond to any of these requirements, it would not be required to be installed.

DOE is aware of a number of cooking tops on the market with varying implementations of connected functionality. On such products, DOE has observed inconsistent implementations of these connected features across different brands, and that the design and operation of these features is continuously evolving as the market continues to grow for these products.

DOE remains unaware of any data available, nor did interested parties provide any such data, regarding the consumer use of connected features. Without such data, DOE is unable to establish a representative test configuration for assessing the energy consumption of connected functionality for conventional cooking tops during an average period of use, as required by EPCA. (See 42 U.S.C. 6293(b)(3))

DOE has determined that if network functionality cannot be disabled by the consumer, or if the manufacturer's user manual does not provide instruction for disabling the function, including the energy consumption of the enabled network function is more representative than excluding the energy consumption associated with the network function. For such products, the energy consumption of a connected function that cannot be disabled will be measured.

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed definitions of product configurations and installation requirements.

3. Power Settings

In the November 2021 NOPR, DOE proposed to clarify power setting selection by adding definitions of "power setting," "infinite power settings," "multi-ring cooking zone," and "maximum power setting" in new appendix I1, and by specifying which power settings are considered for each type of cooking zone. 86 FR 60974, 60991.

DOE proposed to define power setting as "a setting on a cooking zone control that offers a gas flame, electric resistance heating, or electric inductive heating." *Id*.

DOE proposed to define infinite power settings as "a cooking zone control without discrete power settings, allowing for selection of any power setting below the maximum power setting." *Id*.

DOE proposed to define a multi-ring cooking zone as "a cooking zone on a conventional cooking top with multiple concentric sizes of electric resistance heating elements or gas burner rings." *Id*.

DOE proposed to define maximum power setting as "the maximum possible power setting if only one cookware item is used on the cooking zone or cooking area of a conventional cooking top, including any optional power boosting features. For conventional electric cooking tops with multi-ring cooking zones or cooking areas, the maximum power setting is the maximum power corresponding to the concentric heating element with the largest diameter, which may correspond to a power setting which may include one or more of the smaller concentric heating elements. For conventional gas cooking tops with multi-ring cooking zones, the maximum power is the maximum heat input rate when the maximum number of rings of the cooking zone are ignited." *Id*. This definition is based on the definition of "maximum power" in Section 3.14 of both IEC 60350–2:2017 and IEC 60350–2:2021, which includes a note specifying that boost function must be considered in determining the maximum power setting.

DOE also proposed to clarify in new appendix I1 which power settings would be considered in the search for the simmering setting, based on its testing experience. *Id*. On a multi-ring cooking zone on a conventional gas cooking top, all power settings would be considered, whether or not they ignite all rings of orifices. *Id*. On a multi-ring cooking zone on a conventional electric cooking top, only power settings corresponding to the concentric heating element with the largest diameter would be considered, which may correspond to operation with one or more of the smaller concentric heating elements energized. *Id*.

On a cooking zone with infinite power settings for which the available range of rotation from maximum to minimum is more than 150 rotational degrees, power settings that are spaced by 10 rotational degrees would be evaluated. *Id*. On a cooking zone with infinite power settings for which the available range of rotation from maximum to minimum is less than or equal to 150 rotational degrees, power settings that are spaced by 5 rotational degrees would be evaluated. *Id*. Based on its testing experience, DOE tentatively determined in the November 2021 NOPR that 5 or 10 rotational degrees, as appropriate, would provide sufficient granularity in determining the simmering setting. *Id*. Given the provision, detailed in section III.E.4 of this document, to normalize the energy use of the Energy Test Cycle to a value representative of a simmering test with a final water temperature of 90 °C, DOE tentatively determined in the November 2021 NOPR that testing more settings would be unduly burdensome. *Id*. at 86 FR 60991–60992.

For cooking tops with rotating knobs for selecting the power setting, DOE stated in the November 2021 NOPR that it is aware that the knob may yield different input power results for the same setting depending on the direction in which the knob is turned to reach that setting. *Id*. at 86 FR 60992. The cause of this is hysteresis caused by potential backlash in the knob or valve. *Id*. at 86 FR 60992. To avoid hysteresis and ensure consistent input power results for the same knob setting, DOE proposed in the November 2021 NOPR that the selection knob be turned in the direction from higher power to lower power to select the potential simmering setting for the test. *Id*. DOE also proposed that if the appropriate setting is passed, the test must be repeated after allowing the product to return to ambient conditions. *Id*. DOE tentatively determined in the November 2021 NOPR that this specification would help obtain consistent input power for a given power setting, particularly on gas cooking tops, and thus improve repeatability and reproducibility of the test procedure. *Id*.

DOE requested comment on its proposed definitions of "power setting," "infinite power settings," "multi-ring cooking zone," and "maximum power setting." *Id*. DOE also requested comment on its proposal for the subsets of power settings on each type of cooking zone that are considered as part of the identification of the simmering setting. *Id*. DOE further requested comment on its proposal that for cooking tops with rotating knobs for selecting the power setting, the selection knob always be turned in the direction from higher power to lower power to select the potential simmering setting for a simmering test. *Id*.

NYSERDA agreed with the clarification as to which direction knobs should be rotated during the potential simmering setting determination to ensure repeatability and reproducibility. (NYSERDA, No. 10 at p. 2)

The CA IOUs supported DOE's proposal to demarcate discrete test settings for cooking tops with infinite controls, stating that this would minimize the chance that laboratories conduct tests under different test conditions. (CA IOUs, No. 14 at p. 2) The CA IOUs also commented that it is not immediately clear where the 5 or 10-degree increments start. (CA IOUs, No. 14 at p. 7) The CA IOUs requested greater clarity from DOE on this setting selection process, and that DOE include visual examples to reference. (*Id.*)

In response to the CA IOUs' request for greater clarity on the starting location of the 5 or 10-degree increments on a cooking top knob with infinite controls, DOE notes that the lowest power setting on a cooking top is the first position that meets the definition of a power setting (*i.e.*, a setting that offers a gas flame, electric resistance heating, or electric inductive heating), irrespective of how the knob is labeled. The 5 or 10-degree increments would start at the location of the lowest power setting. In this final rule, DOE is adding this clarification on where the 5 or 10-degree increments start to section 2.8.3 of appendix I1. A small difference in determining the lowest power setting between testing laboratories should not affect the reproducibility of the test results because of the requirement to normalize the per-cycle energy use for the final water temperature, as discussed in section III.E.4 of this document. Indeed, in the 2021 Round Robin, each testing laboratory determined for itself the location of the lowest power setting based on these instructions and in aggregate produced results with reproducibility COVs that DOE has determined are acceptable.

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed definitions of "power setting," "infinite power settings," "multi-ring cooking zone," and "maximum power setting". DOE also finalizes its proposal, consistent with the November 2021 NOPR and with the changes discussed above, to specify the subset of power settings on each type of cooking zone that are considered as part of the identification of the simmering setting. DOE also finalizes its proposal to require that for cooking tops with rotating knobs for selecting the power setting, the selection knob always be turned in the direction from higher power to lower power to select the potential simmering setting for a simmering test.

4. Specialty Cooking Zone

In the November 2021 NOPR, DOE proposed to include a definition of a "specialty cooking zone," including the clarification that such a cooking zone would not be tested under new appendix I1. 86 FR 60974, 60992. DOE proposed to define a specialty cooking zone as "any cooking zone that is designed for use only with non-circular cookware, such as bridge zones, warming plates, grills, and griddles. Specialty cooking zones are not tested under this appendix." *Id*.

DOE requested comment on its proposed definition of specialty cooking zone. *Id*.

The CA IOUs expressed uncertainty regarding why specialty cooking zones should be exempted from testing and recommended that DOE investigate the usage of specialty cooking zones. (CA IOUs, No. 14 at p. 7) The CA IOUs stated that testing units with specialty cooking zones would require a novel approach, but that they do not believe these units should be discounted simply because they are not a uniform circle. (*Id.*) The CA IOUs commented that IEC 60350–2:2017 has some direction for rectangular shapes and elliptical cookware. (*Id.*)

AHAM supported the exclusion of specialty cooking zones under the proposed test procedure and commented that specialty cooking zones for circular and non-circular cookware exist. (AHAM, No. 12 at p. 14) AHAM recommended removing the reference to non-circular cookware from the definition of a specialty cooking zone, stating that the proposed definition is too strict. (*Id.*)

In response to the CA IOUs' comment, the predominance of circular cookware on the market suggests that non-circular cookware is not representative of typical consumer usage. Therefore, a cooking zone designed for use only with non-circular cookware would not be expected to be used with any regularity, such that measuring its energy use would not be representative of the energy use of a cooking top during a representative average consumer use cycle, as is required by EPCA. (See 42 U.S.C. 6293(b)(3))

DOE further notes that its definition of specialty cooking zone does not categorize specialty cooking zones on the basis of the shape of the cooking zone itself; rather, the definition categorizes cooking zones designed for use *only with non-circular cookware* as one type of specialty cooking zone (emphasis added). See section III.E.1 of this document, for further discussion on testing non-circular cooking zones that are not specialty cooking zones.

For the reasons discussed, DOE finalizes its proposed definition of specialty cooking zone, consistent with the November 2021 NOPR. In response to AHAM's comment and for additional clarity, DOE is reordering the wording of the list of example specialty cooking zones within the definition to clarify that bridge zones are the only specific example provided of a cooking zone that is designed for use only with non-circular cookware; the references to warming plate, grill, and griddle are examples of types of specialty cooking zones other than cooking zones that are designed for use only with non-circular cookware.

5. Turndown Temperature

The turndown temperature (labeled "Tc" in both IEC 60350–2:2017 and IEC 60350–2:2021) is the measured water temperature at the time at which the tester begins adjusting the cooking top controls to change the power setting, *i.e.*, at "turndown." The target turndown temperature (which DOE proposed to label "Tc_{target}" in the November 2021 NOPR) is calculated for each cooking zone according to Section 7.5.2.1 of both IEC 60350–2:2017 and IEC 60350–2:2021 and section 3.1.4.2 of appendix I1, after conducting the overshoot test.[68] The target turndown temperature is the "ideal" turndown temperature, in that it is calculated such that the temperature of the water can rise higher than 90 °C with the lowest amount of energy use after the power is reduced, making use of the stored thermal energy of the cooking top, test vessel, and water load. Tc_{target} is calculated as 93 °C minus the amount that the water temperature "overshoots" the

[68] The overshoot test is a test conducted before any simmering tests are initiated. The appropriate test vessel and water load are placed on the heating element or burner, which is turned to the maximum power setting. The power or heat input is shut off when the water temperature reaches 70 °C. The maximum water temperature reached after the power/heat input is shut off is used to calculate the target turndown temperature.

temperature at which the power is turned off during the overshoot test. If the measured turndown temperature, Tc, is not between – 0.5 °C and + 1 °C of Tc_{target}, the simmering test evaluated according to section 3.1.4.5 of appendix I1 is considered invalid and must be repeated after allowing the product to return to ambient conditions.

In response to the November 2021 NOPR, Whirlpool commented that when the time at which the tester has physically taken the action to rotate the knob is different than the time at which the power stops, the identification of the turndown temperature is unclear. (Whirlpool, Public Meeting Transcript, No. 8 at p. 15) Whirlpool commented that its data has shown that if the element stays on after the knob has been physically rotated, the water temperature exceeds what Whirlpool characterized as the 93 °C limit. (Whirlpool, Public Meeting Transcript, No. 8 at p. 16)

In response to Whirlpool's concern that the water temperature may exceed 93 °C during the simmering test, DOE notes that the test procedure does not define a temperature limit (at 93 °C or any other temperature) that the water temperature must remain under for a simmering test to be valid. Although the value of 93 °C is used as a constant in the formula for calculating Tc_{target}, this formula does not imply a temperature limit during the simmering test.

Nevertheless, DOE agrees with Whirlpool that additional clarification regarding the turndown temperature is needed, in particular to address situations when there is a delay between the time at which the tester turns down the controls and the time at which the power decreases accordingly. DOE considered the test burden of defining the turndown temperature based on the time at which the power decreases. This led DOE to determine that the burden could be significant for products exhibiting this behavior because a larger than typical number of tests could be considered invalid on the basis of Tc not being within the required range and subsequently needing re-testing. DOE compared this burden to the potential repeatability concerns of defining the turndown temperature based on the time at which the tester takes the physical action of adjusting the cooking top controls (*e.g.*, rotating the knob) if the power decrease lag is unrepeatable. In DOE's testing, for many electric cooking tops, the power level at the lower power settings is achieved by duty-cycling the power to the heating element. For some units this duty cycle may start with the "on" part of the duty cycle. For these units in particular, it may be impossible to determine retroactively from the data when the cooking top power setting has been changed, because the measured power will remain at the maximum output even after the setting has been changed. Therefore, DOE has determined that defining the turndown temperature at the time at which the power drops would not be repeatable. Therefore, in this final rule, DOE is defining the turndown temperature based on the time at which the tester adjusts the cooking top controls to change the power setting. In particular, because it can take several seconds to adjust the cooking top controls on certain cooking tops, DOE is defining the turndown temperature based on the time at which the tester *begins* adjusting the cooking top controls (emphasis added).

In this final rule, DOE is including definitions for the target turndown temperature and the turndown temperature in section 1 of appendix I1. DOE defines target turndown temperature (Tc_{target}) as "the temperature as calculated according to Section 7.5.2.1 of

IEC 60350–2:2021 and section 3.1.4.2 of appendix I1, for each cooking zone." DOE defines turndown temperature (Tc) for each cooking zone, as "the measured water temperature at the time at which the tester begins adjusting the cooking top controls to change the power setting." The test procedure adopted in this final rule uses the defined terms where applicable.

In the November 2021 NOPR, DOE proposed to include in new appendix I1 the formula for calculating the target turndown temperature after conducting the overshoot test based on DOE testing experience. That experience has shown that referencing the definition of this value in IEC 60350–2 (rather than providing the definition within the DOE test procedure) can lead to inadvertent errors in performing the calculation. 86 FR 60974, 60992. The target turndown temperature is calculated as 93 °C minus the difference between the maximum measured temperature during the overshoot test, T_{max}, and the 20-second average temperature at the time the power is turned off during the overshoot test, T_{70}. Two common mistakes in calculating the target turndown temperature are using the target value of 70 °C rather than the measured T_{70} in the formula and failing to round the target turndown temperature to the nearest degree Celsius. *Id*. By including the formula for the target turndown temperature in the new appendix I1, DOE stated in the November 2021 NOPR that it aims to reduce the incidence of such errors. *Id*.

DOE requested comments on its proposal to include the formula for the target turndown temperature in the new appendix I1. *Id*.

DOE did not receive any comments regarding its proposal to include the formula for the target turndown temperature in the new appendix I1.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to include the formula for the target turndown temperature in the new appendix I1.

H. Test Conditions and Instrumentation

In this final rule, DOE is incorporating the test conditions and instrumentation requirements of IEC 60350–2:2021 into the new appendix I1 with the following additions.

1. Electrical Supply

Section 5.2 of both IEC 60350–2:2017 and IEC 60350–2:2021 specifies that the electrical supply is required to be at "the rated voltage with a relative tolerance of ±1 %" and "the rated frequency ±1 %." Both IEC 60350–2:2017 and IEC 60350–2:2021 further specify that the supply voltage and frequency shall be the nominal voltage and frequency of the country in which the appliance is intended to be used. In the November 2021 NOPR, DOE proposed to specify in new appendix I1 that the electrical supply for active mode testing be maintained at either 240 volts ±1 percent or 120 volts ±1 percent, according to the manufacturer's instructions, and at 60 Hz ± 1 percent, except for products which do not allow for a mains electrical supply. 86 FR 60974, 60992.

DOE requested comment on its proposed electrical supply requirements for active mode testing. *Id*.

DOE did not receive any comments regarding the proposed electrical supply requirements for active mode testing.

During the 2021 Round Robin, DOE observed intermittent instantaneous voltage fluctuations outside of the required tolerance on certain units in its test sample. DOE understands that these fluctuations are a normal response to the turning on or off of major electrical components and that such momentary fluctuations do not measurably affect the unit's energy consumption. The Task Force has added a statement on the voltage conditions to AHAM's draft test method, stating that "The actual voltage shall be maintained and recorded throughout the test. Instantaneous voltage fluctuations caused by the turning on or off of electrical components shall not be considered." This is consistent with language included in AHAM's HRF-1-2019 test method, "Energy and Internal Volume of Consumer Refrigeration Products", which DOE has incorporated by reference into its test procedures for refrigerators, refrigerator-freezers, and freezers, and miscellaneous refrigeration products. 86 FR 56790, 56801 (Oct. 12, 2021). In this final rule, DOE incorporates this same language into its electrical supply specification for active mode testing of conventional cooking tops.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to specify in new appendix I1 that the electrical supply for active mode testing be maintained at either 240 volts ±1 percent or 120 volts ±1 percent, according to the manufacturer's instructions, and at 60 Hz ± 1 percent, except for products which do not allow for a mains electrical supply, with the new addition regarding instantaneous fluctuations discussed above.

2. Water Load Mass Tolerance

In the November 2021 NOPR, DOE proposed to specify a tolerance on the water load mass in the new appendix I1. 86 FR 60974, 60992. Neither the version of appendix I as finalized in the December 2016 Final Rule, IEC 60350–2:2017 nor IEC 60350–2:2021 includes a tolerance on the water load mass. DOE proposed to specify a tolerance of ± 0.5 grams ("g") for each water load mass, to improve the repeatability and reproducibility of the test procedure. *Id*.

DOE requested comment on the proposed tolerance of ± 0.5 g for each water load mass. *Id*.

NYSERDA commented that it supports DOE's effort to define a tolerance for water load mass to ensure repeatability and reproducibility. (NYSERDA, No. 10 at p. 2)

AHAM opposed DOE's proposal to set the allowable tolerance on the water load mass as ± 0.5 g, stating that the proposed tolerance is too small and increases test burden. (AHAM, No. 12 at p. 14) AHAM commented that DOE has not presented data showing the need for this tight of a tolerance and that AHAM has not seen evidence that tightening this tolerance will reduce overall test variation. (*Id*.) AHAM commented that it requests that DOE investigate alternative tolerances for the water load mass. (*Id*.)

In response to AHAM's comment, DOE notes that the ± 0.5 g water load mass tolerance was used for the 2021 Round Robin testing, and none of the participating laboratories reported any problem achieving this tolerance. Furthermore, this testing achieved repeatable results. In addition, no stakeholders provided any data indicating that a wider tolerance would not negatively impact the results.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to specify a tolerance of ± 0.5 g for each water load mass.

3. Test Vessel Flatness

In its petition, AHAM raised concerns about the impact of pan warpage on the repeatability and reproducibility of the test procedure. 83 FR 17944, 17958. In the November 2021 NOPR, DOE investigated potential pan warpage over repeated test cycles. 86 FR 60974, 60992.

DOE test data showed some amount of variation in the flatness measurement over time for each test vessel, but there was no consistent or substantive trend. *Id*. at 86 FR 60993. Therefore, in the November 2021 NOPR, DOE tentatively determined that pan warpage is not an issue of concern for the test procedure. *Id*.

DOE requested comment on its proposed determination that pan warpage does not affect repeatability and reproducibility of the test procedure. *Id*.

AHAM commented that DOE's assessment of the effects of pan warpage are inadequate because no gas units were evaluated. (AHAM, No. 12 at p. 15) AHAM commented that if part of the test vessel is closer or further from the heating source, it will likely have an effect on how the water is heated. (*Id.*) AHAM commented that it requests information on the types of electric units that DOE evaluated, particularly induction units. (*Id.*) AHAM commented that this may have implications relating to the use of the same pots for gas and electric units, stating that warpage from gas testing may have significant impact on induction testing when using the same vessels, for example. (*Id.*)

In response to AHAM's comment, DOE notes that while it does not have data on the effects of gas cooking top testing on test vessel flatness at this time, the 2021 Round Robin testing, which achieved repeatable results, was conducted using the same test vessels for both electric and gas cooking tops. This indicates that if any warpage did occur, it did not significantly impact the repeatability or reproducibility of test results on either gas or electric cooking tops.

In response to AHAM's request for information on DOE's flatness testing, Table III.3 lists the number of test cycles that were run on each unit type for each test vessel size for which flatness data was presented in the November 2021 NOPR.

Table III.3 Number of Test Cycles on Each Unit Type for Each Test Vessel Size Presented in the November 2021 NOPR

Test Vessel Diameter (mm)	**150**	**180**	**210**	**270**	**Total**
Number of Cycles on Coil Units	21	7	0	0	**28**
Number of Cycles on Radiant Units	4	12	10	5	**31**

Number of Cycles on Induction Units	0	6	0	0	**6**

For the reasons discussed, DOE finalizes its determination, consistent with the November 2021 NOPR, that to the extent pan warpage occurs during testing, it does not affect repeatability and reproducibility of the test procedure.

I. Standby Mode and Off Mode Energy Consumption

1. Incorporation by Reference of IEC 62301

EPCA requires DOE to include the standby mode and off mode energy consumption in any energy consumption metric, if technically feasible. (See 42 U.S.C. 6295(gg)(2)(A)) In the October 2012 Final Rule, DOE incorporated IEC 62301 Second Edition for measuring the power in standby mode and off mode of conventional cooking products. This includes five provisions: the room ambient air temperature from Section 4, Paragraph 4.2 of IEC 62301 Second Edition, the electrical supply voltage from Section 4, Paragraph 4.3.2 of IEC 62301 Second Edition, the watt-meter from Section 4, Paragraph 4.4 of IEC 62301 Second Edition, portions of the installation and set-up from Section 5, Paragraph 5.2 of IEC 62301 Second Edition, and the stabilization requirements from Section 5, Paragraph 5.1, Note 1 of IEC 62301 Second Edition. 77 FR 65942, 65948. DOE also specified that the measurement of standby mode and off mode power be made according to Section 5, Paragraph 5.3.2 of IEC 62301 Second Edition, except for conventional cooking products in which power varies as a function of the clock time displayed in standby mode (see section III.I.2 of this final rule). *Id*. This procedure is used by microwave ovens in the current version of appendix I. In the November 2021

NOPR, DOE proposed to include the same procedure in the new appendix I1 for conventional cooking tops. 86 FR 60974, 60993.

DOE requested comment on its proposal to incorporate IEC 62301 Second Edition to provide the method for measuring standby mode and off mode power, except for conventional cooking products in which power varies as a function of the clock time displayed in standby mode. *Id*.

DOE did not receive any comments regarding its proposal to incorporate IEC 62301 Second Edition to provide the method for measuring standby mode and off mode power, except for conventional cooking products in which power varies as a function of the clock time displayed in standby mode.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to incorporate IEC 62301 Second Edition to provide the method for measuring standby mode and off mode power, except for conventional cooking products in which power varies as a function of the clock time displayed in standby mode.

2. Standby Power Measurement for Cooking Tops With Varying Power as a Function of Clock Time

In the October 2012 Final Rule, DOE determined that for conventional cooking products in which power varies as a function of the clock time displayed in standby mode, measuring standby mode and off mode power according to Section 5, Paragraph

5.3.2 of IEC 62301 Second Edition would cause manufacturers to incur significant burden that would not be warranted by any potential improved accuracy of the test measurement. 77 FR 65942, 65948. Therefore, the October 2012 Final Rule required a modified approach from IEC 62301 First Edition. It implemented the following language in appendix I: for units in which power varies as a function of displayed time in standby mode, clock time would be set to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 First Edition, and the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 First Edition would be used, but with a single test period of 10 minutes +0/-2 sec after an additional stabilization period until the clock time reached 3:33. *Id*.

In a final rule published on January 18, 2013, DOE implemented the same approach for microwave ovens in appendix I. 78 FR 4015, 4020.

In the November 2021 NOPR, DOE proposed to incorporate in the new appendix I1 the same approach for measuring the standby power of cooking tops in which the power consumption of the display varies as a function of the time displayed, with clarifications. 86 FR 60974, 60994. In response to a test laboratory's feedback, DOE proposed to update the wording from that finalized in the October 2012 Final Rule to provide additional direction regarding the two stabilization periods. *Id*. The proposed language read, "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 an initial stabilization period, as specified in Section 5, Paragraph 5.3 of IEC 62301 First Edition. After an additional 10-minute stabilization period, measure the power use for a single test period of 10 minutes

+0/−2 seconds that starts when the clock time first reads 3:33. Use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 First Edition." *Id*.

DOE requested comment on its proposal to incorporate into appendix I1 IEC 62301 First Edition for measuring standby mode and off mode power for conventional cooking tops in which power varies as a function of the clock time displayed in standby mode. *Id*. DOE did not receive any comments regarding this proposal.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to incorporate IEC 62301 First Edition for measuring standby mode and off mode power for conventional cooking tops in which power varies as a function of the clock time displayed in standby mode.

J. Metrics

1. Annual Active Mode Energy Consumption

In the November 2021 NOPR, DOE proposed to calculate cooking top annual active mode energy consumption as the average normalized per-cycle energy use across all tested cooking zones multiplied by the number of annual cycles. 86 FR 60974, 60994. The per-cycle energy use would be normalized in two ways: first, by interpolating to represent a final water temperature of 90 °C, as described in section III.E.4 of this document, and second, by scaling according to the ratio of a representative water load mass to the water mass used in the test. *Id*.

To determine the representative water load mass for both electric and gas cooking tops for the December 2016 Final Rule, DOE reviewed the surface unit diameters and input rates for cooking tops (including those incorporated into combined cooking products) available on the market at the time of a supplemental NOPR that DOE published prior to the December 2016 Final Rule. 81 FR 57374, 57387 (Aug. 22, 2016). To determine the market-weighted average water load mass, DOE used the methodology in EN 60350–2:2013, which is the same as the methodology in IEC 60350–2:2017 and IEC 60350–2:2021 for selecting test vessel diameters and their corresponding water load masses. DOE determined that the market-weighted average water load mass for both electric and gas cooking top models available on the U.S. market was 2,853 g (equivalent to around 12 U.S. cups or 0.75 gallons) and used that value in the December 2016 Final Rule. 81 FR 91418, 91437.

DOE proposed in the November 2021 NOPR to use the same representative water load mass for per-cycle energy use normalization of 2,853 g in the new appendix I1. 86 FR 60974, 60994.

DOE requested comment on its proposal to use a representative water load mass of 2,853 g in the new appendix I1. *Id*.

AHAM commented that it believes that DOE's proposed representative water load mass of 2,853 g is overestimated and multiplied by more than one cooking use per day. (AHAM, No. 12 at p. 15) AHAM commented that it is unclear that this load is representative of actual use. (*Id*.) AHAM asked DOE to reanalyze this calculation using updated appliance shipments and stated that AHAM is glad to consider providing updated shipments under confidentiality agreement upon request. (*Id.*)

In response to AHAM's comment, DOE notes that it does not expect the representative water load mass per cycle to have changed since 2016. DOE also notes, as discussed in further detail below, that AHAM's opposition to the proposed water load mass value is based in part on a mistaken understanding that the annual active-mode energy consumption is calculated based on 12 cups of water per *cooking zone* per day (emphasis added). DOE clarifies that the annual active-mode energy consumption, as proposed in the November 2021 NOPR, was calculated based on 12 cups of water per *cooking top* per day (emphasis added); *i.e.*, not multiplied by the number of cooking zones on the cooking top.

For reference, DOE further notes that a water load of 12 cups represents roughly enough water to cook 12 ounces of pasta, which is approximately 3–5 individual servings.[69] This further supports the determination of 12 cups of water per cooking top per day as a reasonable estimate of representative consumer use.

For these reasons, DOE maintains its determination that 2,853 g per cooking top per day is a representative water load mass.

[69] A reputable cooking website states that 4 quarts (16 cups) of water are needed to cook 1 pound (16 ounces) of pasta; *i.e.*, 1 cup of water per ounce of pasta. The same source states that 2 ½ to 4 ½ ounces of pasta represent an individual serving. Using this conversion, 12 ounces of pasta equates to 2.7 to 4.8 servings. See *www.eataly.com/us_en/magazine/how-to/how-to-cook-pasta/*. Last accessed April 8, 2022.

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to use a representative water load mass of 2,853 g per cooking top per day in the new appendix I1.

In the December 2016 Final Rule, DOE used data from the 2009 Residential Energy Consumption Survey ("RECS") and a review of field energy consumption survey data of residential cooking from 2009 and 2010 to estimate 207.5 cycles per year for electric cooking tops and 214.5 cycles per year for gas cooking tops. 81 FR 91418, 91438. For the November 2021 NOPR, DOE determined an updated value of annual cooking top cycles based on analyzing data from three more recent sources. 86 FR 60974, 60994.

In the November 2021 NOPR, DOE analyzed the 5,686 household responses from the 2015 RECS to estimate the number of annual cooking top cycles by installation configuration. *Id*. The 2015 RECS asked respondents, geographically distributed in the United States, to provide the number of uses per week of their standalone cooking top and the cooking top portion of a combined cooking product (which included a cooking top with a conventional oven.) From these weekly frequency-of-use data, DOE calculated a weighted-average annual number of cooking top cycles of 418. *Id*. This value represents an average of both gas and electric cooking tops, as well as an average of both standalone cooking tops and the cooking top components of combined cooking products. In the November 2021 NOPR, DOE tentatively determined that a single value for both gas and electric cooking tops is most representative of consumer usage, as DOE is not aware of any reason for consumers of products with different energy sources to use their cooking products more or less frequently. *Id*.

In the November 2021 NOPR, DOE also reviewed data provided by AHAM through its Task Force, which summarized the cooking patterns of 3,508 consumers with connected cooking products, based on information collected via their network functions. *Id*. Although the data did not identify specific geographical locations, AHAM indicated the sample of consumers represented a distribution of connected cooking product owners across the United States. *Id*. This AHAM data set showed an average annual number of cooking top cycles of 365. *Id*. DOE also analyzed a third set of field-metered data (*i.e.*, data collected from measuring the consumption of individual cooking tops as used by consumers in real-world installations), which showed a median of 437 annual cooking top cycles. *Id*.

In the November 2021 NOPR, DOE proposed to use the 2015 RECS value of 418 cycles per year for calculating annual active mode energy use. *Id*. This is the median of the three considered values and is based on the largest sample size and broadest distribution by geography and household characteristics.

DOE requested comment on its proposal to use a value of 418 annual cooking top cycles per year. *Id*.

The CA IOUs commented that they recommend that frequency of use data be updated to include information collected showing the impact of the COVID-19 pandemic on home cooking habits, as identified in the CA IOUs' comment in response to DOE's notification of proposed determination not to amend energy conservations standards for conventional cooking products published on December 14, 2020. (CA IOUs, No. 14 at p. 7 referencing 85 FR 80982) The CA IOUs commented referencing a marketing and public relations firm's study [70] which found that COVID-19 has increased cooking habits and that consumers expect that these new habits will persist. (*Id*. referencing EERE-2014-BT-STD-005, CA IOUs, No. 89 at p. 3) The CA IOUs commented that this projection would increase annual energy consumption projections. (CA IOUs, No. 14 at p. 7)

AHAM commented that DOE's proposed value of 418 annual cooking top cycles per year in combination with the proposed 2,853 g representative water load mass contribute to an overestimate of annual energy use. (AHAM, No. 12 at p. 15) AHAM commented that DOE should provide details on its methodology and calculation steps justifying the annual number of cycles from 2015 RECS data. (*Id*.) AHAM commented that it believes the proposed number of annual cycles is too high and that it exaggerates the representative cycles and the representative water load mass, stating that these values should not be determined separately. (*Id*.) AHAM commented that the proposed test procedure requires the energy of all four cooking zones to be calculated during a heat up and a simmer, and stated that by its calculation, the annual energy use represents the equivalent of 1,672 operations of one cooking zone's heat up and simmer per year. (*Id*.)

[70] HUNTER: FOOD STUDY 2020 SPECIAL REPORT (America Gets Cooking: The Impact of COVID-19 on Americans' Food Habits). Published in December 2020. Available at *www.hunterpr.com/foodstudy_coronavirus/*.

AHAM commented that the energy test represents, on average, 1,400 seconds of operation per run on each cooking zone and stated that this equates to 23.3 minutes per cooking zone or, by AHAM's calculation, a total of 93 minutes of operations per unit per test (23.3 minutes x 4 cooking zones). (*Id*.) AHAM commented that the operation time of 93 minutes multiplied by DOE's proposed number of cycles of 418 and divided by 365 days in a year results in 107 minutes (1.8 hours) of total operation of the cooking top per day. (*Id*.) AHAM commented that this value conflicts with AHAM consumer research and manufacturers connected data on usage, which show daily usage of 70.1 minutes and 53.8 minutes, respectively. (AHAM, No. 12 at pp. 15–16)

In response to the CA IOUs' comment, DOE notes that while the CA IOUs provided data suggesting that COVID-19 has increased cooking habits and that consumers expect that these new habits will persist, DOE does not have data reflecting the degree to which these cooking habits may have changed. DOE is also unable to make projections about future trends in consumer cooking habits. DOE will continue to monitor patterns in consumer frequency of use data and will consider updating its annual energy consumption projections in the future, should additional data suggest that updates are warranted.

As AHAM's requested, below are details about how DOE calculated its proposed value of 418 annual cooking top cycles per year. DOE divided the weekly frequency of use data obtained from 2015 RECS data by 7 to obtain a daily frequency of use of 1.144 average daily cooking top cycles across all product types that include a cooking top.

DOE then multiplied 1.144 daily cooking top cycles by 365 days in a year to obtain 418 annual cooking top cycles per year.[71]

In response to AHAM's comment regarding its calculation of daily cooking top usage, the annual energy calculation proposed in the November 2021 NOPR represents 418 annual cycles multiplied by the average of all heating elements on a cooking top, not, as AHAM stated, the sum of all heating elements. For example, as proposed, on a cooking top with four cooking zones, the proposed 418 annual cooking top cycles would be allocated over all 4 cooking zones, for an average of 104.5 annual cooking cycles per cooking zone. DOE does not expect, nor does the test procedure calculation project, that each cooking zone be used for 418 annual cycles (for a total of 1,672 cycles on a cooking top with four cooking zones), as posited by AHAM.

Assuming a range of 23 to 37 minutes per test cycle (as supported by DOE's test data),[72] 418 annual cooking top cycles would result in a range of 9,614[73] to 15,466[74] minutes of cooking top use per year, or an average range of 34 to 42 minutes per day. This is within the range of data AHAM has provided as part of this rulemaking, and the

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[71] 1.144 × 365 = 417.6, rounded to 418.

[72] Based on DOE's test data, the time to t_{90} (see definition in section III.E.3 of this document) varies by technology type. For induction units, the time to t_{90} is around 3 minutes; for coil and radiant units, the time to t_{90} is around 6–9 minutes; and for gas units, the time to t_{90} is around 15–17 minutes. The test cycle duration is equal to the time to t_{90} plus a 20-minute simmering period.

[73] 23 minutes per test cycle × 418 annual cooking top cycles = 9,614 minutes of cooking top use per year.

[74] 37 minutes per test cycle × 418 annual cooking top cycles = 15,466 minutes of cooking top use per year.

ongoing Task Force, which suggest daily cooking top use ranging from 18 minutes[75] to 70.1 minutes[76] (see section III.J.2 for further discussion of cooking top cycle time).

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to use a value of 418 annual cooking top cycles per year.

2. Combined Low-Power Mode Hours

The number of cooking top annual combined low-power mode hours is calculated as the number of hours in a year, 8,760, minus the number of annual active mode hours for the cooking top, which for most product types is equal to the number of annual cycles multiplied by cycle time. Additional calculations, as discussed below, are necessary for the cooking top component of a combined cooking product.

In a NOPR preceding the October 2012 Final Rule, DOE investigated the hours and energy consumption associated with each possible operating mode for conventional cooking tops, including inactive, Sabbath, off, and active modes. 75 FR 75290, 75310 (Dec. 2, 2010). In the October 2012 Final Rule, DOE described "Sabbath mode" as a mode in which the automatic shutoff is overridden to allow for warming of pre-cooked foods during such periods as the Jewish Sabbath. 77 FR 65942, 65952. In its analysis leading up to the October 2012 Final Rule, DOE assigned the hours for which the cooking product is in Sabbath mode as active mode hours, because the energy use of those hours is similar to the energy use of the active mode. 75 FR 75290, 75311. DOE

[75] See discussion of this data in section III.J.2 of this document.
[76] See AHAM, No. 12 at p. 15.

estimated an equivalent of 8.6 annual hours in Sabbath mode, based on the number of annual work-free hours and the percentage of U.S. households that observe kosher practices. *Id*. at 75 FR 75309. In that rule, DOE scaled the 8.6 hours according to the number of annual cooking cycles, the number of cooking products per household, and an assumption that a cooking top would only be used on the Sabbath a quarter of the time. *Id*. This resulted in 2.2 hours per year for standalone cooking tops, and 8.8 hours per year for conventional ranges.

In 2010, DOE estimated that the total number of cooking top cycles per year was 211 (see section III.J.1 of this document), the average cycle time was 1 hour, and cooking tops spent 2.1 annual hours in Sabbath mode. *Id*. Therefore, in the October 2012 Final Rule, DOE specified that the number of annual active-mode hours was 213.2 and the number of annual combined low-power mode hours was 8,546.9. 77 FR 65942, 65994.

In the December 2016 Final Rule, DOE observed that for combined cooking products, the annual combined low-power mode energy consumption could be measured only for the combined cooking product and not the individual components. 81 FR 91418, 91423. For a combined cooking product, DOE calculated the annual combined low-power mode of the conventional cooking top component. This involved 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 in the combined cooking product. *Id*.

In the November 2021 NOPR, DOE proposed to update the estimate of the annual combined low-power mode hours for standalone cooking tops and for the cooking top component of combined cooking products. This involved using more recent estimates for the number of annual cooking top cycles and the representative cycle time. 86 FR 60974, 60995. As discussed in section III.J.1 of this document, DOE is using a value of 418 annual cooking top cycles for all cooking tops.

For representative average cooking top cycle time, in the November 2021 NOPR, DOE reviewed data provided by AHAM. The data summarized the cooking patterns of 3,508 consumers with connected cooking products, based on information collected via their network functions. *Id*. Although the data did not identify specific geographical locations, AHAM indicated the sample of consumers represented a distribution of connected cooking product owners across the United States. This AHAM data set showed an average cooking top cycle time of 18 minutes. However, as DOE stated in the November 2021 NOPR, it is concerned that because higher-income households tend to purchase connected cooking products, usage patterns of those consumers may not be representative of the usage patterns for all U.S. consumers. *Id*.

DOE also analyzed field-metered data that showed a median cycle time of 31 minutes. *Id*. DOE expects the distribution of usage patterns among these homes are more representative of consumer habits in the United States as a whole because the metering was not limited to premium products. In the November 2021 NOPR, DOE proposed to calculate the number of cooking top annual active mode hours per installation configuration by multiplying the annual cycles estimated from the 2015

RECS by the 31-minute median cycle time, and then adding the appropriate number of Sabbath mode hours.[77] *Id*. DOE estimated the number of annual active mode hours for the overall cooking product using five additional values. The first additional value was the number of cooking tops per household, which was determined to be 1.02 using the 2015 RECS. Second was the annual number of conventional oven cycles conducted per year on combined cooking products, which was determined to be 145 using the 2015 RECS. Third was the number of microwave oven cycles per year, which was determined to be 627 using the 2015 RECS. Fourth was the average cycle time for a conventional oven, which was assumed to be 1 hour. Fifth was the average cycle time for a microwave oven, which was assumed to be 6 minutes. *Id*.

DOE proposed to estimate the annual combined low-power mode hours for the overall product for each installation configuration by subtracting the resulting annual active mode hours from 8,760 annual hours. *Id*. Finally, DOE calculated the percentages of combined lower-power mode hours assigned to the cooking top component by determining the proportion of overall active mode hours that are associated with the cooking top component of the combined cooking product. *Id*. The results for DOE's combined low-power mode usage factors and resulting cooking top annual combined low-power mode hours proposed in the November 2021 NOPR are shown in Table III.4.

[77] Given the value of 1.02 cooking tops per household determined using 2015 RECS, and using the same 25-percent assumption of the percent of time a cooking top is left on during the Sabbath (as opposed to a conventional oven), DOE assumed 2.2 hours per year in Sabbath mode for standalone cooking tops and for combined cooking products comprised of a microwave oven and a cooking top; and 8.8 hours per year in Sabbath mode for combined cooking products that include a conventional oven.

Table III.4 Combined Low-Power Mode Usage Factors Proposed in the November 2021 NOPR

Product Type	Overall Product		Cooking Top	
	Active Mode Hours per Year	Combined Low-Power Mode Hours per Year	Percentage of Overall Combined Low-Power Mode Hours Allocated to the Cooking Top	Combined Low-Power Mode Hours per Year
Standalone cooking top	216	8,544	100%	8,544
Conventional range (cooking top + conventional oven)	368	8,392	60%	5,004
Cooking top + microwave oven	279	8,481	77%	6,560
Cooking top + conventional oven + microwave oven	431	8,329	51%	4,228

DOE requested comment on its proposed usage factors and annual hours for cooking top combined low-power mode, as well as on any of the underlying assumptions. *Id*.

DOE did not receive any comments regarding its proposed usage factors and annual hours for cooking top combined low-power mode, or on any of the underlying assumptions, except for comments about the number of annual cycles, as discussed in section III.J.1 of this document.

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed usage factors and annual hours for cooking top combined low-power mode.

3. Annual Combined Low-Power Mode Energy

In the November 2021 NOPR, DOE proposed that the annual energy in combined low-power mode for a cooking top be calculated as follows. Multiply the power consumption of the overall cooking product in standby and/or off mode (see sections III.I.1 and III.I.2 of this document) by the number of annual combined low-power mode hours for the cooking top or cooking top component of a combined cooking product (see section III.J.2 of this document). 86 FR 60974, 60995–60996. As DOE has done in the test procedures for other appliances that can have either an inactive (standby) mode, an off mode, or both, DOE proposed that the total number of cooking top annual combined low-power mode hours be allocated to each of inactive mode or off mode as illustrated in Table III.5. *Id*. at 86 FR 60996.

Table III.5 Allocation of Cooking Top Combined Low-Power Mode Hours from the November 2021 NOPR

Types of Low-Power Mode(s) Available	Allocation to Inactive Mode	Allocation to Off Mode
Both inactive and off mode	0.5	0.5
Inactive mode only	1	0
Off mode only	0	1

DOE requested comment on its proposed allocation of combined low-power mode hours. *Id*.

DOE did not receive any comments regarding its proposed allocation of combined low-power mode hours.

For the reasons discussed, DOE finalizes, consistent with the November 2021 NOPR, its proposed allocation of combined low-power mode hours.

4. Integrated Annual Energy Consumption

In the November 2021 NOPR, DOE proposed to define the integrated annual energy consumption ("IAEC") for each tested cooking top. 86 FR 60974, 60996. For electric cooking tops, IAEC was defined in kilowatt-hours ("kWh") per year and is equal to the sum of the annual active mode energy and the annual combined low-power mode energy. *Id*. For gas cooking tops, IAEC was defined in kilo-British thermal units ("kBtu") per year and is equal to the sum of the annual active mode gas energy consumption, the annual active mode electric energy consumption (converted into kBtu per year), and the annual combined low-power mode energy (converted into kBtu per year). *Id*.

DOE did not receive any comments regarding its proposed definition of IAEC.

In this final rule, DOE finalizes, consistent with the November 2021 NOPR, its proposed definition of IAEC.

5. Annual Energy Consumption and Annual Cost

Section 430.23(i) of title 10 of the CFR lists the test procedures for measuring the energy consumption of cooking products. As there are no current test procedures for conventional cooking tops, 10 CFR 430.23(i) contains provisions only for microwave ovens.

In the November 2021 NOPR, DOE proposed to renumber the existing microwave oven paragraph as 10 CFR 430.23(i)(1) and to add new paragraphs (i)(2) through (i)(6) containing provisions for measuring the electrical energy consumption, gas energy consumption, and annual cost of conventional cooking tops. 86 FR 60974, 60996.

New paragraph (i)(2) as proposed in the November 2021 NOPR would provide the means of calculating the integrated annual energy consumption for a conventional cooking top, whether electric or gas, including any conventional cooking top component of a combined cooking product. *Id*. The result would be rounded to the nearest 1 kWh per year for electric cooking tops, and to the nearest 1 kBtu per year for gas cooking tops. *Id*.

New paragraph (i)(3) as proposed in the November 2021 NOPR would provide the means of calculating the total annual gas energy consumption of a conventional gas cooking top, including any conventional cooking top component of a combined cooking product. *Id*. The result would be rounded to the nearest 1 kBtu per year. *Id*.

New paragraph (i)(4) as proposed in the November 2021 NOPR would provide the means of calculating the total annual electrical energy consumption for a conventional cooking top, whether electric or gas, including any conventional cooking top component of a combined cooking product. *Id*. The result would be rounded to the nearest 1 kWh per year. *Id*. The total annual electrical energy consumption of a conventional electric cooking top would equal the integrated annual energy consumption of the conventional electric cooking top, as determined in paragraph (i)(2). *Id*.

New paragraph (i)(5) as proposed in the November 2021 NOPR would provide the means of calculating the estimated annual operating cost corresponding to the energy consumption of a conventional cooking top, including any conventional cooking top component of a combined cooking product. *Id*. The result would be rounded to the nearest dollar per year. *Id*.

New paragraph (i)(6) as proposed in the November 2021 NOPR would allow the definition of other useful measures of energy consumption for conventional cooking tops that the Secretary determines are likely to assist consumers in making purchasing decisions and that are derived from the application of appendix I1. *Id*.

DOE requested comment on its proposed provisions for measuring annual energy consumption and estimated annual cost. *Id*.

DOE did not receive any comments regarding its proposed provisions for measuring annual energy consumption and estimated annual cost.

In this final rule, DOE finalizes, consistent with the November 2021 NOPR, its proposed provisions for measuring annual energy consumption and estimated annual cost.

K. Alternative Proposals

In the November 2021 NOPR, DOE stated that it was aware of alternative approaches to the proposed cooking top test procedure and listed alternative approaches that were being considered by stakeholders. 86 FR 60974, 60996. DOE added that it could consider adopting these alternative proposals if sufficient data were available to evaluate whether such test procedures are reasonably designed to produce test results which measure energy use of conventional cooking tops during a representative average use cycle or period of use and are not unduly burdensome to conduct. *Id*. (*See* 42 U.S.C. 6293(b)(3)) In this final rule, DOE is not adopting any of the alternative proposals.

1. Replacing the Simmering Test with a Simmering Usage Factor

In the November 2021 NOPR, DOE considered an approach to simplify the test procedure such that it requires only a single test per cooking zone. 86 FR 60974, 60997. This test could entail a simple heat-up test at the maximum power setting until the water temperature reaches a threshold temperature, such as 90 °C or the target turndown temperature. A simmering usage factor could then be applied to the measured energy use to scale the energy of the heat-up only test to a value that is representative of typical consumer usage including a simmering phase.

In the November 2021 NOPR, DOE presented an initial analysis of its test data suggesting that for electric cooking tops, the simmering energy may be a consistent fraction of the heat-up energy for each heating technology type. *Id*. However, for gas cooking tops, the potential simmering usage factor is more variable by individual cooking top and cooking zone.

DOE noted that if it were to adopt a test procedure that uses a simmering usage factor, the usage factor would need to be based on test data and would need to be representative of a tested simmering period on multiple types of products. *Id*. DOE tentatively determined in the November 2021 NOPR, based on the available data, that no such single simmering usage factor by heating technology can be defined, and did not propose to pursue this approach. *Id*.

DOE requested data on the representativeness of a simmering usage factor across technology types. *Id*.

The Joint Commenters commented in support of DOE's proposal to include a simmering test for electric and gas cooking top test procedures, stating that it is representative of how consumers will be using the products. (Joint Commenters, No. 11 at p. 3)

The Joint Commenters agreed with DOE's tentative determination that the use of a representative simmer usage factor to determine simmering energy would be difficult to define due to the variability of cooking tops and cooking zones, stating that a simmering usage factor would not accomplish the same goals as a simmering test. (Joint Commenters, No. 11 at pp. 3–4) The Joint Commenters commented that the inclusion of a simmering test may change the relative ranking of products compared to a heat-up only test. (Joint Commenters, No. 11 at p. 4) The Joint Commenters commented that if a usage factor were applied instead of running a simmering test, a consistent factor would be used for each technology type to scale up the energy consumption value. (*Id*.) The Joint Commenters stated this would fail to reflect differences in simmering energy between different models of the same technology type. (*Id*.)

NEEA commented in support of DOE's proposal to proceed with a test procedure that includes a simmering portion rather than applying a simmering usage factor, stating that simmer energy cannot be accurately estimated through the application of a universal usage factor. (NEEA, No. 15 at p. 2) NEEA commented that a Food Service Technology Center report illustrated that simmer rates vary across different appliances and do not necessarily correlate with input rate or boil efficiency. (*Id.*) NEEA commented that attempting to apply a universal usage factor would oversimplify and misrepresent the range of simmering energies that cooking appliances might exhibit. (*Id.*) NEEA commented that any attempt to simplify the process of collecting simmering energy data would only be able to occur after a rigorous sample of simmering energy data indicates a clear relationship. (*Id.*)

The CA IOUs commented in support of DOE's decision to use an actual simmering test rather than a simmering usage factor. (CA IOUs, No. 14 at p. 7) The CA IOUs commented that it is unlikely that a single simmering usage factor would accurately apply to all cooking tops. (*Id.*)

AHAM commented that DOE's tentative determination that a single simmering usage factor by heating technology cannot be defined was based on only minimal evaluation. (AHAM, No. 12 at p. 16) AHAM commented that it is collecting data to determine a simmering usage factor and stated that DOE should wait until its data is available before it concludes that no single simmering usage factor by heating technology can be defined. (*Id.*) AHAM commented that a single simmering usage factor may or may not properly encompass variation but stated that other techniques may be useful such as multivariable extrapolation based on factors like cooking zone size, cooking zone rating and/or technology types. (*Id*.) AHAM commented that the simmering portion of the test introduces the most variation and adds the most burden and stated that a calculation factor would help reduce variation and burden. (*Id*.) AHAM commented that DOE should consider a simmering usage factor in order to meet EPCA's requirements given the concerns with variation and test burden. (*Id*.) AHAM commented that it agrees that it is unlikely that a single factor could be applied across different technologies and stated that this is why its testing is investigating other techniques as listed above. (*Id*.) AHAM commented that developing a multivariable extrapolation would involve testing of multiple technologies with cooking zones of different sizes and ratings, and then creating an equation to estimate simmering energy consumption based on data for each technology, size, and rating. (*Id*.) AHAM commented that the measured boiling energy consumption could then be added to the calculated simmering energy consumption for a final result. (*Id*.) AHAM commented that its test plan includes these additional techniques, and that DOE should wait for those results before it can reach a conclusion that a calculation methodology is not representative. (*Id*.)

AHAM commented that the use of a simmering usage factor would reduce test burden and stated that a simmering usage factor would allow for a 6-minute test for each cooking zone without a turndown, compared to what AHAM calculated as 475 minutes (7.9 hours) for the proposed test procedure (using coil and induction cooking top testing as an example). (AHAM, No. 12 at pp. 16–17) AHAM presented a table supporting this value of 475 minutes per cooking zone to conduct the proposed test procedure based on the summation of 300 seconds (5 minutes) of overshoot testing; 2,100 seconds of pre-selection testing (a 10-minute test run on 3–4 settings, for a total of around 35 minutes); 3,000 seconds of simmering testing (25 minutes each for the minimum-above threshold and maximum-below threshold settings); 1,500 seconds (25 minutes) of likely additional simmering testing due to various issues; and 21,600 seconds of cooldown time (60 minutes between each test, for a total of 6 cooldown periods). (AHAM, No. 12 at p. 17)

DOE has determined through its testing that a test procedure including a simmering test produces the most representative results for the energy consumption of each conventional cooking top basic model and is not unduly burdensome to conduct. Use of a simmering usage factor in lieu of a simmering test, as suggested by AHAM, relies upon the inaccurate assumption that the energy use profile of every cooking top is similar to that of other cooking tops throughout a representative usage cycle, which includes both a heat-up and a simmering phase. However, these profiles differ according to the specific design and performance characteristics among various models (*e.g.*, electric heating technology, shape and size of the electric coil, grate material and geometry, gas burner flame turndown behavior and relationship to the grate, *etc.*). DOE has observed throughout its testing programs that the ratio of energy use during the simmering phase to energy use during the heat-up phase varies between cooking tops and even between heating elements or burners on a single cooking top. The use of a single simmering usage factor would impede the ability for the test procedure to differentiate between various energy-saving simmering strategies among different conventional cooking tops. The use of a single simmering factor or other similar analytic approach could disincentivize manufacturers from innovating new energy-saving simmering strategies. Because the use of a simmering usage factor would not capture the differences between various simmering strategies, it would also, therefore, produce results that are not representative of the consumer usage of each conventional cooking top basic model as compared to a test that includes a simmering phase.

Regarding AHAM's comment on test burden, DOE agrees with AHAM that a test procedure that includes only a heat-up phase would take less time to conduct. However, as discussed, this type of test would not produce results that are representative of consumer usage. Further, AHAM's calculation of 7.9 hours per cooking zone for the test procedure proposed in the November 2021 NOPR overcounts the amount of cooling periods needed. A cooldown period is needed only before an overshoot or simmering test. It is not needed before or in-between the pre-selection tests, as discussed in section III.D.2.d of this document. Using the values provided by AHAM while removing the unnecessary cooling periods would result in a total time of 295 minutes, or 4.9 hours,[78] of testing per cooking zone (except for the last cooking zone under test, which would require only 3.9 hours of testing).[79] DOE has determined that the conduct and duration of the test procedure established in this final rule is not unduly burdensome.

For these reasons, consistent with the November 2021 NOPR, DOE is not adopting a test methodology that includes the use of a simmering usage factor. To the

[78] 295 minutes calculated as 5 minutes of overshoot testing + 35 minutes of pre-selection testing + 60 minutes of cooldown + 25 minutes of simmering testing for the minimum-above-threshold setting + 60 minutes of cooldown + 25 minutes of simmering testing for the maximum-below-threshold setting + 60 minutes of cooldown before testing the next cooking zone (except for the last cooking zone under test) + a buffer of 25 minutes to account for potential additional simmering testing = 295 minutes (or 235 for the last cooking zone under test).

[79] For a unit with four cooking zones, this is a total of 18.7 hours of testing. This duration is similar to the November 2021 NOPR value of 17.5 hours of testing. For a unit with six cooking zones, this is a total of 28.5 hours of testing. See section III.N of this document for further discussion of test procedure costs.

extent that commenters in the future may wish to have DOE evaluate methodology for a conventional cooking top test procedure without a simmering test, they should submit data and analysis on the record for DOE to consider. In order to ensure that the test method is representative of consumer usage, any alternative method would need to provide an estimated energy consumption specific to the conventional cooking top model under test, rather than yielding an approximate value by means of a generic approach that applies equally for all models. Any such alternative method would need to produce equivalent estimated energy consumption results and associated product rankings as the test procedure adopted in this final rule.

2. Changing the Setting Used to Calculate Simmering Energy

IEC 60350–2:2021 defines the simmering setting according to the temperature characteristics of the water load at that power setting. In the November 2021 NOPR, DOE considered alternatively defining the simmering setting according to the power supplied at each power setting. 86 FR 60974, 60997. For instance, DOE considered defining the simmering setting as the lowest power setting that is at or above 25 percent of maximum power (or maximum heat input rate for gas cooking tops). *Id*.

To the extent that consumers choose a simmering power setting based on knob position (or setting number) rather than by directly or indirectly monitoring the temperature variation of the food or water in the cookware, this potential alternative could yield more representative results than the current proposal. DOE previously established a power-level-based test procedure as part of the October 2012 Final Rule. 77 FR 65942.

DOE requested data on the representativeness of a simmering setting based on a percentage of the maximum power setting. 86 FR 60974, 60997.

The CA IOUs commented that they agree with using the temperature-based test conditions rather than choosing a simmer power setting based on knob position and stated that this results in more comparable and representative results across different units. (CA IOUs, No. 14 at p. 7)

DOE did not receive any data on the representativeness of a simmering setting based on a percentage of the maximum power setting. For the reasons discussed in the November 2021 NOPR, in this final rule, DOE is not defining the simmering setting based on the knob position or the power level of the potential simmering setting.

3. Industry Test Procedures

DOE is aware that AHAM is developing test procedures for electric and gas cooking tops as part of its Task Force efforts. Although AHAM's test procedures had not been finalized at the time of publication of the November 2021 NOPR, the provisions in the draft test procedures as of September 1, 2021, were substantially the same as those specified in the November 2021 NOPR. DOE also stated in the November 2021 NOPR that if AHAM were to finalize its test procedures before DOE publishes a test procedure final rule for conventional cooking tops, DOE could consider incorporating the AHAM procedure by reference, instead of using the language adopted in this final rule. 86 FR 60974, 60997.

AHAM has not finalized its test procedures as of the publication of this final rule.

AHAM commented that since the August 2020 Final Rule, it has been in the process of developing test procedures for electric and gas cooking tops that decrease variation and test burden. (AHAM, No. 12 at pp. 9–10) AHAM commented that it has been working on a fast track in recognition that DOE is interested in moving this test forward and stated that it has been sharing its insights with DOE throughout the process and plans to share raw data when it becomes available. (AHAM, No. 12 at p. 10) AHAM commented that it is in the process of conducting testing at a third-party laboratory in two separate locations to assess possible test modifications. (*Id.*) AHAM commented that its data may not provide a complete picture of reproducibility but stated that it will be relevant to DOE's proposed test procedure amendments. (*Id.*) AHAM commented that the completion of this testing was a central reason why AHAM requested a comment period extension on the November 2021 NOPR to March 31, 2022. (*Id.*) AHAM commented that it was not able to meet that deadline but stated that it plans to file supplemental comments on the proposed test procedure with DOE, stating that it hopes the testing will be complete by September 2022. (*Id.*) AHAM commented that its members are also considering a scaled-down test plan whereby AHAM could complete testing by July 2022, and that DOE will receive an update if the test plan is revised. (*Id.*)

AHAM commented that the third-party laboratory conducting AHAM's testing has faced numerous obstacles, including difficulty in procuring adequate test vessels, difficulty in executing the technical procedure due to vagueness, logistical issues at the test laboratory, and COVID-19 outbreaks at the testing facility, resulting in closures.

(AHAM, No. 12 at p. 10) AHAM commented that the certified test laboratory found certain provisions of the test procedure vague, stating that this caused delays. (*Id*.) AHAM commented that, according to its interpretation, even DOE had to disregard some of the data collected because of the complicated test setup involved, stating that 25 percent of the results were marked "n/a" in the December 2021 NODA. (AHAM, No. 12 at pp. 10–11) AHAM commented that DOE should allow time for AHAM's testing to be completed in order to ensure DOE defines a test that is accurate, repeatable, reproducible, representative, and not unduly burdensome to conduct. (AHAM, No. 12 at p. 11)

AHAM commented that one of the reasons for this delay in its test data collection was that the laboratory experienced longer cooldown periods for electric units than anticipated. (AHAM, No. 12 at p. 10) AHAM commented that the test laboratory, which AHAM stated has considerable experience running DOE test procedures, found that testing of a single heating element is unlikely to be completed in a single 8-hour shift for certain technologies. (*Id*.) AHAM commented that this is an indication that the procedure is unduly burdensome to complete, as the test requires constant technician interaction and monitoring. (*Id*.)

DOE appreciates AHAM's efforts to develop test procedures for electric and gas cooking tops and notes that it has not yet received any data from AHAM on this issue. DOE encourages AHAM to send any data when it becomes available. DOE notes that it has provided opportunity for stakeholders to provide test results, including two extensions of the comment period on the November 2021 NOPR (see section III.A of this document). As discussed in this final rule, DOE has determined that the established test procedure is reasonably designed to produce test results which measure energy use of conventional cooking tops during a representative period of use and is not unduly burdensome to conduct. DOE continues to welcome AHAM's data and will consider it in the ongoing energy conservation standards rulemaking.

In response to AHAM's assumption that the "n/a" notation on the 2021 Round Robin data presented in the December 2021 NODA represented disregarded test data, DOE clarifies that these "n/a" notations represent units that were not tested at particular laboratories ("not applicable"). As stated in this document and in the December 2021 NODA, each unit was tested at 3 laboratories. 86 FR 71406, 71407. Due to a time constraint, one of the units in the test sample was not tested at Laboratory B, but was instead tested at Laboratory E, resulting in the notation of "n/a" because that unit did not have test results for Laboratory B. *Id*. Similarly, the units that *were* tested at Laboratory B were not tested at Laboratory E, resulting in the notation of "n/a" for those tests too.

DOE interprets AHAM's comment regarding longer-than-anticipated cooldown periods for electric units to apply to units that AHAM's test laboratory has observed to take over 2 hours to return to ambient temperature. DOE notes that, in its experience, a cooldown is typically much shorter than 2 hours. Based on the experience of two of the laboratories that participated in the 2021 Round Robin, the cooldown of a unit typically ranges from 20 minutes to 1 hour. DOE reiterates that the test procedure allows active cooling of the unit under test, and that some effective strategies have included the use of a fan blowing air over a wet cloth laid on the cooking top surface to improve evaporative cooling and the use of a fan blowing air directly into the burner cavity. In response to

AHAM's assertion that a single cooking zone is unlikely to be completed in a single 8-hour shift for certain technologies, DOE's testing experience indicates that the test procedure can be completed in under 5 hours on average per cooking zone for any technology.[80]

L. Representations

1. Sampling Plan

In the November 2021 NOPR, DOE proposed to maintain the sampling plan requirements for cooking products in 10 CFR 429.23(a), which specify that for each basic model of cooking product a sample of sufficient size shall be randomly selected and tested to ensure that any represented value for which consumers would favor lower values shall be greater than or equal to the higher of the mean of the sample or the upper 97.5 percent confidence limit of the true mean divided by 1.05. 86 FR 60974, 60997.

DOE sought comment on the proposed method for establishing a sampling plan. *Id*.

DOE did not receive any comments regarding the proposed method for establishing a sampling plan.[81]

[80] See section III.K.1 for a detailed explanation of DOE's calculation of the estimated test time per cooking zone of 4.9 hours, based on AHAM's comments.
[81] See section III.F of this document for discussion of a comment from Samsung regarding certification and compliance tolerances for gas cooking tops.

In this final rule, DOE finalizes its proposed sampling plan, consistent with the November 2021 NOPR.

2. Convertible Cooking Appliances

DOE defines a convertible cooking appliance as any kitchen range and oven which is a household cooking appliance designed by the manufacturer to be changed in service from use with natural gas to use with LP-gas, and vice versa, by incorporating in the appliance convertible orifices for the main gas burners and a convertible gas pressure regulator. 10 CFR 430.2.

In the May 1978 Final Rule, DOE established a requirement for two estimated annual operating costs for convertible cooking appliances: one reflecting testing with natural gas and another reflecting testing with propane. 43 FR 20108, 20110. DOE allowed manufacturers to use the amount of energy consumed during the test with natural gas to determine the estimated annual operating cost of the appliance reflecting testing with propane. *Id*. DOE provided this allowance based on test data that showed that conventional cooking products tested with propane yielded slightly higher efficiencies than the same products tested with natural gas. *Id*.

In the version of 10 CFR 430.23 finalized in the December 2016 Final Rule, convertible cooking tops were required to be tested using both natural gas and propane, although the version of appendix I finalized in that same rule listed the test gas as natural gas or propane. 81 FR 91418, 91448. DOE does not require testing both natural gas and propane for any other convertible appliances.

In the November 2021 NOPR, DOE proposed to specify that all gas cooking tops be tested using the default test gas (*i.e.*, the appropriate test gas given the as-shipped configuration of the cooking top) and proposed not to require testing any convertible cooking top using both natural gas and propane. 86 FR 60974, 60998.

DOE further proposed to delete the definition of convertible cooking appliance in 10 CFR 430.2, since such distinction would no longer be needed and may cause confusion. *Id*.

DOE requested comment on its proposal to test all gas cooking tops using the default test gas, as defined by the as-shipped configuration of the unit. *Id*. DOE also requested comment on its proposal to delete the definition of convertible cooking appliance from 10 CFR 430.2. *Id*.

AHAM commented in support of DOE's proposal to test all gas cooking tops using the default test gas, as defined by the as-shipped configuration of the unit and stated that it understands this proposal to be consistent with test procedures for other product categories, such as clothes dryers. (AHAM, No. 12 at p. 17)

For the reasons discussed, DOE finalizes its proposal, consistent with the November 2021 NOPR, to test all gas cooking tops using the default test gas, as defined by the as-shipped configuration of the unit and to delete the definition of convertible cooking appliance from 10 CFR 430.2.

M. Reporting

In the November 2021 NOPR, DOE did not propose to require reporting of cooking top energy use until such time as compliance is required with a performance-based energy conservation standard, should such a standard be established. 86 FR 60974, 60998. DOE proposed to add an introductory note to new appendix I1 to that effect. *Id*.

DOE did not receive any comments regarding its proposed introductory note to new appendix I1.

In this final rule, DOE finalizes its introductory note to appendix I1, consistent with the November 2021 NOPR.

N. Test Procedure Costs

In this document, DOE establishes a new test procedure for conventional cooking tops in a new appendix I1. The test procedure adopts the latest version of the relevant industry standard with modifications to adapt the test method to gas cooking tops (including specifying gas supply tolerances), includes measurement of standby mode and off mode energy use, updates certain test conditions, and provides certain clarifying language. If manufacturers voluntarily choose to make representations regarding the energy efficiency of conventional cooking tops before such time as use of the test procedure becomes mandatory to demonstrate compliance with energy conservation standards, manufacturers would be required to test according to the DOE test procedure.

In the November 2021 NOPR, DOE initially determined that the proposed new appendix I1, if finalized, would result in added costs to conventional cooking top manufacturers, if manufacturers choose to make efficiency representations for the conventional cooking tops that they manufacture. 86 FR 60974, 60998. Additionally, manufacturers would incur testing costs if DOE were to establish a performance-based energy conservation standard for conventional cooking tops.

To estimate third-party laboratory costs in the November 2021 NOPR, DOE evaluated quotes from test laboratories on the price of conducting a similar conventional cooking top test procedure. *Id.* at 86 FR 60999. DOE then averaged these prices to arrive at an estimate of what the manufacturers would have to spend to test their product using a third-party test laboratory. *Id.* Using these quotes, DOE estimated that it would cost conventional cooking top manufacturers approximately $3,000 to conduct a single test on a conventional cooking top unit, if this test was conducted at a third-party laboratory test facility. *Id.*

To estimate in-house testing cost, DOE estimated in the November 2021 NOPR, based on its testing experience, that testing a single conventional cooking top unit to the proposed test procedure required approximately 17.5 hours of a technician's time. *Id.*

DOE requested comment on any aspect of the estimated initial testing costs detailed in the November 2021 NOPR. *Id.* DOE also requested comment on any aspect of the estimated recurring testing costs associated with conventional cooking tops detailed in the November 2021 NOPR. *Id.*

AHAM commented in response to the November 2021 NOPR that the cumulative regulatory burden associated with different energy conservation standards and test procedure rulemakings is potentially significant. (AHAM, No. 12 at p. 9) AHAM noted specifically that manufacturers of cooking products, at the time of writing, were in the position of responding to five open rulemakings with limited staff to do so. (*Id.*)

AHAM also commented that the third-party test laboratory that it is working with has updated its test cost quote to $483 per simmering test, for an estimated $3,900 per four-cooking zone cooking top. (AHAM, No. 12 at p. 11)

As discussed in detail in section III.K.1 of this document, AHAM commented that the proposed test procedure requires 7.9 hours per cooking zone to conduct. (AHAM, No. 12 at p. 17)

Were DOE to establish energy conservation standards for conventional cooking tops, manufacturers would be required to test according to the finalized test procedure. DOE recognizes the potential manufacturer burden of multiple simultaneous rulemakings and would evaluate the cumulative regulatory burden in future energy conservation standards rulemakings related to cooking products as provided by its established processes.[82]

In this final rule, DOE reviewed its third-party test laboratory costs and test time estimates, to provide the best estimate of the total cost to manufacturers if DOE were to

[82] See 10 CFR part 430 subpart C appendix A section 13(g).

implement performance-based standards. DOE is further updating its estimates to reflect the range of typical cooking tops on the market and is providing values for both a cooking top with four cooking zones and one with six cooking zones. In subsequent calculations, DOE used an average of the value for the cooking top with four cooking zones and the cooking top with six cooking zones, representative of the fact that DOE determined through a market analysis that cooking tops have an average of five cooking zones.

DOE has reviewed additional test quotes since the November 2021 NOPR, including the one submitted by AHAM in its comments, and has determined that it would cost conventional cooking top manufacturers approximately $3,200 to conduct a single test on a conventional cooking top unit with four cooking zones, if this test was conducted at a third-party laboratory test facility. The same test would cost conventional cooking top manufacturers approximately $5,000 on a conventional cooking top unit with six cooking zones. In the remainder of this document, DOE uses an average value of $4,100 per test.

As discussed in section III.K.1 of this document, DOE has updated its estimated test time per cooking zone to 4.9 hours, except for the last cooking zone under test which would require only 3.9 hours. As a result, DOE estimates that testing a single conventional cooking top unit to appendix I1 requires approximately 18.7 hours of a technician's time for four cooking zones and 28.5 hours for six cooking zones. In the remainder of this document, DOE uses an average value of 23.6 hours per test.

Based on data from the Bureau of Labor Statistics' ("BLS") Occupational Employment and Wage Statistics, the mean hourly wage for mechanical engineering technologists and technicians is $30.47.[83] Additionally, DOE used data from BLS's Employer Costs for Employee Compensation to estimate the percent that wages comprise the total compensation for an employee. DOE estimates that wages make up 70.5 percent of the total compensation for private industry employees.[84] Therefore, DOE estimates that the total hourly compensation (including all fringe benefits) of a technician performing the testing is $43.22.[85] Using these labor rates and the updated average time estimate of 23.6 hours per cooking top, DOE estimates that it would cost conventional cooking top manufacturers approximately $1,020 to conduct a single test on a conventional cooking top unit, if this test was conducted at an in-house test facility.

Using the assumptions discussed in this section, DOE estimates that it would cost conventional cooking top manufacturers approximately $2,040 per basic model, if tested at an in-house test facility and approximately $8,200 per basic model, if tested at a third-party laboratory test facility.

[83] DOE used the mean hourly wage of the "17-3027 Mechanical Engineering Technologists and Technicians" from the most recent BLS Occupational Employment and Wage Statistics (May 2021) to estimate the hourly wage rate of a technician assumed to perform this testing. See *www.bls.gov/oes/current/oes173027.htm*. Last accessed on April 4, 2022.

[84] DOE used the December 2021 "Employer Costs for Employee Compensation" to estimate that for "Private Industry Workers," "Wages and Salaries" are 70.3 percent of the total employee compensation. See *www.bls.gov/news.release/pdf/ecec.pdf*. Last accessed on April 4, 2022.

[85] $30.47 ÷ 0.705 = $43.22.

DOE also estimates that conventional cooking top manufacturers would need to purchase test vessels in accordance with new appendix I1. DOE estimates that each set of test vessels costs approximately $6,000.

O. Compliance Date

The effective date for the adopted test procedure will be 30 days after publication of this final rule in the *Federal Register*. EPCA prescribes that all representations of energy efficiency and energy use, including those made on marketing materials and product labels, must be made in accordance with that new test procedure, beginning 180 days after publication of the final rule in the *Federal Register*. (42 U.S.C. 6293(c)(2)) EPCA provides an allowance for individual manufacturers to petition DOE for an extension of the 180-day period if the manufacturer may experience undue hardship in meeting the deadline. (42 U.S.C. 6293(c)(3)) To receive such an extension, petitions must be filed with DOE no later than 60 days before the end of the 180-day period and must detail how the manufacturer will experience undue hardship. (*Id.*)

As previously stated, no performance-based energy conservation standards are prescribed for conventional cooking tops. Manufacturers are not required to test according to the DOE test procedure unless manufacturers voluntarily choose to make representations as to the energy efficiency or energy use of a conventional cooking top. Were DOE to establish energy conservation standards for conventional cooking tops, manufacturers would be required to test according to the finalized test procedure at such time as compliance would be required with the established standards.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866 and 13563

Executive Order ("E.O.")12866, "Regulatory Planning and Review," as supplemented and reaffirmed by E.O. 13563, "Improving Regulation and Regulatory Review, 76 FR 3821 (Jan. 21, 2011), requires agencies, to the extent permitted by law, to (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public. DOE emphasizes as well that E.O. 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, the Office of Information and Regulatory Affairs ("OIRA") in the Office of Management and Budget ("OMB") has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, this final regulatory action is consistent with these principles.

Section 6(a) of E.O. 12866 also requires agencies to submit "significant regulatory actions" to OIRA for review. OIRA has determined that this final regulatory action does not constitute a "significant regulatory action" under section 3(f) of E.O. 12866. Accordingly, this action was not submitted to OIRA for review under E.O. 12866.

B. Review Under the Regulatory Flexibility Act

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

The following sections detail DOE's FRFA for this test procedure rulemaking:

1. Descriptions of Reasons for Action

DOE is establishing test procedures for conventional cooking tops. Establishing test procedures for conventional cooking tops assists DOE in fulfilling its statutory deadline for amending energy conservation standards for cooking products that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Additionally, establishing test procedures for conventional cooking tops allows manufacturers to produce measurements of energy use that are representative of an average use cycle and uniform for all manufacturers.

2. Objectives of, and Legal Basis for, Rule

DOE has undertaken this rulemaking pursuant to 42 U.S.C. 6292(a)(10), which authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment, including the cooking products that are the subject of this rulemaking.

3. Description and Estimate of Small Entities Regulated

DOE has recently conducted a focused inquiry into small business manufacturers of the products covered by this rulemaking. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. The size standards are listed by North American Industry Classification System ("NAICS") code as well as by industry description and are available at *www.sba.gov/document/support--table-size-standards*. Manufacturing cooking tops is classified under NAICS 335220, "major household appliance manufacturing." The SBA sets a threshold of 1,500 employees or fewer for an entity to be considered as a small business for this category. DOE used available public information to identify potential small manufacturers. DOE accessed the Compliance Certification Database[86] (CCD), the Modernized Appliance Efficiency Database System[87] (MAEDbS), and the National Resources Canada database[88] (NRCan) to create a list of companies that import or otherwise manufacture the products covered by this final rule. Once DOE created a list of potential manufacturers, DOE used market research tools to determine whether any met the SBA's definition of a small entity—based on the total number of employees for each company including parent, subsidiary, and sister entities—and gather annual revenue estimates.

Based on DOE's analysis, DOE identified 43 companies potentially manufacturing cooking tops covered by this test procedure. DOE screened out companies that do not meet the small entity definition and, additionally, screened out companies that are largely or entirely foreign owned and operated. Of the 43 companies, 12 were identified as a small business. Of these 12 small businesses, seven were further identified—through a review of their websites and online documentation—to be original equipment manufacturers manufacturing covered cooking tops as opposed to rebranding covered cooking tops, integrating the covered cooking tops into some broader product offering, or producing cooking tops for commercial applications.

[86] U.S. Department of Energy Compliance Certification Management System, available at: *www.regulations.doe.gov/ccms*.
[87] California Energy Commission's Modernized Appliance Efficiency Database System, available at: *https://cacertappliances.energy.ca.gov/Login.aspx*.
[88] Natural Resources Canada searchable product list, available at: *oee.nrcan.gc.ca/pml-lmp/*.

4. Description and Estimate of Compliance Requirements

Because there are currently no energy conservation standards for conventional cooking tops, DOE estimates that this test procedure would not require any manufacturer to incur any testing burden associated with the test procedure. DOE recognizes that energy conservation standards related to conventional cooking tops may be proposed or promulgated in the future and manufacturers would then be required to test all covered equipment in accordance with the test procedure once compliance with any standard is required. (*See* Docket No. EERE-2020-BT-STD-0013) Therefore, DOE is presenting the costs associated with testing equipment and procedure consistent with the requirements of the test procedure, as would be required to comply with any future energy conservation standards for conventional cooking tops.

DOE observed that a number of the identified small businesses known to produce conventional cooking tops did not have cooking top models reflected in the publicly available CCD, MAEDbS, and NRCan databases. DOE undertook a review of each small business's website in order to develop an approximate model count. DOE estimated that the seven small businesses produced a total of 223 basic models of covered cooking tops, for a range of five to 126 basic models and an average of approximately 32 models per small business.

DOE assumes that small businesses would contract with third party testing labs to test and certify their covered products. Given DOE's previously estimated cost of $8,200 to test and certify a single model, DOE estimates it will cost approximately $1,826,600 to test all identified models manufactured by small businesses for an average of approximately $261,228 per small business. DOE was able to identify annual revenue estimates for all small businesses. From these estimates, DOE determined that the estimated testing costs would represent less than 2 percent of estimated annual revenue for all but one small business—for which the cost is estimated to be somewhat over 7 percent of its estimated annual revenue.

In addition, DOE expects small manufacturers to redesign or introduce new models of cooking tops on the same three-year timeframe as the broader industry described previously. Using this redesign cycle timeframe and the test costs and model count estimates previously stated, DOE estimated that small businesses manufacturing conventional cooking tops would collectively incur approximately $609,533 in costs every year to test approximately 74 newly introduced or redesigned conventional cooking top models.

5. Duplication, Overlap, and Conflict with Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with this final rule.

6. Significant Alternatives to the Rule

DOE is required to review existing DOE test procedures for all covered products and equipment every 7 years. Additionally, DOE shall amend test procedures with respect to any covered product, if the Secretary determines that amended test procedures would more accurately produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product type during a representative average use cycle or period of use, while not being unduly burdensome to conduct. (42 U.S.C. 6293(b)(1)(A)(i)) DOE has determined that the DOE test procedure for conventional cooking tops established by this final rule will produce test results that measure cooking top energy use during a representative average use cycle or period of use without being unduly burdensome to conduct.

In the November 2021 NOPR, DOE examined alternatives to the proposed test procedure, such as determining not to establish a performance-based test procedure for conventional cooking tops or establishing prescriptive-based test procedures for conventional cooking tops. DOE noted in the November 2021 NOPR that while not establishing performance-based test procedures or establishing prescriptive-based test procedures for conventional cooking tops would reduce the burden on small businesses, DOE must use test procedures to determine whether the products comply with relevant standards promulgated under EPCA. 86 FR 61001. Since establishing performance-based test procedures for conventional cooking tops is necessary prior to establishing performance-based standards for conventional cooking tops, and DOE is required under EPCA to evaluate energy conservation standards for conventional cooking products, including conventional cooking tops, DOE tentatively concluded in the November 2021 NOPR that establishing performance-based test procedures supports DOE's authority to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) DOE received no comments on its conclusions in the November 2021 NOPR and thus affirms its determination in this final rule that there are no better alternatives than the final test procedure to meet the agency's objectives to measure energy efficiency more accurately and to reduce burden on manufacturers.

Additional compliance flexibilities may be available through other means. EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. (42 U.S.C. 6295(t)) Additionally, manufacturers subject to DOE's energy efficiency standards may apply to DOE's Office of Hearings and Appeals for exception relief under certain circumstances. Manufacturers should refer to 10 CFR part 430, subpart E, and 10 CFR part 1003 for additional details.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of conventional cooking tops 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 tops. (*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 35 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

There is currently no performance-based energy conservation standard for conventional cooking tops, and the test procedure established by this final rule does not establish any reporting requirements at this time. Were certification data required for conventional cooking tops, DOE would consider such certification requirements and reporting for conventional cooking products under a separate rulemaking regarding appliance and equipment certification. DOE would address changes to OMB Control Number 1910-1400 at that time, as necessary.

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 establishes a test procedure that it expects will be used to develop and implement future energy conservation standards for conventional cooking tops. 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, DOE has determined that adopting test procedures for measuring energy efficiency of consumer products and industrial equipment is consistent with activities identified in 10

CFR part 1021, appendix A to subpart D, A5 and A6. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 4, 1999), imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE 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. Pub. L. 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 *www.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). Pursuant to OMB Memorandum M-19-15, Improving Implementation of the Information Quality Act (April 24, 2019), DOE published updated guidelines which are available at *www.energy.gov/sites/prod/files/2019/12/f70/DOE%20Final%20Updated%20IQA%20Guidelines%20Dec%202019.pdf*. 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 new test procedure for conventional cooking tops adopted in this final rule incorporates testing methods contained in certain sections of the following commercial standards: IEC 60350–2:2021, IEC 62301 First Edition, and IEC 62301 Second Edition. DOE has evaluated these standards 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 the following IEC standards:

IEC 60350–2, "Household electric cooking appliances Part 2: Hobs–Methods for measuring performance", Edition 2.1, 2021-05. This is an industry-accepted test procedure that measures conventional electric cooking top energy use, using a water heating approach. Specifically, the test procedure codified by this final rule references various sections of IEC 60350–2:2021 that address test setup, instrumentation, test conduct, and calculations.

IEC 62301, "Household electrical appliances–Measurement of standby power", first edition, June 2005 is an industry-accepted test procedure that measures standby power in household appliances. The test procedure codified by this final rule references various sections of IEC 62301 that address test setup, instrumentation, and test conduct applicable to units for which standby power varies cyclically (such as units with a display clock).

IEC 62301, "Household electrical appliances–Measurement of standby power", Second Edition, 2011-01 is an industry-accepted test procedure that measures standby power in household appliances. The test procedure codified by this final rule references various sections of IEC 62301 that address test setup, instrumentation, and test conduct for the units for which standby power does not vary cyclically.

Copies of IEC 60350–2:2021, and both editions of IEC 62301 may be purchased from the IEC webstore at webstore.iec.ch, or from the American National Standards Institute at 25 W. 43rd Street, 4th Floor, New York, NY 10036, (212) 642–4900, or by going to *webstore.ansi.org*.

V. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 430

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

Signing Authority

This document of the Department of Energy was signed on July 18, 2022, by Kelly J. Speakes-Backman, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, D.C., on July 18, 2022

X Kelly Speakes-Backman Digitally signed by Kelly Speakes-Backman
Date: 2022.07.18 21:13:28 -04'00'

Kelly J. Speakes-Backman
Principal Deputy Assistant Secretary for
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE amends 10 CFR part 430as follows:

PART 430 -- ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

§430.2 [Amended]

2. Section 430.2 is amended by removing the definition for “Convertible cooking appliance.”

3. Section 430.3 is amended by:

a. Redesignating paragraphs (p)(3) through (9) as (p)(4) through (10);

b. Adding new paragraph (p)(3);

c. Revising newly redesignated paragraph (p)(6); and

d. In newly redesignated paragraph (p)(7),

i. Removing the text “I” and adding, in its place, the text “I, I1”; and

ii. Removing the text “J2” and adding, in its place, the text “J, J2”.

The additions and revisions read as follows:

§430.3 Materials incorporated by reference.

* * * * *

(p) * * *

(3) IEC 60350–2, (“IEC 60350–2”), *Household electric cooking appliances Part 2: Hobs—Methods for measuring performance*, Edition 2.1, 2021-05; IBR approved for appendix I1 to subpart B.

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(6) IEC 62301, *Household electrical appliances—Measurement of standby power*, first edition, June 2005; IBR approved for appendices I, I1 to subpart B.

* * * * *

4. 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 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.

(2)(i) Determine the integrated annual energy consumption of a conventional electric cooking top, including any conventional cooking top component of a combined cooking product, according to section 4.3.1 of appendix I1 to this subpart. Round the result to the nearest 1 kilowatt-hour (kWh) per year.

(ii) Determine the integrated annual energy consumption of a conventional gas cooking top, including any conventional cooking top component of a combined cooking product, according to section 4.3.2 of appendix I1 to this subpart. Round the result to the nearest 1 kilo-British thermal unit (kBtu) per year.

(3) Determine the total annual gas energy consumption of a conventional gas cooking top, including any conventional cooking top component of a combined cooking

product, according to section 4.1.2.2.1 of appendix I1 to this subpart. Round the result to the nearest 1 kBtu per year.

(4)(i) Determine the total annual electrical energy consumption of a conventional electric cooking top, including any conventional cooking top component of a combined cooking product, as the integrated annual energy consumption of the conventional electric cooking top, as determined in paragraph (i)(2)(i) of this section.

(ii) Determine the total annual electrical energy consumption of a conventional gas cooking top, including any conventional cooking top component of a combined cooking product, as follows, rounded to the nearest 1 kWh per year:

$$E_{TGE} = E_{AGE} + E_{TLP}$$

Where:

E_{AGE} is the conventional gas cooking top annual active mode electrical energy consumption as defined in section 4.1.2.2.2 of appendix I1 to this subpart, and

E_{TLP} is the combined low-power mode energy consumption as defined in section 4.1 of appendix I1 to this subpart.

(5) Determine the estimated annual operating cost corresponding to the energy consumption of a conventional cooking top, including any conventional cooking top component of a combined cooking product, as follows, rounded to the nearest dollar per year:

$$(E_{TGE} \times C_{KWH}) + (E_{TGG} \times C_{KBTU})$$

Where:

E_{TGE} is the total annual electrical energy consumption for any electric energy usage, in kilowatt-hours (kWh) per year, as determined in accordance with paragraph (i)(4) of this section;

C_{KWH} is the representative average unit cost for electricity, in dollars per kWh, as provided pursuant to section 323(b)(2) of the Act;

E_{TGG} is the total annual gas energy consumption, in kBtu per year, as determined in accordance with paragraph (i)(3) of this section; and

C_{KBTU} is the representative average unit cost for natural gas or propane, in dollars per kBtu, as provided pursuant to section 323(b)(2) of the Act, for conventional gas cooking tops that operate with natural gas or with LP-gas, respectively.

(6) 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 I1 to this subpart.

* * * * *

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

5. Appendix I to Subpart B of Part 430 is amended by revising the appendix heading to read as set forth above.

6. Appendix I1 to subpart B of part 430 is added to read as follows:

Appendix I1 to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Conventional Cooking Products

Note: Any representation related to energy consumption of conventional cooking tops, including the conventional cooking top component of combined cooking products, made after [**INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER***] must be based upon results generated under this test procedure. Upon the compliance date(s) of any energy conservation standard(s) for conventional cooking tops, including the conventional cooking top component of combined cooking products, use of the applicable provisions of this test procedure to demonstrate compliance with the energy conservation standard is required.

0. Incorporation by Reference

DOE incorporated by reference in §430.3, the entire test standard for IEC 60350–2; IEC 62301 (First Edition); and IEC 62301 (Second Edition). However, only enumerated provisions of those standards are applicable to this appendix, as follows. If there is a conflict, the language of the test procedure in this appendix takes precedence over the referenced test standards.

0.1 IEC 60350–2

(a) Section 5.1 as referenced in section 2.4.1 of this appendix;

(b) Section 5.3 as referenced in sections 2.7.1.1, 2.7.3.1, 2.7.3.3, 2.7.3.4, 2.7.4, and 2.7.5 of this appendix;

(c) Section 5.5 as referenced in section 2.5.1 of this appendix;

(d) Section 5.6.1 as referenced in section 2.6.1 of this appendix;

(e) Section 5.6.1.5 as referenced in section 3.1.1.2 of this appendix;

(f) Section 6.3 as referenced in section 3.1.1.1.1 of this appendix;

(g) Section 6.3.1 as referenced in section 3.1.1.1.1 of this appendix;

(h) Section 6.3.2 as referenced in section 3.1.1.1.1 of this appendix;

(i) Section 7.5.1 as referenced in section 2.6.2 of this appendix;

(j) Section 7.5.2 as referenced in section 3.1.4.4 of this appendix;

(k) Section 7.5.2.1 as referenced in sections 1 and 3.1.4.2 of this appendix;

(l) Section 7.5.2.2 as referenced in section 3.1.4.4 of this appendix;

(m) Section 7.5.4.1 as referenced in sections 1 and 3.1.4.5 of this appendix;

(n) Annex A as referenced in section 3.1.1.2 of this appendix;

(o) Annex B as referenced in sections 2.6.1 and 2.8.3 of this appendix; and

(p) Annex C as referenced in section 3.1.4.1 of this appendix.

0.2 IEC 62301 (First Edition)

(a) Paragraph 5.3 as referenced in section 3.2 of this appendix; and

(b) Paragraph 5.3.2 as referenced in section 3.2 of this appendix.

0.3 IEC 62301 (Second Edition)

(a) Paragraph 4.2 as referenced in section 2.4.2 of this appendix;

(b) Paragraph 4.3.2 as referenced in section 2.2.1.1.2 of this appendix;

(c) Paragraph 4.4 as referenced in section 2.7.1.2 of this appendix;

(d) Paragraph 5.1 as referenced in section 3.2 of this appendix; and

(e) Paragraph 5.3.2 as referenced in section 3.2 of this appendix.

1. Definitions

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

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, or electric inductive heating.

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.

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.

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

Cooking area means 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 may or may not include limitative markings.

Cooking top control means 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.

Cooking zone means a part of a conventional cooking top surface that is either a single electric resistance heating element, 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.

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

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

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.

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.

Infinite power settings means a cooking zone control without discrete power settings, which allows for selection of any power setting up to the maximum power setting.

Maximum-below-threshold power setting means the power setting on a conventional cooking top that is the highest power setting that results in smoothened water temperature data that do not meet the evaluation criteria specified in Section 7.5.4.1 of IEC 60350–2.

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, including any optional power boosting features. For conventional electric cooking tops with multi-ring cooking zones or cooking areas, the maximum power setting is the maximum power corresponding to the concentric heating element with the largest diameter, which may correspond to a power setting which may include one or more of the smaller concentric heating elements. For conventional gas cooking tops with multi-ring cooking zones, the maximum power setting is the maximum heat input rate when the maximum number of rings of the cooking zone are ignited.

Minimum-above-threshold power setting means the power setting on a conventional cooking top that is the lowest power setting that results in smoothened water temperature data that meet the evaluation criteria specified in Section 7.5.4.1 of IEC 60350–2. This power setting is also referred to as the simmering setting.

Multi-ring cooking zone means a cooking zone on a conventional cooking top with multiple concentric sizes of electric resistance heating elements or gas burner rings.

Off mode means any mode in which a 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.

Power setting means a setting on a cooking zone control that offers a gas flame, electric resistance heating, or electric inductive heating.

Simmering period means, for each cooking zone, the 20-minute period during the simmering test starting at time t_{90}.

Smoothened water temperature means the 40-second moving-average temperature as calculated in Section 7.5.4.1 of IEC 60350–2, rounded to the nearest 0.1 degree Celsius.

Specialty cooking zone means a warming plate, grill, griddle, or any cooking zone that is designed for use only with non-circular cookware, such as a bridge zone. Specialty cooking zones are not tested under this appendix.

Stable temperature means a temperature that does not vary by more than 1 °C over a 5-minute period.

Standard cubic foot of gas means the quantity of gas that occupies 1 cubic foot when saturated with water vapor at a temperature of 60 °F and a pressure of 14.73 pounds per square inch (30 inches of mercury or 101.6 kPa).

Standby mode means any mode in which a 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.

Target turndown temperature (Tc_{target}) means the temperature as calculated according to Section 7.5.2.1 of IEC 60350–2 and section 3.1.4.2 of this appendix, for each cooking zone.

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.

Time t_{90} means the first instant during the simmering test for each cooking zone at which the smoothened water temperature is greater than or equal to 90 °C.

Turndown temperature (Tc) means, for each cooking zone, the measured water temperature at the time at which the tester begins adjusting the cooking top controls to change the power setting.

2. Test Conditions and Instrumentation

2.1 *Installation.* Install the conventional cooking top or combined cooking product in accordance with the manufacturer's instructions. If the manufacturer's instructions specify that the product may be used in multiple installation conditions, install the product according to the built-in configuration. 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. If the product can communicate through a network (*e.g.*, Bluetooth® or internet connection), disable the network function, if it is possible to disable it by means provided in the manufacturer's user manual, for the duration of testing. If the network function cannot be disabled, or if means for disabling the function are not provided in the manufacturer's user manual, the product shall be tested in the factory default setting or in the as-shipped condition.

2.1.1 *Freestanding combined cooking product.* 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 product and 1 foot beyond both sides of the product, and with no side walls.

2.1.2 *Drop-in or built-in combined cooking product.* Install a drop-in or built-in combined cooking product in a test enclosure in accordance with manufacturer's instructions.

2.1.3 *Conventional cooking top.* Install a conventional cooking top with the back directly against, or as near as possible to, a vertical wall which extends at least 1 foot above the product and 1 foot beyond both sides of the product.

2.2 *Energy supply.*

2.2.1 *Electrical supply.*

2.2.1.1 *Supply voltage*.

2.2.1.1.1 *Active mode supply voltage.* During active mode testing, maintain the electrical supply to the product at either 240 volts ±1 percent or 120 volts ±1 percent, according to the manufacturer's instructions, except for products which do not allow for a mains electrical supply. The actual voltage shall be maintained and recorded throughout the test. Instantaneous voltage fluctuations caused by the turning on or off of electrical components shall not be considered.

2.2.1.1.2 *Standby mode and off mode supply voltage*. During standby mode and off mode testing, maintain the electrical supply to the product at either 240 volts ±1 percent, or 120 volts ±1 percent, according to the manufacturer's instructions. Maintain the electrical supply voltage waveform specified in Section 4, Paragraph 4.3.2 of IEC 62301 (Second Edition), disregarding the provisions regarding batteries and the determination, classification, and testing of relevant modes. If the power measuring instrument used for testing is unable to measure and record the total harmonic content during the test measurement period, total harmonic content may be measured and recorded immediately before and after the test measurement period.

2.2.1.2 *Supply frequency*. Maintain the electrical supply frequency for all tests at 60 hertz ±1 percent.

2.2.2 *Gas supply*.

2.2.2.1 *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, except as specified in section 3.1.3 of this appendix. The natural gas supplied should have a higher heating value (dry-basis) of approximately 1,025 Btu per standard cubic foot. Obtain the higher heating value on a dry basis of gas, H_n, in Btu per standard cubic foot, for the natural gas 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 2.7.2.2 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 2.7.2.2 of this appendix.

2.2.2.2 *Propane*. Maintain the propane pressure immediately ahead of all controls of the unit under test at 11 to 13 inches of water column, except as specified in section 3.1.3 of this appendix. The propane supplied should have a higher heating value (dry-basis) of approximately 2,500 Btu per standard cubic foot. Obtain the higher heating value on a dry basis of gas, H_p, in Btu per standard cubic foot, 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 2.7.2.2 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 2.7.2.2 of this appendix.

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.

2.4 *Ambient room test conditions*.

2.4.1 *Active mode ambient conditions*. During active mode testing, maintain the ambient room air pressure specified in Section 5.1 of IEC 60350–2, and maintain the ambient room air temperature at 25 ± 5 °C with a target temperature of 25 °C.

2.4.2 *Standby mode and off mode ambient conditions.* During standby mode and off mode testing, maintain the ambient room air temperature conditions specified in Section 4, Paragraph 4.2 of IEC 62301 (Second Edition).

2.5 *Product temperature.*

2.5.1 *Product temperature stability.* Prior to any testing, the product must achieve a stable temperature meeting the ambient room air temperature specified in section 2.4 of this appendix. For all conventional cooking tops, forced cooling may be used to assist in reducing the temperature of the product between tests, as specified in Section 5.5 of IEC 60350–2. Forced cooling must not be used during the period of time used to assess temperature stability.

2.5.2 *Product temperature measurement*. Measure the product temperature in degrees Celsius using the equipment specified in section 2.7.3.3 of this appendix at the following locations.

2.5.2.1 Measure the product temperature at the center of the cooking zone under test for any gas burner adjustment in section 3.1.3 of this appendix and per-cooking zone energy consumption test in section 3.1.4 of this appendix, except that the product temperature measurement is not required for any potential simmering setting pre-selection test in section 3.1.4.3 of this appendix. For a conventional gas cooking top, measure the product temperature inside the burner body of the cooking zone under test, after temporarily removing any burner cap on that cooking zone.

2.5.2.2 Measure the temperature at the center of each cooking zone for the standby mode and off mode power test in section 3.2 of this appendix. For a conventional gas cooking top, measure the temperature inside the burner body of each cooking zone, after temporarily removing any burner cap on that cooking zone. Calculate the product temperature as the average of the temperatures at the center of each cooking zone.

2.6 *Test loads*.

2.6.1 *Test vessels*. The test vessel for active mode testing of each cooking zone must meet the specifications in Section 5.6.1 and Annex B of IEC 60350–2.

2.6.2 *Water load*. The water used to fill the test vessels for active mode testing must meet the specifications in Section 7.5.1 of IEC 60350–2. The water temperature at the start of each test, except for the gas burner adjustment in section 3.1.3 of this appendix and the potential simmering setting pre-selection test in section 3.1.4.3 of this appendix, must have an initial temperature equal to 25 ± 0.5 °C.

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

2.7.1 *Electrical measurements.*

2.7.1.1 *Active mode watt-hour meter*. The watt-hour meter for measuring the active mode electrical energy consumption must have a resolution as specified in Table 1 of Section 5.3 of IEC 60350–2. Measurements shall be made as specified in Table 2 of Section 5.3 of IEC 60350–2.

2.7.1.2 *Standby mode and off mode watt meter.* The watt meter used to measure standby mode and off mode power must meet the specifications in Section 4, Paragraph 4.4 of IEC 62301 (Second Edition). 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 specifications in Section 4, Paragraph 4.4 of IEC 62301 (Second Edition).

2.7.2 *Gas measurements*.

2.7.2.1 *Gas meter*. The gas meter used for measuring gas consumption must have a resolution of 0.01 cubic foot 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.

2.7.2.2 *Standard continuous flow calorimeter.* The maximum error of the basic calorimeter must be no greater than 0.2 percent of the actual heating value of the gas used in the test. The indicator readout must have a maximum error no greater than 0.5 percent of the measured value within the operating range and a resolution of 0.2 percent of the full-scale reading of the indicator instrument.

2.7.2.3 *Gas line temperature*. The incoming gas temperature must be measured at the gas meter. The instrument for measuring the gas line temperature shall have a maximum error no greater than ±2 °F over the operating range.

2.7.2.4 *Gas line pressure*. The incoming gas pressure must be measured at the gas meter. The instrument for measuring the gas line pressure must have a maximum error no greater than 0.1 inches of water column.

2.7.3 *Temperature measurements.*

2.7.3.1 *Active mode ambient room temperature.* The room temperature indicating system must meet the specifications in Table 1 of Section 5.3 of IEC 60350–2. Measurements shall be made as specified in Table 2 of Section 5.3 of IEC 60350–2.

2.7.3.2 *Standby mode and off mode ambient room temperature.* 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).

2.7.3.3 *Product temperature.* 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). Measurements shall be made as specified in Table 2 of Section 5.3 of IEC 60350–2.

2.7.3.4 *Water temperature*. Measure the test vessel water temperature with a thermocouple that meets the specifications in Table 1 of Section 5.3 of IEC 60350–2. Measurements shall be made as specified in Table 2 of Section 5.3 of IEC 60350–2.

2.7.4 *Room air pressure*. The room air pressure indicating system must meet the specifications in Table 1 of Section 5.3 of IEC 60350–2.

2.7.5 *Water mass*. The scale used to measure the mass of the water load must meet the specifications in Table 1 of Section 5.3 of IEC 60350–2.

2.8 *Power settings*.

2.8.1 On a multi-ring cooking zone on a conventional gas cooking top, all power settings are considered, whether they ignite all rings of orifices or not.

2.8.2 On a multi-ring cooking zone on a conventional electric cooking top, only power settings corresponding to the concentric heating element with the largest diameter are considered, which may correspond to operation with one or more of the smaller concentric heating elements energized.

2.8.3 On a cooking zone with infinite power settings where the available range of rotation from maximum to minimum is more than 150 rotational degrees, evaluate power settings that are spaced by 10 rotational degrees. On a cooking zone with infinite power settings where the available range of rotation from maximum to minimum is less than or equal to 150 rotational degrees, evaluate power settings that are spaced by 5 rotational degrees, starting with the first position that meets the definition of a power setting, irrespective of how the knob is labeled. Polar coordinate paper, as provided in Annex B of IEC 60350–2 may be used to mark power settings.

3. Test Methods and Measurements

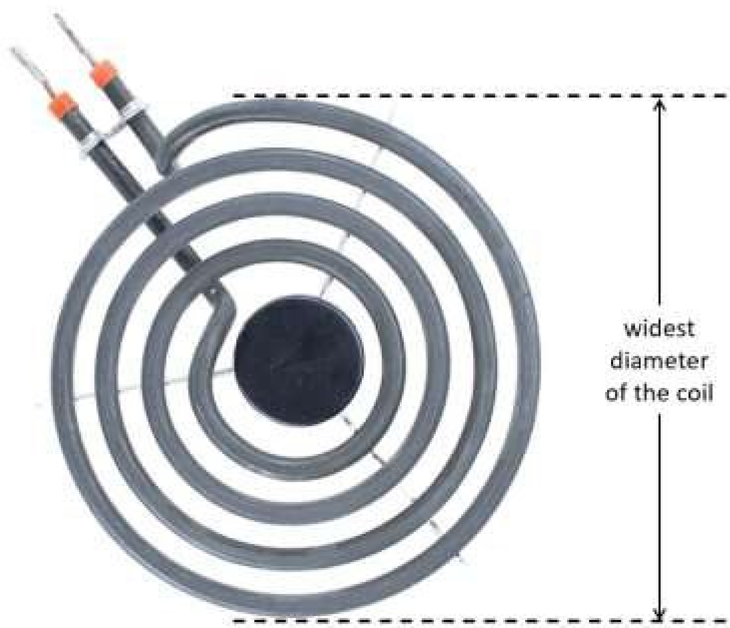
3.1. *Active mode.* Perform the following test methods for conventional cooking tops and the conventional cooking top component of a combined cooking product.

3.1.1 *Test vessel and water load selection.*

3.1.1.1 *Conventional electric cooking tops.*

3.1.1.1.1 For cooking zones, measure the size of each cooking zone as specified in Section 6.3.2 of IEC 60350–2, not including any specialty cooking zones as defined in section 1 of this appendix. For circular cooking zones on smooth cooking tops, the cooking zone size is determined using the outer diameter of the printed marking, as specified in Section 6.3 of IEC 60350–2. For open coil cooking zones, the cooking zone size is determined using the widest diameter of the coil, see Figure 3.1.1.1. For non-circular cooking zones, the cooking zone size is determined by the measurement of the shorter side or minor axis. For cooking areas, determine the number of cooking zones as specified in Section 6.3.1 of IEC 60350–2.

Figure 3.1.1.1 Evaluation of the Size of a Coil Cooking Zone



3.1.1.1.2 Determine the test vessel diameter in millimeters (mm) and water load mass in grams (g) for each measured cooking zone. For cooking zones, test vessel selection is based on cooking zone size as specified in Table 3 in Section 5.6.1.5 of IEC 60350–2. For cooking areas, test vessel selection is based on the number of cooking zones as specified in Annex A of IEC 60350–2. If a selected test vessel (including its lid) cannot be centered on the cooking zone due to interference with a structural component of the cooking top, the test vessel with the largest diameter that can be centered on the cooking zone shall be used. The allowable tolerance on the water load weight is ±0.5 g.

3.1.1.2 *Conventional gas cooking tops*.

3.1.1.2.1 Record the nominal heat input rate for each cooking zone, not including any specialty cooking zones as defined in section 1 of this appendix.

3.1.1.2.2 Determine the test vessel diameter in mm and water load mass in g for each measured cooking zone according to Table 3.1 of this appendix. If a selected test vessel cannot be centered on the cooking zone due to interference with a structural component of the cooking top, the test vessel with the largest diameter that can be centered on the cooking zone shall be used. The allowable tolerance on the water load weight is ±0.5 g.

TABLE 3.1—TEST VESSEL SELECTION FOR CONVENTIONAL GAS COOKING TOPS

Nominal gas burner input rate (Btu/h)		Test vessel diameter (mm)	Water load mass (g)
Minimum (>)	Maximum (≤)		
--	5,600	210	2,050
5,600	8,050	240	2,700
8,050	14,300	270	3,420
14,300	--	300	4,240

3.1.2 *Unit Preparation*. Before the first measurement is taken, all cooking zones must be operated simultaneously for at least 10 minutes at maximum power. This step shall be conducted once per product.

3.1.3 *Gas burner adjustment*. Prior to active mode testing of each tested burner of a conventional gas cooking top, the burner heat input rate must be adjusted, if necessary, to within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. Prior to ignition and any adjustment of the burner heat input rate, the conventional cooking top must achieve the product temperature specified in section 2.5 of this appendix. Ignite and operate the gas burner under test with the test vessel and water mass specified in section 3.1.1 of this appendix. Measure the heat input rate of the gas burner under test starting 5 minutes after ignition. If the measured input rate of the gas burner under test is within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer, no adjustment of the heat input rate shall be made.

3.1.3.1 *Conventional gas cooking tops with an adjustable internal pressure regulator*. If the measured heat input rate of the burner under test is not within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer, adjust the product's internal pressure regulator such that the heat input rate of the burner under test is within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. Adjust the burner with sufficient air flow to prevent a yellow flame or a flame with yellow tips. Complete section 3.1.4 of this appendix while maintaining the same gas pressure regulator adjustment.

3.1.3.2 *Conventional gas cooking tops with a non-adjustable internal pressure regulator or without an internal pressure regulator*. If the measured heat input rate of the burner under test is not within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer, remove the product's internal pressure regulator, or block it in the open position, and initially maintain the gas pressure ahead of all controls of the unit under test approximately equal to the manufacturer's recommended manifold pressure. Adjust the gas supply pressure such that the heat input rate of the burner under test is within 2 percent of the nominal heat input rate of the burner as specified by the manufacturer. Adjust the burner with sufficient air flow to prevent a yellow flame or a flame with yellow tips. Complete section 3.1.4 of this appendix while maintaining the same gas pressure regulator adjustment.

3.1.4 *Per-cooking zone energy consumption test*. Establish the test conditions set forth in section 2 of this appendix. Turn off the gas flow to the conventional oven(s), if so equipped. The product temperature must meet the specifications in section 2.5 of this appendix.

3.1.4.1 *Test vessel placement*. Position the test vessel with water load for the cooking zone under test, selected and prepared as specified in section 3.1.1 of this appendix, in the center of the cooking zone, and as specified in Annex C to IEC 60350–2.

3.1.4.2 *Overshoot test*. Use the test methods set forth in Section 7.5.2.1 of IEC 60350–2 to determine the target turndown temperature for each cooking zone, Tc_{target}, in degrees Celsius, as follows.

$Tc_{target} = 93\ °C – (T_{max} – T_{70})$

Where:

T_{max} is highest recorded temperature value, in degrees Celsius; and

T_{70} is the average recorded temperature between the time 10 seconds before the power is turned off and the time 10 seconds after the power is turned off.

If T_{70} is within the tolerance of 70 ± 0.5 °C, the target turndown temperature is the highest of 80 °C and the calculated Tc_{target}, rounded to the nearest integer. If T_{70} is outside of the tolerance, the overshoot test is considered invalid and must be repeated after allowing the product to return to ambient conditions.

3.1.4.3 *Potential simmering setting pre-selection test.* The potential simmering setting for each cooking zone may be determined using the potential simmering setting pre-selecting test. If a potential simmering setting is already known, it may be used instead of completing sections 3.1.4.3.1 through 3.1.4.3.4 of this appendix.

3.1.4.3.1 Use the test vessel with water load for the cooking zone under test, selected, prepared, and positioned as specified in sections 3.1.1 and 3.1.4.1 of this appendix. The temperature of the conventional cooking top is not required to meet the specification for the product temperature in section 2.5 of this appendix for the potential simmering setting pre-selection test. Operate the cooking zone under test with the lowest available power setting. Measure the energy consumption for 10 minutes ±2 seconds.

3.1.4.3.2 Calculate the power density of the power setting, j, on a conventional electric cooking top, Qe_j, in watts per square centimeter, as:

$$Qe_j = \frac{6 \times E_j}{a}$$

Where:

a = the surface area of the test vessel bottom, in square centimeters; and

E_j = the electrical energy consumption during the 10-minute test, in Wh.

3.1.4.3.3 Calculate the power density of the power setting, j, on a conventional gas cooking top, Qg_j, in Btu/h per square centimeter, as:

$$Qg_j = \frac{6 \times (V_j \times CF \times H + Ee_j \times K_e)}{a}$$

Where:

a = the surface area of the test vessel bottom, in square centimeters;

V_j = the volume of gas consumed during the 10-minute test, in cubic feet;

CF = the gas correction factor to standard temperature and pressure, as calculated in section 4.1.1.2.1 of this appendix;

H = either H_n or H_p, the heating value of the gas used in the test as specified in sections 2.2.2.1 and 2.2.2.2 of this appendix, in Btu per standard cubic foot of gas;

Ee_j = the electrical energy consumption of the conventional gas cooking top during the

10-minute test, in Wh; and

K_e = 3.412 Btu/Wh, conversion factor of watt-hours to Btu.

3.1.4.3.4 Repeat the measurement for each successively higher power setting until Qe_j exceeds 0.8 W/cm^2 for conventional electric cooking tops or Qg_j exceeds 4.0 Btu/h·cm^2 for conventional gas cooking tops.

For conventional cooking tops with rotating knobs for selecting the power setting, the selection knob shall be turned to the maximum power setting in between each test, to avoid hysteresis. The selection knob shall be turned in the direction from higher power to lower power to select the power setting for the test. If the appropriate power setting is passed, the selection knob shall be turned to the maximum power setting again before repeating the power setting selection.

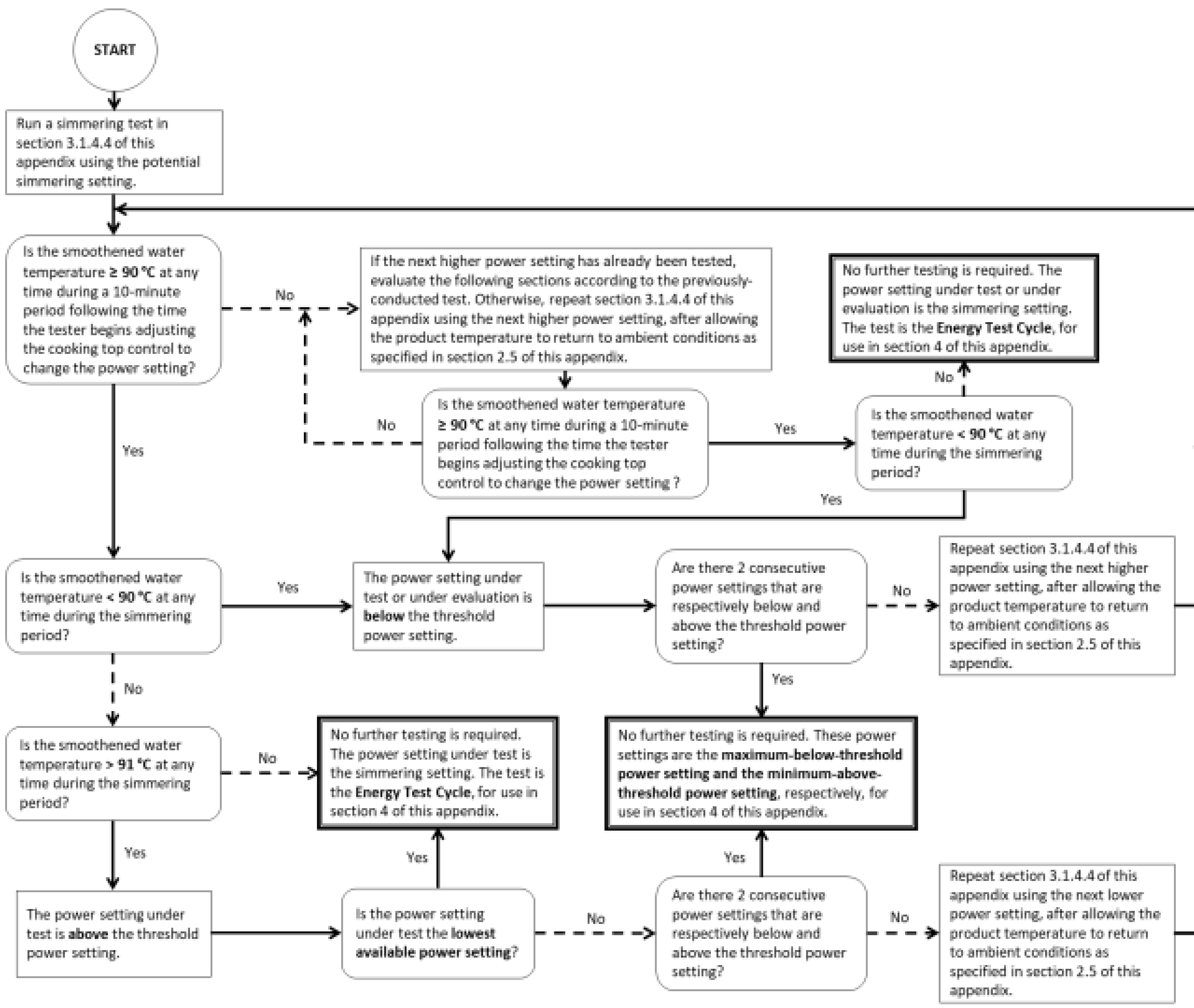
Of the last two power settings tested, the potential simmering setting is the power setting that produces a power density closest to 0.8 W/cm^2 for conventional electric cooking tops or 4.0 Btu/h·cm^2 for conventional gas cooking tops. The closest power density may be higher or lower than the applicable threshold value.

3.1.4.4 *Simmering test*. The product temperature must meet the specifications in section 2.5 of this appendix at the start of each simmering test. For each cooking zone, conduct the test method specified in Section 7.5.2 of IEC 60350–2, using the potential simmering setting identified in section 3.1.4.3 of this appendix for the initial simmering setting used in Section 7.5.2.2 of IEC 60350–2.

For conventional cooking tops with rotating knobs for selecting the power setting, the selection knob shall be turned in the direction from higher power to lower power to select the potential simmering setting for the test, to avoid hysteresis. If the appropriate setting is passed, the test is considered invalid and must be repeated after allowing the product to return to ambient conditions.

3.1.4.5 *Evaluation of the simmering test*. Evaluate the test conducted under section 3.1.4.4 of this appendix as set forth in Section 7.5.4.1 of IEC 60350–2 according to Figure 3.1.4.5 of this appendix. If the measured turndown temperature, Tc, is not within –0.5 °C and +1 °C of the target turndown temperature, Tc_{target}, the test is considered invalid and must be repeated after allowing the product to return to ambient conditions.

Figure 3.1.4.5 Evaluation of the Simmering Test



3.2 *Standby mode and off mode power*. Establish the standby mode and off mode testing conditions set forth in section 2 of this appendix. For 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), allow sufficient time for the 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 3.2.1 and 3.2.2 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 an initial stabilization period, as specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition). After an additional 10-minute stabilization period, measure the power use for a single test period of 10 minutes +0/−2 seconds that starts when the clock time first reads 3:33. Use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition).

3.2.1 If the product has an inactive mode, as defined in section 1 of this appendix, measure the average inactive mode power, P_{IA}, in watts.

3.2.2 If the product has an off mode, as defined in section 1 of this appendix, measure the average off mode power, P_{OM}, in watts.

3.3 *Recorded values.*

3.3.1 *Active mode*.

3.3.1.1 For a conventional gas cooking top tested with natural gas, record the natural gas higher heating value in Btu per standard cubic foot, H_n, as determined in section 2.2.2.1 of this appendix for the natural gas supply. For a conventional gas cooking top tested with propane, record the propane higher heating value in Btu per standard cubic foot, H_p, as determined in section 2.2.2.2 of this appendix for the propane supply.

3.3.1.2 Record the test room temperature in degrees Celsius and relative air pressure in hectopascals (hPa) during each test.

3.3.1.3 *Per-cooking zone energy consumption test*.

3.3.1.3.1 Record the product temperature in degrees Celsius, T_P, prior to the start of each overshoot test or simmering test, as determined in section 2.5 of this appendix.

3.3.1.3.2 *Overshoot test.* For each cooking zone, record the initial temperature of the water in degrees Celsius, T_i; the average water temperature between the time 10 seconds before the power is turned off and the time 10 seconds after the power is turned off in degrees Celsius, T_{70}; the highest recorded water temperature in degrees Celsius, T_{max}; and the target turndown temperature in degrees Celsius, Tc_{target}.

3.3.1.3.3 *Simmering test*. For each cooking zone, record the temperature of the water throughout the test, in degrees Celsius, and the values in sections 3.3.1.3.3.1 through 3.3.1.3.3.7 of this appendix for the Energy Test Cycle, if an Energy Test Cycle is measured in section 3.1.4.5 of this appendix, otherwise for both the maximum-below-threshold power setting and the minimum-above-threshold power setting. Because t_{90} may not be known until completion of the simmering test, water temperature, any electrical energy consumption, and any gas volumetric consumption measurements may be recorded for several minutes after the end of the simmering period to ensure that the full simmering period is recorded.

3.3.1.3.3.1 The power setting under test.

3.3.1.3.3.2 The initial temperature of the water, in degrees Celsius, T_i.

3.3.1.3.3.3 The time at which the tester begins adjusting the cooking top control to change the power setting, to the nearest second, t_c and the turndown temperature, in degrees Celsius, Tc.

3.3.1.3.3.4 The time at which the simmering period starts, to the nearest second, t_{90}.

3.3.1.3.3.5 The time at which the simmering period ends, to the nearest second, t_S and the smoothened water temperature at the end of the simmering period, in degrees Celsius, T_S.

3.3.1.3.3.6 For a conventional electric cooking top, the electrical energy consumption from the start of the test to t_S, E, in watt-hours.

3.3.1.3.3.7 For a conventional gas cooking top, the volume of gas consumed from the start of the test to t_S, V, in cubic feet of gas; and any electrical energy consumption of the cooking top from the start of the test to t_S, E_e, in watt-hours.

3.3.2 *Standby mode and off mode*. Make measurements as specified in section 3.2 of this appendix. If the product is capable of operating in inactive mode, as defined in section 1 of this appendix, record the average inactive mode power, P_{IA}, in watts as specified in section 3.2.1 of this appendix. If the product is capable of operating in off mode, as defined in section 1 of this appendix, record the average off mode power, P_{OM}, in watts as specified in section 3.2.2 of this appendix.

4. Calculation of Derived Results from Test Measurements

4.1. Active mode energy consumption of conventional cooking tops and any conventional cooking top component of a combined cooking product.

4.1.1 Per-cycle active mode energy consumption of a conventional cooking top and any conventional cooking top component of a combined cooking product.

4.1.1.1 Conventional electric cooking top per-cycle active mode energy consumption.

4.1.1.1.1 Conventional electric cooking top per-cooking zone normalized active mode energy consumption. For each cooking zone, calculate the per-cooking zone normalized active mode energy consumption of a conventional electric cooking top, E, in watt-hours, using the following equation:

$$E = E_{ETC}$$

for cooking zones where an Energy Test Cycle was measured in section 3.1.4.5 of this appendix, and

$$E = E_{MAT} - \frac{E_{MAT} - E_{MBT}}{T_{S,MAT} - T_{S,MBT}} \times (T_{S,MAT} - 90)$$

for cooking zones where a minimum-above-threshold cycle and a maximum-below-threshold cycle were measured in section 3.1.4.5 of this appendix.

Where:

E_{ETC} = the electrical energy consumption of the Energy Test Cycle from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

E_{MAT} = the electrical energy consumption of the minimum-above-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

E_{MBT} = the electrical energy consumption of the maximum-below-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

$T_{S,MAT}$ = the smoothened water temperature at the end of the minimum-above-threshold power setting test for the cooking zone, in degrees Celsius; and

$T_{S,MBT}$ = the smoothened water temperature at the end of the maximum-below-threshold power setting test for the cooking zone, in degrees Celsius.

4.1.1.1.2 Calculate the per-cycle active mode total energy consumption of a conventional electric cooking top, E_{CET}, in watt-hours, using the following equation:

$$E_{CET} = \frac{2853g}{n} \times \sum_{z=1}^{n} \frac{E_z}{m_z}$$

Where:

n = the total number of cooking zones tested on the conventional cooking top;

E_z = the normalized energy consumption representative of the Energy Test Cycle for each cooking zone, as calculated in section 4.1.1.1.1 of this appendix, in watt-hours;

m_z is the mass of water used for each cooking zone, in grams; and

2853 = the representative water load mass, in grams.

4.1.1.2 Conventional gas cooking top per-cycle active mode energy consumption.

4.1.1.2.1 Gas correction factor to standard temperature and pressure. Calculate the gas correction factor to standard temperature and pressure, which converts between standard cubic feet and measured cubic feet of gas for a given set of test conditions:

$$CF = \frac{(P_{gas} \times 0.0361) + P_{atm}}{P_{base}} \times \frac{T_{base}}{(T_{gas} + T_k)}$$

Where:

P_{gas} = the measured line gas gauge pressure, in inches of water column;

0.0361= the conversion factor from inches of water column to pounds per square inch;

P_{atm} = the measured atmospheric pressure, in pounds per square inch;

P_{base} = 14.73 pounds per square inch, the standard sea level air pressure;

T_{base} = 519.67 degrees Rankine (or 288.7 Kelvin);

T_{gas} = the measured line gas temperature, in degrees Fahrenheit (or degrees Celsius); and

T_k = the adder converting from degrees Fahrenheit to degrees Rankine, 459.7 (or from degrees Celsius to Kelvin, 273.16).

4.1.1.2.2 Conventional gas cooking top per-cooking zone normalized active mode gas consumption. For each cooking zone, calculate the per-cooking zone normalized active mode gas consumption of a conventional gas cooking top, V, in cubic feet, using the following equation:

$$V = V_{ETC}$$

for cooking zones where an Energy Test Cycle was measured in section 3.1.4.5 of this appendix, and

$$V = V_{MAT} - \frac{V_{MAT} - V_{MBT}}{T_{S,MAT} - T_{S,MBT}} \times (T_{S,MAT} - 90)$$

for cooking zones where a minimum-above-threshold cycle and a maximum-below-threshold cycle were measured in section 3.1.4.5 of this appendix.

Where:

V_{ETC} = the gas consumption of the Energy Test Cycle from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in cubic feet;

V_{MAT} = the gas consumption of the minimum-above-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in cubic feet;

V_{MBT} = the gas consumption of the maximum-below-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in cubic feet;

$T_{S,MAT}$ = the smoothened water temperature at the end of the minimum-above-threshold power setting test for the cooking zone, in degrees Celsius; and

$T_{S,MBT}$ = the smoothened water temperature at the end of the maximum-below-threshold power setting test for the cooking zone, in degrees Celsius.

4.1.1.2.3 Conventional gas cooking top per-cooking zone active mode normalized electrical energy consumption. For each cooking zone, calculate the per-cooking zone normalized active mode electrical energy consumption of a conventional gas cooking top, E_e, in watt-hours, using the following equation:

$$E_e = E_{e,ETC}$$

for cooking zones where an Energy Test Cycle was measured in section 3.1.4.5 of this appendix, and

$$E_e = E_{e,MAT} - \frac{E_{e,MAT} - E_{e,MBT}}{T_{S,MAT} - T_{S,MBT}} \times (T_{S,MAT} - 90)$$

for cooking zones where a minimum-above-threshold cycle and a maximum-below-threshold cycle were measured in section 3.1.4.5 of this appendix.

Where:

$E_{e,ETC}$ = the electrical energy consumption of the Energy Test Cycle from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

$E_{e,MAT}$ = the electrical energy consumption of the minimum-above-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

$E_{e,MBT}$ = the electrical energy consumption of the maximum-below-threshold power setting from the start of the test to the end of the test for the cooking zone, as determined in section 3.1.4.5 of this appendix, in watt-hours;

$T_{S,MAT}$ = the smoothened water temperature at the end of the minimum-above-threshold power setting test for the cooking zone, in degrees Celsius; and

$T_{S,MBT}$ = the smoothened water temperature at the end of the maximum-below-threshold power setting test for the cooking zone, in degrees Celsius.

4.1.1.2.4 Conventional gas cooking top per-cycle active mode gas energy consumption. Calculate the per-cycle active mode gas energy consumption of a conventional gas cooking top, E_{CGG}, in Btu, using the following equation:

$$E_{CGG} = \frac{2853g}{n} \times \sum_{z=1}^{n} \frac{V_z \times CF \times H}{m_z}$$

Where:

n, m_z, and 2853 are defined in section 4.1.1.1.2 of this appendix;

V_z = the normalized gas consumption representative of the Energy Test Cycle for each cooking zone, as calculated in section 4.1.1.2.2 of this appendix, in cubic feet; and

CF = the gas correction factor to standard temperature and pressure, as calculated in section 4.1.1.2.1 of this appendix

H = either H_n or H_p, the heating value of the gas used in the test as specified in sections 2.2.2.1 and 2.2.2.2 of this appendix, expressed in Btu per standard cubic foot of gas.

4.1.1.2.5 Conventional gas cooking top per-cycle active mode electrical energy consumption. Calculate the per-cycle active mode electrical energy consumption of a conventional gas cooking top, E_{CGE}, in watt-hours, using the following equation:

$$E_{CGE} = \frac{2853g}{n} \times \sum_{z=1}^{n} \frac{E_{ez}}{m_z}$$

Where:

n, m_z, and 2853 are defined in section 4.1.1.1.2 of this appendix; and

E_{ez} = the normalized electrical energy consumption representative of the Energy Test Cycle for each cooking zone, as calculated in section 4.1.1.2.3 of this appendix, in watt-hours.

4.1.1.2.6 Conventional gas cooking top per-cycle active-mode total energy consumption. Calculate the per-cycle active mode total energy consumption of a conventional gas cooking top, E_{CGT}, in Btu, using the following equation:

$$E_{CGT} = E_{CGG} + (E_{CGE} \times K_e)$$

Where:

E_{CGG} = the per-cycle active mode gas energy consumption of a conventional gas cooking top as determined in section 4.1.1.2.4 of this appendix, in Btu;

E_{CGE} = the per-cycle active mode electrical energy consumption of a conventional gas cooking top as determined in section 4.1.1.2.5 of this appendix, in watt-hours; and

K_e = 3.412 Btu/Wh, conversion factor of watt-hours to Btu.

4.1.2 Annual active mode energy consumption of a conventional cooking top and any conventional cooking top component of a combined cooking product.

4.1.2.1 Conventional electric cooking top annual active mode energy consumption. Calculate the annual active mode total energy consumption of a conventional electric cooking top, E_{AET}, in kilowatt-hours per year, using the following equation:

$$E_{AET} = E_{CET} \times K \times N_C$$

Where:

E_{CET} = the conventional electric cooking top per-cycle active mode total energy consumption, as determined in section 4.1.1.1.2 of this appendix, in watt-hours;

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

N_C = 418 cooking cycles per year, the average number of cooking cycles per year normalized for duration of a cooking event estimated for conventional cooking tops.

4.1.2.2 Conventional gas cooking top annual active mode energy consumption.

4.1.2.2.1 Conventional gas cooking top annual active mode gas energy consumption. Calculate the annual active mode gas energy consumption of a conventional gas cooking top, E_{AGG}, in kBtu per year, using the following equation:

$$E_{AGG} = E_{CGG} \times K \times N_C$$

Where:

K and N_C are defined in section 4.1.2.1 of this appendix; and

E_{CGG} = the conventional gas cooking top per-cycle active mode gas energy consumption, as determined in section 4.1.1.2.4 of this appendix, in Btu.

4.1.2.2.2 Conventional gas cooking top annual active mode electrical energy consumption. Calculate the annual active mode electrical energy consumption of a conventional gas cooking top, E_{AGE}, in kilowatt-hours per year, using the following equation:

$$E_{AGE} = E_{CGE} \times K \times N_C$$

Where:

K and N_C are defined in section 4.1.2.1 of this appendix; and

E_{CGE} = the conventional gas cooking top per-cycle active mode electrical energy consumption, as determined in section 4.1.1.2.5 of this appendix, in watt-hours.

4.1.2.2.3 Conventional gas cooking top annual active mode total energy consumption. Calculate the annual active mode total energy consumption of a conventional gas cooking top, E_{AGT}, in kBtu per year, using the following equation:

$$E_{AGT} = E_{AGG} + (E_{AGE} \times K_e)$$

Where:

E_{AGG} = the conventional gas cooking top annual active mode gas energy consumption as determined in section 4.1.2.2.1 of this appendix, in kBtu per year;

E_{AGE} = the conventional gas cooking top annual active mode electrical energy consumption as determined in section 4.1.2.2.2 of this appendix, in kilowatt-hours per year; and

K_e is defined in section 4.1.1.2.6 of this appendix.

4.2 Annual combined low-power mode energy consumption of a conventional cooking top and any conventional cooking top component of a combined cooking product.

4.2.1 Conventional cooking top annual combined low-power mode energy consumption. Calculate the annual combined low-power mode energy consumption for a conventional cooking top, E_{TLP}, in kilowatt-hours per year, using the following equation:

$$E_{TLP} = [(P_{IA} \times F_{IA}) + (P_{OM} \times F_{OM})] \times K \times S_T$$

Where:

P_{IA} = inactive mode power, in watts, as measured in section 3.2.1 of this appendix;

P_{OM} = off mode power, in watts, as measured in section 3.2.2 of this appendix;

F_{IA} and F_{OM} are the portion of annual hours spent in inactive mode and off mode hours respectively, as defined in Table 4.2.1 of this appendix;

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

S_T =8,544, total number of inactive mode and off mode hours per year for a conventional cooking top.

TABLE 4.2.1—ANNUAL HOUR MULTIPLIERS

Types of Low-Power Mode(s) Available	F_{IA}	F_{OM}
Both inactive and off mode	0.5	0.5
Inactive mode only	1	0
Off mode only	0	1

4.2.2 Conventional cooking top component of a combined cooking product annual combined low-power mode energy consumption. Calculate the annual combined low-power mode energy consumption for the conventional cooking top component of a combined cooking product, E_{TLP}, in kilowatt-hours per year, using the following equation:

$$E_{TLP} = [(P_{IA} \times F_{IA}) + (P_{OM} \times F_{OM})] \times K \times S_{TOT} \times H_C$$

Where:

P_{IA}, P_{OM}, F_{IA}, F_{OM}, and K are defined in section 4.2.1 of this appendix;

S_{TOT} = the total number of inactive mode and off mode hours per year for a combined cooking product, as defined in Table 4.2.2 of this appendix; and

H_C = the percentage of hours per year assigned to the conventional cooking top component of a combined cooking product, as defined in Table 4.2.2 of this appendix.

TABLE 4.2.2—COMBINED COOKING PRODUCT USAGE FACTORS

Type of Combined Cooking Product	S_{TOT}	H_C
Cooking top and conventional oven (conventional range)	8,392	60%
Cooking top and microwave oven	8,481	77%

Cooking top, conventional oven, and microwave oven	8,329	51%

4.3 Integrated annual energy consumption of a conventional cooking top and any conventional cooking top component of a combined cooking product.

4.3.1 Conventional electric cooking top integrated annual energy consumption. Calculate the integrated annual energy consumption, IAEC, of a conventional electric cooking top, in kilowatt-hours per year, using the following equation:

$IAEC = E_{AET} + E_{TLP}$

Where:

E_{AET} = the conventional electric cooking top annual active mode energy consumption, as determined in section 4.1.2.1 of this appendix; and

E_{TLP} = the annual combined low-power mode energy consumption of a conventional cooking top or any conventional cooking top component of a combined cooking product, as determined in section 4.2 of this appendix.

4.3.2 Conventional gas cooking top integrated annual energy consumption. Calculate the integrated annual energy consumption, IAEC, of a conventional gas cooking top, in kBtu per year, defined as:

$IAEC = E_{AGT} + (E_{TLP} \times K_e)$

Where:

E_{AGT} = the conventional gas cooking top annual active mode total energy consumption, as determined in section 4.1.2.2.3 of this appendix;

E_{TLP} = the annual combined low-power mode energy consumption of a conventional cooking top or any conventional cooking top component of a combined cooking product, as determined in section 4.2 of this appendix; and

K_e is defined in section 4.1.1.2.6 of this appendix.