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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket No. EERE-2012-BT-TP-0013]

RIN: 1904-AC71

Energy Conservation Program: Test Procedures for Conventional Cooking Products

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

ACTION: Supplemental notice of proposed rulemaking and corrections

SUMMARY: On January 18, 2013, the U.S. Department of Energy (DOE) issued a notice of proposed rulemaking (NOPR) to revise its test procedures for cooking products established under the Energy Policy and Conservation Act. The NOPR proposed a change to the test equipment that would allow for measuring the energy efficiency of induction cooking tops and ranges. To address issues raised in comments regarding the NOPR, DOE conducted additional research and analysis. In this supplemental notice of proposed rulemaking (SNOPR), DOE modifies its proposal to change the test equipment to allow for measuring the energy efficiency of induction cooking tops and proposes to add an additional test block size for electric surface units with large diameters (both induction and electric resistance). In addition, DOE proposes methods to test non-circular electric surface units, electric surface units with flexible concentric cooking zones, and full-surface induction cooking tops. In this SNOPR, DOE also proposes amendments to add a larger test block size to test gas surface units with higher input rates. DOE also proposes to

incorporate methods for measuring conventional oven volume, to clarify that the existing oven test block must be used to test all ovens regardless of input rate, and to measure the energy consumption and efficiency of conventional ovens equipped with an oven separator. Additionally, DOE is proposing technical corrections to the units of measurement in certain calculations and the annual useful cooking energy output for gas cooktops.

DATES: DOE will accept comments, data, and information regarding this NOPR no later than [**INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**]. See section V, "Public Participation," for details.

ADDRESSES: Any comments submitted must identify the SNOPR for Test Procedures for conventional cooking products, and provide docket number EERE-2012-BT-TP-0013 and/or regulatory information number (RIN) number 1904-AC71. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: http://www.regulations.gov. Follow the instructions for submitting comments.
2. E-mail: Induction-Cooking-Prod-2012-TP-0013@ee.doe.gov Include the docket number and/or RIN in the subject line of the message.
3. Mail: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. Hand Delivery/Courier: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC, 20024.

Telephone: (202) 586-2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

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

Docket: The docket, which includes Federal Register notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at regulations.gov. All documents in the docket are listed in the 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: http://www.regulations.gov/#!docketDetail;dct=FR+PR+N+O+SR+PS;rpp=50;so=DESC;sb=postedDate;po=0;D=EERE-2012-BT-TP-0013. This web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through regulations.gov.

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

FOR FURTHER INFORMATION CONTACT:

Ms. Ashley Armstrong, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-6590. E-mail: ashley.armstrong@ee.doe.gov.

Ms. Celia Sher, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 202-287-6122. E-mail: Celia.Sher@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Title III of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6291, et seq.; "EPCA" or, "the Act") sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the American Energy

Manufacturing Technical Corrections Act (AEMTCA), Pub. L. 112-210 (Dec. 18, 2012).) Part B of title III, which for editorial reasons was re-designated as Part A upon incorporation into the U.S. Code (42 U.S.C. 6291–6309, as codified), establishes the "Energy Conservation Program for Consumer Products Other Than Automobiles." These include residential kitchen ranges and ovens, the subject of this SNOPR. (42 U.S.C. 6292(a)(10))

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

A. General Test Procedure Rulemaking Process

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

In addition, if DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2)) Finally, in any rulemaking to amend a test procedure, DOE must determine to what extent, if any, the proposed test procedure would alter the measured energy efficiency of any covered product as determined under the existing test procedure. (42 U.S.C. 6293(e)(1))

B. Test Procedures for Cooking Products

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

DOE established the test procedures in a final rule published in the Federal Register on May 10, 1978. 43 FR 20108, 20120–28. These test procedures did not cover induction cooking products because they were, at the time, relatively new products, and represented a small share of the market. 43 FR 20117. DOE revised its test procedures for cooking products to more accurately measure their efficiency and energy use, and published the revisions as a final rule in 1997. 62 FR 51976 (Oct. 3, 1997). These test procedure amendments did not address induction cooking, but included: (1) a reduction in the annual useful cooking energy; (2) a reduction in the number of self-cleaning oven cycles per year; and (3) incorporation of portions of International Electrotechnical Commission (IEC) Standard 705-1988, "Methods for measuring the performance of microwave ovens for household and similar purposes," and Amendment 2-1993 for the testing of microwave ovens. Id. The test procedures for conventional cooking products establish provisions for determining estimated annual operating cost, cooking efficiency (defined as the ratio of cooking energy output to cooking energy input), and energy factor (defined as the ratio of annual useful cooking energy output to total annual energy input). 10 CFR 430.23(i); Appendix I. These provisions for conventional cooking products are not currently used for compliance with any energy conservation standards because the present standards only regulate design requirements, nor is there an EnergyGuide[1] labeling program for cooking products.

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

C. The January 2013 NOPR

On January 30, 2013, DOE published a NOPR (78 FR 6232, hereinafter referred to as the January 2013 NOPR) proposing amendments to Appendix I that would allow for testing the active mode energy consumption of induction cooking products; i.e., conventional cooking tops and ranges equipped with induction heating technology for one or more surface units[2] on the cooking top. DOE proposed to incorporate induction cooking tops by amending the definition of "conventional cooking top" to include induction heating technology. Furthermore, DOE

[1] For more information on the EnergyGuide labeling program, see: www.access.gpo.gov/nara/cfr/waisidx_00/16cfr305_00.html.
[2] The term surface unit refers to burners for gas cooking tops, electric resistance heating elements for electric cooking tops, and inductive heating elements for induction cooking tops.

proposed to require for all cooking tops the use of test equipment compatible with induction technology. Specifically, DOE proposed to replace the solid aluminum test blocks currently specified in the test procedure for cooking tops with hybrid test blocks comprising two separate pieces: an aluminum body and a stainless steel base. Appendix I currently specifies the test block size for electric cooking tops based on the surface unit diameter; however, there are no provisions for determining which test block size to use for non-circular electric surface units. In the January 2013 NOPR, DOE also proposed amendments to include a clarification that the test block size be determined using the smallest dimension of the electric surface unit. 78 FR 6232, 6234 (Jan. 30, 2013).

D. The February 2014 RFI

On February 12, 2014, DOE published a request for information (RFI) (79 FR 8337, hereinafter referred to as the February 2014 RFI) to initiate an effort to determine whether to amend the current energy conservation standards for conventional cooking products. As part of the February 2014 RFI, DOE stated that it tentatively plans to consider energy conservation standards for all consumer conventional cooking products, including commercial-style gas cooking products[3] and standard gas cooking products that have burners with higher input rates. These products were not included in the analysis underlying the previous standards rulemaking due to a lack of data upon which to determine the measurement of energy efficiency for these products. 79 FR 8337, 8341 (Feb. 12, 2014); 74 FR 16040, 16054 (Apr. 8, 2009). Because DOE is tentatively planning to consider energy conservation standards for all gas cooking products,

[3] DOE considered commercial-style gas cooking tops to be those products that incorporate cooking tops with higher input rate burners (i.e., one or more burners greater than 14,000 Btu/h) and heavy-duty grates that provide faster cooking and the ability to cook larger quantities of food in larger cooking vessels. DOE also stated that the burners are optimized for the larger-scale cookware to maintain high cooking performance. Similarly, DOE considered commercial-style gas ovens to have higher input rates (i.e., greater than 22,500 Btu/h).

including those with high input rate cooking tops and ovens, DOE is also considering amending the cooking products test procedure in Appendix I to include methods for measuring the energy consumption of these products as part of the SNOPR.

II. Summary of the Supplemental Notice of Proposed Rulemaking and Corrections

Based on review of the public comments received in response to the January 2013 NOPR and the potential for considering additional product types in future energy conservation standards rulemakings for conventional cooking products as discussed in the February 2014 RFI, DOE conducted further analysis in support of the proposals discussed in this SNOPR.

DOE continues to propose a hybrid test block comprising a stainless steel base and aluminum body for conventional cooking top testing, including conventional cooking tops with induction heating technology. Further testing conducted by DOE at multiple test laboratories indicated that this test block type produces repeatable and reproducible results. For comparison, DOE also conducted additional water-heating tests at multiple test laboratories, but found the results to be less repeatable and reproducible than the hybrid block-heating tests, consistent with the results discussed in the January 2013 NOPR. 78 FR 6232, 6240–41 (Jan. 30, 2013). DOE's testing, however, showed that adding a layer of thermal grease improves the thermal contact between the base and body of the test block and results in thermal behavior of the test block that is more representative of real-world cooking vessels. Therefore, in this SNOPR, DOE proposes to require the application of thermal grease between the stainless steel base and aluminum body to improve thermal contact between the two parts. The proposed thermal grease would be required to have a thermal conductivity of at least 1.73 British thermal units per hour per foot per degree Fahrenheit (Btu/hr-ft-°F) (1.0 watts per meter per degree Kelvin (W/m-K))[4].

In its additional investigative testing, DOE determined that the existing test block diameters, 6.25 inches and 9 inches, may not be appropriate for testing conventional electric cooking top surface units with large diameters. For large-diameter electric surface units, the 9-inch test block typically results in lower measured efficiencies when compared to a larger test block with a diameter that may more accurately reflect consumer use. To address this issue, DOE proposes a 10.5-inch diameter hybrid test block for testing electric cooking top surface units with diameters of at least 10 inches.

In the January 2013 NOPR, DOE proposed that test block selection for non-circular electric cooking top surface units be based on the surface unit's shortest dimension. 78 FR 6232, 6241 (Jan. 30, 2013). Based on stakeholder feedback and a review of the market, DOE has revised its proposal to address the different types of units available on the market. In the SNOPR, DOE proposes that for electric cooking tops: (1) test blocks for non-circular surface units be selected based on the surface unit's shortest dimension; (2) surface units with flexible concentric sizes (i.e., units with multiple zones of the same shape but varying shortest dimensions) shall be tested at each unique size setting; and (3) full-surface induction cooking tops with "cook anywhere" functionality be tested with all three test block sizes in the center of the usable

[4] In support of the investigative testing performed for the discussion in section III.C.5, DOE tested two types of thermal grease, each having different thermal conductivities according to manufacturer published data at or above 1.73 Btu/hr-ft-°F. Efficiencies obtained with either type of thermal grease for an induction cooktop fell within the expected and observed test-to-test variation as discussed in sections III.C.1 and III.C.2.

cooking surface. DOE also clarifies in the SNOPR that for all cooking tops, specialty surface units such as bridge zones, warming plates, grills, and griddles, are not covered by Appendix I.

DOE also proposes a clarification to the cooking top test procedure in Appendix I to specify that the maximum energy input rate, as referenced in section 3.1.2 of Appendix I, shall be the average energy input rate determined over the duration of the test period at the maximum setting. The average energy input rate determined over the duration of the test period at the reduced setting shall be 25±5 percent of the maximum energy input rate.

Additionally, DOE is proposing amendments that would allow for testing the active mode energy consumption of gas cooking tops with higher surface unit input rates. Based on investigative testing of these cooking tops using a range of test block sizes to represent larger food loads and cookware diameters, DOE proposes that all gas surface units rated above 14,000 Btu/h be tested using a 10.5-inch hybrid test block. For gas ovens, investigative testing of larger oven test blocks for use in ovens with higher input rates did not suggest that the oven test block size should be modified. Thus, DOE proposes that the existing oven test block be used to test all ovens, including ovens having input rates greater than 22,500 Btu/h.

As discussed in the February 2014 RFI, DOE is considering amending the standards for conventional cooking products. As part of any amended standards for conventional ovens, DOE may propose standards as a function of oven cavity volume. Because Appendix I does not currently contain a measure of conventional oven volume, DOE considered methodology for determining this value. Based on DOE's review of the Association of Home Appliance Manufacturers (AHAM) Standard OV-1-2011 "Procedures for the Determination and Expression of the Volume of Household Microwave and Conventional Ovens" (AHAM-OV-1-2011), DOE tentatively concludes that this test method provides a repeatable and reproducible method for measuring conventional oven cavity volume. As a result, DOE is proposing in the SNOPR to incorporate by reference the relevant sections of AHAM-OV-1-2011 for determining conventional oven cavity volume in the DOE test procedure.

Based on DOE's review of products available on the market, DOE is additionally proposing test methods for conventional ovens equipped with an oven separator that allows for cooking using the entire oven cavity in the absence of the separator or, if the separator is installed, splitting the oven into two smaller cavities that may be operated individually with independent temperature controls. DOE is proposing in the SNOPR that conventional ovens equipped with an oven separator shall be tested in each possible oven configuration (i.e., full oven cavity, upper cavity, and lower cavity) with the results averaged.

DOE received comments from interested parties agreeing with its preliminary determination in the January 2013 NOPR that the existing definitions of standby mode and off mode do not require revision. 78 FR 6232, 6241 (Jan. 30, 2013). Therefore DOE is not proposing changes to these definitions in the supplemental proposal. Additionally, DOE did not observe any standby mode or off mode operation or features unique to induction cooking tops and cooking tops and ovens with high input rate burners tested in support of the SNOPR that would warrant changes to the standby mode and off mode test methods for conventional cooking tops. Id.

DOE is also proposing technical corrections to the calculation of derived results from test measurements in section 4 of Appendix I. Section 4 contains a number of references to incorrect units of measurement and an incorrect value for the annual useful cooking energy output for gas cooktops.

Finally, DOE noted that the headings for sections 4.2 and 4.2.1 in Appendix I regarding the calculations for conventional cooking tops were inadvertently removed. As a result, DOE is proposing to add the headings for section 4.2 "Conventional cooking top," and section 4.2.1, "Surface unit cooking efficiency" to appropriately describe these sections..

III. Discussion

A. Products Covered by This Test Procedure Rulemaking

1. Induction Cooking Products

As discussed in section I of this notice, the test procedures currently in Appendix I do not apply to induction cooking products. In the January 2013 NOPR, DOE proposed to amend the definition of "conventional cooking top" to include products that feature electric inductive heating surface units. DOE noted that the definition of "conventional range" would remain unchanged but would include the cooking top component of a range that heats by means of induction technology. 78 FR 6232, 6234–35 (Jan. 30, 2013). DOE similarly proposed in the January 2013 NOPR to revise the definition of "active mode" included in Appendix I to account for electric inductive heating, consistent with the proposed definition of "conventional cooking top." Id.

The Association of Home Appliance Manufacturers (AHAM) and BSH Home Appliances Corporation (BSH) commented that they do not oppose the proposed amended definitions of "conventional cooking top" or "active mode," but do oppose the overall amendments to include inductive heating in the test procedure at this time. (AHAM, TP No. 7 at p. 2[5]; BSH, TP No. 8 at p. 2) AHAM and BSH stated that they do not believe DOE's proposed amendments to the test procedure allow for direct comparisons across cooking technologies, and claimed that because induction cooking tops and ranges do not heat the test block directly, the induction technology will be penalized. (AHAM, TP No. 7 at p. 2; BSH, TP No. 8 at p. 2) Natural Resources Defense Council (NRDC) supported the expansion of the cooking products test procedure to include induction cooking products, based on increased market availability of these products. (NRDC, TP No. 4, at p. 1) NRDC also urged DOE to ensure that its test procedures allow for comparisons of efficiency across product types (gas, electric resistance, and induction units) so that consumers are able to make informed decisions. (NRDC, TP No. 4 at p. 1)

From its testing in support of this rulemaking, DOE determined that the proposed amendments accurately compare the energy consumption of induction cooking tops with the energy consumption of other conventional cooking tops. Although induction cooking tops heat the hybrid test block differently compared to other conventional cooking tops, this manner of heating is representative of how food loads in pots or pans are heated during typical consumer use (i.e., the thermal energy is generated in the stainless steel base which represents the cookware, and then is transferred by conduction to the aluminum body which simulates the food

[5] A notation in the form "AHAM, TP No. 7 at p. 2" identifies a written comment (1) made by AHAM; (2) recorded in document number 7 that is filed in the docket of this test procedures rulemaking (Docket No. EERE-2012-BT-TP-0013) and maintained in the Resource Room of the Building Technologies Program; and (3) which appears on page 2 of document number 7.

load.) Additionally, DOE maintains the proposal that the hybrid test block be used to test all cooking top types (gas, electric resistance, and induction), which would allow for comparable efficiency measurements across all of the covered technologies.

2. Gas Cooking Products with High Input Rates

In the previous energy conservation standards rulemaking for conventional cooking products, DOE excluded "commercial-style" residential gas cooking products from its analysis in considering whether to adopt amended energy conservation standards, due to a lack of available data for determining efficiency characteristics of those products. DOE also noted that its cooking products test procedures may not adequately measure the performance of higher input rate burners . 74 FR 16040, 16054 (Apr. 8, 2009); 72 FR 64432, 64444-45 (Nov. 15, 2007). DOE considers a cooking top burner with a high input rate to be a burner rated greater than 14,000 Btu/h. Similarly, DOE considers gas ovens with high burner input rates to be those with burners rated greater than 22,500 Btu/h.

Based on investigative testing in support of this notice, DOE is proposing to amend the conventional cooking top test procedure in Appendix I to measure the energy use of gas surface units with high input rates and to clarify that the existing conventional oven test procedure is appropriate for ovens with high input rates. DOE notes that the current definitions for "conventional cooking top," "conventional oven," and "conventional range" in 10 CFR 430.2 already cover conventional gas cooking products with higher input rates (including commercial-style gas cooking products), as these products are household cooking appliances with surface units or compartments intended for the cooking or heating of food by means of a gas flame.

B. Effective Date

The amended test procedure would become effective 30 days after any test procedure final rule is published in the Federal Register. Pursuant to EPCA, manufacturers of covered products must use the applicable test procedure as the basis for determining that their products comply with the applicable energy conservation standards adopted pursuant to EPCA and for making representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s)) Beginning 180 days after publication of any test procedure final rule, representations related to the energy consumption of conventional cooking products must be based upon results generated under the applicable provisions of the amended test procedures in Appendix I. (42 U.S.C. 6293(c)(2))

C. Conventional Cooking Top Active Mode Test Procedure

The current active mode test procedure for conventional cooking tops involves heating an aluminum test block on each surface unit of the cooking top. Two aluminum test blocks, of different diameters, are specified for testing different size surface units. The small test block (6.25 inches diameter) is used for electric surface units with diameters of 7 inches or less, and the large test block (9 inches diameter) is used for electric surface units with diameters greater than 7 inches and all gas surface units. Once the initial test and ambient conditions are met, the surface unit is turned to its maximum energy input setting. After the test block temperature increases by 144 degrees Fahrenheit (°F), the surface unit input rate is immediately reduced to 25 percent ± 5 percent of the maximum energy input rate for 15 ± 0.1 minutes. The efficiency of the surface unit is calculated as the ratio of the energy transferred to the test block (based on its temperature rise) to the energy consumed by the cooking top during the test. The cooking top cooking efficiency is calculated as the average efficiency of the surface units on the cooking top. The current active mode test procedure is compatible with gas cooking tops and electric cooking tops with electric resistance heating elements (i.e., electric resistance heating under a smooth ceramic surface and open coil electric resistance heating).

1. Test Block Construction

Induction cooking products are compatible with only ferromagnetic cooking vessels because the high magnetic permeability of these vessels concentrates the induced current near the surface of the metal, increasing resistance and thus heating. Aluminum is not a ferromagnetic metal—its lower magnetic permeability allows the magnetic field to penetrate further into the material so that the induced current flows with little resistance, and thus does not heat up when it encounters an oscillating magnetic field. Therefore, the aluminum test blocks currently required by Appendix I are not appropriate for testing induction cooking products.

As part of the January 2013 NOPR, DOE conducted testing to investigate potential substitute test blocks for testing induction cooking products. DOE conducted tests using the same basic test method specified in Appendix I, as described above, using carbon steel, carbon steel hybrid, and stainless steel hybrid test blocks. 78 FR 6232, 6235 (Jan. 30, 2013). Table III.1 describes the construction of the current aluminum test blocks and the three substitute test blocks.

Table III.1 Test Block Composition Descriptions

Test Block Classification	**Test Block Composition** (Component and Material)
Aluminum	One solid aluminum alloy 6061 block
Carbon Steel	One solid carbon steel alloy 1018 block
Carbon Steel Hybrid	Carbon steel alloy 1018 base + Aluminum alloy 6061 body
Stainless Steel Hybrid	Stainless steel alloy 430 base + Aluminum alloy 6061 body

Based on its initial investigative testing, DOE observed that the stainless steel hybrid test block, hereinafter referred to as the hybrid test block, produced the most repeatable results, and proposed amending Appendix I to require these blocks for all cooking top testing. 78 FR 6232, 6235, 6241 (Jan. 30, 2013). DOE verified these initial conclusions through additional testing conducted for this SNOPR (see section III.C.1 through section III.C.4 of this notice), and further evaluated an improvement to the hybrid test block through the application of thermal grease between the stainless steel base and aluminum body (see section III.C.5 of this SNOPR.)

In response to the January 2013 NOPR, AHAM asked whether DOE had information on the typical thickness of a pot or pan, questioning the proposed thickness of the hybrid test block base at 0.25 inches. (AHAM, Public Meeting Transcript, TP No. 5 at p. 29)[6] Through a market search, DOE determined that the typical thickness of cookware compatible with induction cooking tops range from 20 gauge (~0.04 inch) to 8 gauge (~0.17 inch) depending on the type and application of the cookware.[7] Heavy-gauge pans have thicknesses as large as 8 or 9 millimeters (mm) (0.32 to 0.35 inch). Additionally, the IEC Standard 60350-2 Edition 1.0 "Household electric cooking appliances – Part 2: Hobs – Method for measuring performance" specifies test cookware with a base thickness of 6 mm (0.24 inch). DOE selected the 0.25-inch stainless steel base to reduce the impact of warping but still remain within the plausible thickness of a pot or pan, and to harmonize with the IEC cookware base (to the nearest common dimension in inches).

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[6] A notation in the form "AHAM, Public Meeting Transcript, TP No. 5 at p. 29" identifies an oral comment that DOE received during the March 4, 2013, NOPR public meeting, was recorded in the public meeting transcript in the docket for this test procedure rulemaking (Docket No. EERE-2012-BT-TP-0013), and is maintained in the Resource Room of the Building Technologies Program. This particular notation refers to a comment (1) made by AHAM during the public meeting; (2) recorded in document number 5, which is the public meeting transcript that is filed in the docket of this test procedure rulemaking; and (3) which appears on page 29 of document number 5.

[7] Cookware Manufacturers Association. Please see: http://www.cookware.org/tools_2.php

AHAM and BSH expressed concern that the results presented in the January 2013 NOPR were obtained using one laboratory and a single set of test blocks. (AHAM, TP No. 7 at p. 4; BSH, TP No. 8 at p. 4) AHAM and BSH asked whether DOE had examined whether warping of the blocks might impact their heat transfer. (AHAM, Public Meeting Transcript, TP No. 5 at p. 27; AHAM, TP No. 7 at pp. 2, 4; BSH, TP No. 8 at pp. 2, 4) AHAM and BSH emphasized that any change in the flatness of the test blocks, including between layers, whether due to construction or warping over time, could impact test results and increase variation from test to test as there might not be uniform contact between the block and the surface unit. AHAM and BSH requested that DOE study the impact of flatness on energy measurements to define technically feasible and consistent limits for flatness. (AHAM, TP No. 7, at pp. 3–4; BSH, TP No. 8 at pp. 3–4) AHAM and BSH also commented that the proposed flatness of 0.002 total indicator reading (TIR) is not technically feasible for the 9-inch diameter test block because it cannot be verified with commonly accepted laboratory equipment. Id.

DOE evaluated the amount of warping observed for both the stainless steel base and aluminum body of the 6.25-inch and 9-inch hybrid test blocks originally purchased for testing in support of the January 2013 NOPR. Each of these test blocks underwent approximately 100 tests. The aluminum body in both test block sizes remained within the 0.002 TIR tolerance specified in the existing test procedure. However, the stainless steel base for both the 6.25-inch and 9-inch test block did not remain within tolerance, resulting in a flatness greater than 0.002 TIR but less than 0.004 inch TIR after one year of use. The cooking tops evaluated for this test series included the test sample listed in Table III.2.

Table III.2 Cooking Top Test Sample

Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Diameter	Surface Unit Max Rated Power (W)
A	Smooth – Electric Resistance	Front Right (FR)	9	3000
A	Smooth – Electric Resistance	Back Left (BL)	6	1200
B	Coil – Electric Resistance	Front Right (FR)	8	2350
B	Coil – Electric Resistance	Front Left (FL)	6	1500
C	Smooth – Induction	Back Right (BR)	10	3300
C	Smooth – Induction	Front Left (FL)	7	2400
D	Smooth – Induction	Front Right (FR)	11	3700
D	Smooth – Induction	Back Right (BR)	6	1800
E	Gas	Front Right (FR)	-	9000[a]
F	Smooth – Electric Resistance	Front Right (FR)	12	3000
F	Smooth – Electric Resistance	Back Left (BL)	8	2400
G	Smooth – Electric Resistance	Front Right (FR)	12	3000
G	Smooth – Electric Resistance	Back Left (BL)	6	1200

[a] Gas surface unit max rated power is in Btu/h

As part of the testing conducted for the SNOPR, DOE fabricated a new set of test blocks to evaluate the effects of potential warping and to evaluate the reproducibility of the test procedure between multiple test laboratories. DOE conducted tests with these new test blocks as well as additional tests with the original test blocks that exceeded the 0.002 inch TIR requirement. The results shown in Table III.3 provide a comparison between tests run with in-tolerance hybrid test blocks at Laboratory 1 and out-of-tolerance test blocks at Laboratory 2.

Table III.3 Block Warping Comparison of Measured Surface Unit Efficiency

Test Block Size	Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Mean Efficiency (Laboratory 1 ≤ 0.002 inch TIR)	Mean Efficiency (Laboratory 2 ≤ 0.004 inch TIR)	Difference in Measured Efficiency
9-inch Test Block	B	Coil – Electric Resistance	FR	71.87%	71.50%	0.37%
	D	Induction	FR	73.59%	72.63%	0.96%
6.25-inch Test Block	B	Coil – Electric Resistance	FL	71.42%	71.80%	-0.39%
	D	Induction	BR	72.71%	73.21%	-0.50%

The difference in the average measured surface unit efficiency between the test blocks in tolerance and out of tolerance and between the two test facilities is consistently less than 1 percent. Additionally, the out-of-tolerance test block measured efficiencies are not consistently higher or lower than the in-tolerance test block efficiencies, suggesting that the out-of-tolerance test blocks do not have a clear positive or negative effect on the measured efficiencies. Based on these results, DOE tentatively concludes that the hybrid test block produces results that are reproducible and that minor warping has a minimal effect on measured efficiency.

DOE proposes to maintain the current specified flatness of 0.002 inch TIR for the construction of both the aluminum body and stainless steel base of the hybrid test block. Based on the testing results showing that hybrid test block pieces having a flatness of 0.004 inch TIR or less will not greatly impact measured efficiency, DOE proposes that the stainless steel hybrid test blocks may continue to be used until their flatness exceeds 0.004 inch TIR. This will help reduce the burden associated with replacing the test blocks and ensuring they remain within the flatness tolerance. DOE expects that standard machine shops will likely have the ability to measure flatness within the specified tolerances.

AHAM and BSH also stated that larger test blocks may have an increased potential for warping that could lead to increased variation in the test results, especially if a larger test block will need to reach higher temperatures. (AHAM, TP No. 7 at p. 4; BSH, TP No. 8 at p.4) AHAM and BSH suggested that larger test blocks may not be technologically feasible because there is likely no way to transfer the heat out of the block fast enough. Id. Additionally, AHAM and BSH suggested that as the temperature of the block increases, the heat loss increases, and could potentially result in an inaccurate measurement. (AHAM, TP No. 7 at p. 5; BSH, TP No. 8 at p. 5)

To address the concerns of the large test block reaching higher temperatures, DOE evaluated the final block temperatures observed for both the 6.25-inch and 9-inch test blocks. Figure III.1 correlates test block final temperature with surface unit rated power for induction, smooth – electric resistance, and coil – electric resistance cooking tops.

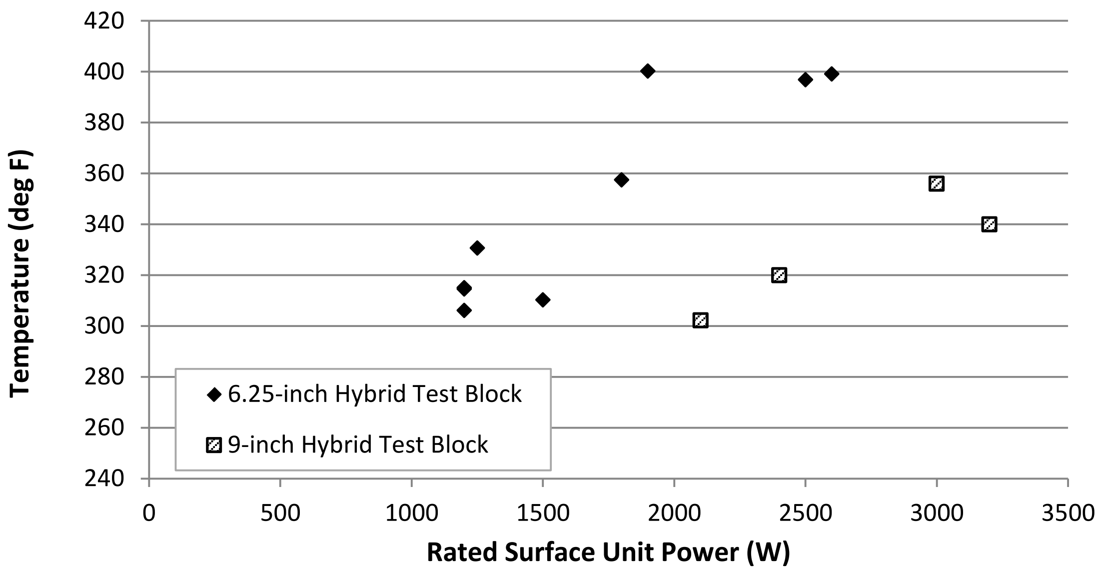

Figure III.1 Test Block Final Temperatures[8]

For a given, rated, surface unit power, final temperatures for the 6.25-inch test block were higher than for the 9-inch test block. Generally, the 9-inch test block does not reach significantly higher temperatures when compared to the 6.25-inch test block. Therefore, DOE does not expect any additional warping concerns or heat transfer issues for the 9-inch test block compared to the 6.25-inch test block.

AHAM and BSH noted that because AHAM members have seen variation in stainless steel composition within the same nominal steel type (e.g., differences in the amounts of carbon and chrome), DOE should study the impact of changes in the stainless steel composition on the surface unit efficiency measurement. (AHAM, TP No. 7 at p. 4; BSH, TP No. 8 at p.4)

[8] Note that because the application of thermal grease between the hybrid test block pieces affected the rate of temperature increase of the test block, as discussed further in section III.C.5, the final temperatures presented in Figure III.1 were obtained using the hybrid test block with thermal grease.

DOE spoke with material suppliers during the test block fabrication process. Suppliers did not express any concern that magnetic or thermal properties might change from lot to lot of stainless steel alloy 430. Moreover, there is limited variation of the thermal properties even among different grades of stainless steel alloy. Thus, DOE does not anticipate any significant variation within a single grade of stainless steel 430. Additionally, DOE notes that the test results presented above in Table III.3 are based on test blocks purchased in different years. DOE expects that the blocks were manufactured from different lots of stainless steel and aluminum, yet even with the warping issues and testing at different labs, they still produced consistent results.

For the reasons described above, DOE proposes an additional clarification requiring that the block flatness of the hybrid test blocks must be maintained within 0.004 inch TIR for testing.

2. Water-Heating Test Method

For the January 2013 NOPR, DOE also conducted tests to heat water in standardized cooking vessels to compare test repeatability with the metal block-heating tests. DOE stated that water provides a heating medium that is more representative of actual consumer use because many foods cooked on a cooking top have a relatively high liquid content. However, DOE also noted that water heating introduces additional sources of variability not present for metal block heating—the temperature distribution in the water is not always uniform, the properties of the water can vary from laboratory to laboratory, and the ambient conditions and cookware surface effects can have a large impact on the water boiling and evaporating throughout the test. DOE conducted these water-heating tests using the test loads and test methods specified in a draft amendment to the IEC Standard 60350-2 Edition 1.0 “Household electric cooking appliances –

Part 2: Hobs – Method for measuring performance" (Draft IEC 60350 Amendment)[9] with additional calculations to estimate the efficiency of the water-heating process. 78 FR 6232, 6239–40 (Jan. 30, 2013). On April 25, 2014, IEC made available the draft version of IEC Standard 60350-2 Edition 2.0 Committee Draft (IEC 60350-2 CD). DOE noted that the Draft IEC 60350 Amendment and IEC 60350-2 CD include the same basic test method.

AHAM and BSH commented that data presented in the January 2013 NOPR did not clearly identify the test block method as being preferable to the water-heating method for induction units and requested DOE perform an additional study to determine which method produces more accurate, repeatable, and reproducible results. (AHAM, TP No. 7 at p.2; BSH, TP No. 8 at p. 2) AHAM and BSH also commented that they do not believe that the January 2013 NOPR sufficiently demonstrated the stainless steel hybrid test block as the best method for testing induction cooking tops, and that neither of the considered test methods emerged as a more repeatable and reproducible method. Specifically, AHAM and BSH noted that in the January 2013 NOPR, the results were split, with about half of the standard deviations being smaller for the hybrid test block and half being smaller for the water-heating method. (AHAM, TP No. 7 at pp. 3, 4; BSH, TP No. 8 at pp. 3, 4)

In preparation for the SNOPR, DOE performed additional tests to further evaluate the repeatability and reproducibility of the hybrid test block method as compared to the water-heating method. Table III.4 summarizes the test results from Laboratory 1 using the hybrid test

[9] The Draft IEC 60350 Amendment specifies the quantity of water to be heated in a standardized cooking vessel whose size is based on the diameter of the surface unit. For the January 2013 analysis, DOE chose the two IEC-specified cooking vessels with diameters closest to the diameters specified for the aluminum test blocks (6.25 inches and 9 inches).

blocks, the aluminum-only test blocks, and the IEC 60350-2 CD water loads. The test sample included two induction cooking tops, two conventional electric cooking tops, and one conventional gas cooking top. Because aluminum is not compatible with induction cooking, DOE only tested the aluminum blocks on the three conventional cooking tops in the test sample. The 6.25-inch diameter test load was used for electric surface units with diameters of 7 inches or less. The 9-inch diameter test load was used for electric surface units with diameters greater than 7 inches and all gas surface units, as required by Appendix I.

Table III.4 Laboratory 1 Mean Cooking Top Efficiency

Test Load Size	Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Mean Efficiency (%) Hybrid	Mean Efficiency (%) Aluminum	Mean Efficiency (%) Water Load
Large[a]	A	Smooth – Electric Resistance	FR	67.72%	75.81%	79.76%
	B	Coil – Electric Resistance	FR	71.87%	79.83%	79.98%
	C	Induction	BR	70.73%	-	78.65%
	D	Induction	FR	73.59%	-	80.49%
	E	Gas	FR	43.94%	47.02%	-
Small[b]	A	Smooth – Electric Resistance	BL	66.22%	71.01%	70.44%
	B	Coil – Electric Resistance	FL	71.42%	76.17%	76.95%
	C	Induction	FL	69.43%	-	79.16%
	D	Induction	BR	72.71%	-	78.49%

[a] Large = (9-inch for Hybrid Load and 9.45-inch for IEC Water Load)
[b] Small = (6.25-inch for Hybrid Load and 5.91-inch for IEC Water Load)

To investigate the laboratory-to-laboratory reproducibility of test results, DOE conducted testing in support of the SNOPR at two laboratories. Two of the units in the test sample were tested at both laboratories. At Laboratory 1, a set of ten tests were performed on each surface unit using the proposed hybrid test blocks and the IEC 60350-2 CD water-heating test method.

At Laboratory 2, three tests were performed for each surface unit and each test method.[10] Table III.5 compares the measured efficiencies for the hybrid test blocks and the IEC 60350-2 CD water loads for the two cooking tops that were tested at both test laboratories.

Table III.5 Mean Cooking Top Efficiency Comparison between Test Laboratories

				Hybrid Mean Efficiency			Water Load Mean Efficiency		
Test Block Size	**Cooking Top Unit Designation**	**Heating Technology**	**Surface Unit Designation**	**Lab 1**	**Lab 2**	**Diff.**	**Lab 1**	**Lab 2**	**Diff.**
Large[a]	B	Coil – Electric Resistance	FR	71.87%	71.50%	0.37%	79.98%	79.22%	0.76%
	D	Induction	FR	73.59%	72.63%	0.96%	80.49%	81.51%	-1.02%
Small[b]	B	Coil – Electric Resistance	FL	71.42%	71.80%	-0.39%	76.95%	76.80%	0.15%
	D	Induction	FL	72.71%	73.21%	-0.50%	78.49%	81.67%	-3.18%

[a] Large = (9-inch for Hybrid Load and 9.45-inch for IEC Water Load)
[b] Small = (6.25-inch for Hybrid Load and 5.91-inch for IEC Water Load)

As discussed in section III.C.1 and shown in Table III.5, the hybrid test blocks produced reproducible results at the two test laboratories. The IEC 60350-2 CD test load also produced similar results between the two test laboratories, with a slightly greater difference in efficiencies compared to the hybrid test blocks for the two induction surface units.

To assess the repeatability of the two test loads, Table III.6 compares the standard deviations for each surface unit tested at Laboratory 1 with both the water-heating and hybrid block-heating tests. As shown in Table III.4, the water-heating tests generally result in higher measured efficiencies compared to the hybrid tests. To account for the higher standard deviations

[10] The additional number of tests conducted at Laboratory 1, as compared to Laboratory 2, were primarily to evaluate repeatability of results from test-to-test.

that may be associated with higher measured efficiencies, Table III.6 also includes the coefficient of variation for each set of tests.

Table III.6 Test Method Standard Deviations

	Test Load Size	Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Standard Deviation (%)		Coefficient of Variation	
					Hybrid	Water Load	Hybrid	Water Load
Lab 1	Large	A	Smooth – Electric Resistance	FR	0.57%	3.05%	0.008	0.039
		B	Coil – Electric Resistance	FR	1.05%	2.15%	0.015	0.027
		C	Induction	BR	0.74%	0.66%	0.011	0.008
		D	Induction	FR	1.02%	0.57%	0.014	0.007
	Small	A	Smooth – Electric Resistance	BL	1.26%	3.03%	0.019	0.044
		B	Coil – Electric Resistance	FL	2.01%	1.50%	0.028	0.020
		C	Induction	FL	1.63%	2.22%	0.023	0.029
		D	Induction	BR	1.34%	0.64%	0.019	0.008
Lab 2	Large	B	Coil – Electric Resistance	FR	0.39%	0.37%	0.004	0.004
		D	Induction	FR	0.24%	0.71%	0.003	0.008
	Small	B	Coil – Electric Resistance	FL	0.48%	4.58%	0.005	0.052
		D	Induction	FL	0.31%	1.30%	0.003	0.015

As shown in Table III.6, the proposed DOE test method produced standard deviations of just over 2 percent or less for each surface unit. Conversely, standard deviations for the IEC 60350-2 CD water-heating test method exceeded 3 percent for some tested surface units, and ranged as high as 4.58 percent. The average standard deviation for the proposed DOE test method across induction units was 0.60 percent for the 9-inch test block and 0.94 percent for the 6.25-inch test block. The average standard deviation across all induction units for the water-heating method was 0.58 percent for the large IEC cookware and 2.19 percent for the small IEC cookware.

Because DOE is proposing the use of the hybrid test block for all surface unit types, DOE also considered the standard deviation across all surface unit types for each test method. The average standard deviation for the proposed DOE test method across all test surface units was 0.67 percent for the 9-inch test block and 1.17 percent for the 6.25-inch block. The average standard deviation across all surface unit types for the water-heating method was 1.25 percent for the large IEC cookware and 2.21 percent for the small IEC cookware. Similarly, the coefficients of variation for the hybrid tests were, on average, lower than for the water-heating tests. The average coefficient of variation across all surface unit types was 0.009 for the 9-inch test block and 0.016 for the 6.25-inch block, while the average coefficients of variation of the large and small IEC cookware were 0.016 and 0.028, respectively.

The water-heating test variability could potentially be reduced by imposing more stringent tolerances on the ambient conditions than Appendix I requires. Ambient air pressure, temperature, and humidity significantly impact the amount of water that evaporates during the test and the temperature at which the water begins to boil. Appendix I, however, only specifies ambient air temperature, and its relatively large tolerance, 77 °F ± 9 °F, could contribute to increased test variability. However, AHAM and BSH also noted that that if DOE were to adopt tighter ambient controls, it could require considerable financial investment to construct or modify a test facility to meet these requirements, depending on the limits identified. Test blocks also lose heat to the ambient air and the impact of heat loss could cause variation in test results. (AHAM, TP No. 7 at p.6; BSH, TP No. 8 at p. 6)

The water-heating tests under the current DOE test conditions do not show an improvement in test-to-test repeatability or laboratory-to-laboratory reproducibility compared to the hybrid block-heating tests across all surface unit types. For induction cooktops alone, the repeatability and reproducibility of the hybrid test block are sufficiently small. Because DOE seeks to implement a single test method applicable to all surface unit types, and because achieving reduced ambient temperature tolerances and adding humidity and pressure tolerances per IEC 60350-2 CD would potentially place a high burden on manufacturers, DOE maintains its proposal to use hybrid test blocks for all products covered under the proposed definition of conventional cooking tops and is not proposing any amendments to the existing ambient test conditions in Appendix I.

In the January 2013 NOPR, DOE indicated that it developed additional calculations to estimate the efficiency of the water-heating process in order to account for the amount of water that evaporated or boiled off. 78 FR 6232, 6240 (Jan. 30, 2013). AHAM and BSH commented that it is inappropriate to calculate efficiency with a water-heating test precisely because it is always unknown how much water evaporates during the test. (AHAM, TP No. 7 at p. 5; BSH, TP No. 8 at p. 5) AHAM and BSH also claimed they cannot fully or meaningfully evaluate the results DOE presented in the notice of proposed rulemaking because those results are based on energy efficiency, not consumption. AHAM and BSH requested that DOE provide energy consumption data to stakeholders and also analyze the energy consumption data itself in order to properly evaluate the accuracy, repeatability, and reproducibility of the water-heating test. AHAM and BSH suggested that it is possible that the standard deviations could be different if energy consumption results are evaluated instead of energy efficiency results and might indicate that the water-heating test is more reproducible and/or repeatable than the hybrid block test procedure. (AHAM, TP No. 7 at p. 5; BSH, TP No. 8 at p. 5)

Table III.7 and Table III.8 list the standard deviations and coefficients of variation for the energy consumption measured for the cooking tops in the test sample using the IEC 60350-2 CD water-heating test method and the proposed DOE test block. Data collected for both the January 2013 NOPR and this SNOPR were used to calculate the standard deviations and coefficients of variation presented in Table III.7 and Table III.8.

Table III.7 Water-Heating Test Load Energy Consumption Repeatability

Test Load Size	Cooking top Unit Designation	Heating Technology	Surface Unit Designation	Average Test Energy Consumption (Wh)	Standard Deviation (Wh)	Coefficient of Variation
Large	A	Smooth – Electric Resistance	FR	550.93	10.14	0.02
	B	Coil – Electric Resistance	FR	533.05	12.25	0.02
	C	Induction	BR	455.96	20.94	0.05
	D	Induction	FR	522.06	7.14	0.01
Small	A	Smooth – Electric Resistance	BL	230.78	1.67	0.01
	B	Coil – Electric Resistance	FL	241.41	5.60	0.02
	C	Induction	FL	247.44	3.67	0.02
	D	Induction	BR	226.41	9.01	0.04

Table III.8 Proposed DOE Test Block Energy Consumption Repeatability

Test Load Size	Cooking top Unit Designation	Heating Technology	Surface Unit Designation	Average Test Energy Consumption (Wh)	Standard Deviation	Coefficient of Variation
Large	A	Smooth – Electric Resistance	FR	560.3	11.65	0.02
	B	Coil – Electric Resistance	FR	456.77	6.49	0.01
	C	Induction	BR	379.37	3.26	0.01
	D	Induction	FR	453.27	12.58	0.03

Small	A	Smooth – Electric Resistance	BL	225.84	8.1	0.04
	B	Coil – Electric Resistance	FL	231.6	10.54	0.05
	C	Induction	FL	226.95	3.48	0.02
	D	Induction	BR	210.56	3.93	0.02

Consistent with testing in support of the January 2013 NOPR, DOE found that energy consumption using the IEC 60350-2 CD water-heating test method is not a more repeatable or reproducible metric than cooking efficiency for evaluating cooking top performance. The results based on energy consumption resulted in an average coefficient of variation 0.024 for the water-heating test method, which is similar to the average coefficient of variation for cooking top water-heating efficiency (0.022). Energy consumption as measured with the proposed DOE test block resulted in an average coefficient of variation of 0.025 which is similar to the variation observed using the water-heating test method. In turn, these coefficients of variation are both higher than the average coefficient of variation for cooking efficiency using the hybrid test block (0.0125 on average for both test block sizes). DOE observed that a specific turndown setting would not always maintain the appropriate simmering temperature from test to test. Accordingly, adjustments to the turndown setting between tests were necessary to meet the simmering requirements. These differences in the turndown setting resulted in a wide range of measured energy consumptions. DOE noted that these differences in the reduced settings corresponded to varying amounts of water boiled or evaporated off during the test. Accordingly, DOE developed efficiency calculations that address this variation, which factor in: (a) the total temperature rise of the water to account for differences in simmering temperatures, and (b) the total amount of water lost to boiling or evaporation during the test by measuring the mass of the cookware plus water at the start and end of the test. However, even with these adjustments, the test results with DOE's water-heating efficiency calculations are still less repeatable than the hybrid block-heating tests. For these additional reasons, DOE continues to propose the block-heating test method using the hybrid test blocks.

3. Test Block Sizes

AHAM and BSH noted that because induction coils do not reach full power unless the test block covers the entire surface unit, two test blocks might not be sufficient. According to AHAM and BSH, many use and care guides instruct consumers to match the pot or pan to the size of the coil. Therefore, AHAM and BSH stated that in order for an induction cooking top test procedure to be representative of actual consumer use, the test blocks must fully cover the surface unit. (AHAM, TP No. 7 at p. 4; BSH, TP No. 8 at p. 4)

DOE tested four electric surface units covering a range of diameters using both the 6.25-inch and 9-inch test blocks. The test results evaluated the effects of either oversizing (using the 9-inch test block on a smaller surface unit) or under-sizing (using the 6.25-inch test block on a larger surface unit) the test block relative to the surface unit as shown in Table III.9.

Table III.9 Difference in Efficiencies Measured with 9-inch and 6.25-inch Test Blocks

Cooking top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Diameter (inches)	6.25-inch Block Measured Efficiency (%)	9-inch Block Measured Efficiency (%)	Measured Efficiency Difference (%)
C	Induction	FL	7	69.43%	71.39%	1.96%
A	Smooth – Electric Resistance	BL	6	66.22%	71.25%	5.03%
F[a]	Smooth – Electric Resistance	FR	12	33.17%	58.95%	25.78%
F[a]	Smooth – Electric Resistance	BL	8	49.61%	72.87%	23.26%

[a] Cooking top F was added to the test sample to investigate block sizing but was not included in the repeatability results as it was not tested for the January 2013 NOPR.

Results showed that for surface units with diameters up to 7 inches, the difference in measured efficiency between the 9-inch test block and the 6.25-inch test block was on average less than 3.5 percent and within the typical test-to-test variation. However, for surface unit diameters exceeding the small test block diameter by 1.75 inches or more, differences in measured efficiency were on the order of 25 percent. These results show that as the difference between test block diameter and surface unit diameter increases, an undersized test block would reduce measured cooking efficiency for surface units with larger diameters. The results do not show a similar effect for oversizing the test block. While it is not possible to undersize the test block on an induction surface unit because internal controls sense the cookware diameter to protect the unit from misuse, oversizing the test block does not greatly affect current generation in the base of the hybrid test block based on DOE testing, and resulted in similar measured efficiencies between the 6.25-inch and 9-inch block. For smooth cooking tops with electric resistance heating, when the test block is undersized, heat from the surface unit's heating element that exceeds the test block diameter is transferred to the ambient air. When oversized, the entire smooth heating element serves to heat the test block with only limited heat transfer back to the cooktop surface.

Based on a review of the market, DOE found that electric cooking top surface unit diameters typically reach up to 12 inches. In determining an appropriate test block size for these larger surface units, DOE noted that the hybrid test block proposed for use with gas cooking tops with higher surface unit input rates, as described in section III.D.1 below, had the appropriate diameter to capture the range of large electric surface units in the residential market. Selecting this test block for use with large electric surface units would also minimize manufacturer burden because the two test blocks proposed for use with gas cooking tops could be used to test electric cooking tops. Table III.10 contains efficiencies measured with the 10.5-inch test block for four surface units greater than 10 inches in diameter.

Table III.10 Difference in Efficiencies Measured with 10.5-inch and 9-inch Test Blocks

Cooking top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Diameter (inches)	9-inch Block Measured Efficiency (%)	10.5-inch Block Measured Efficiency (%)	Measured Efficiency Difference (%)
A	Smooth – Electric Resistance	FL	12	52.95%	56.07%	3.12%
F[a]	Smooth – Electric Resistance	FR	12	58.95%	63.04%	4.09%
G[a]	Smooth – Electric Resistance	FR	12	57.09%	71.22%	14.13%

[a] Cooking tops F and G were added to the test sample to investigate block sizing but were not included in the repeatability results as it was not tested for the January 2013 NOPR.

Results indicated that efficiencies measured with the 10.5-inch test block are higher than those measured with the 9-inch test block. However, because the difference in size between the two blocks is less than the difference in size between the 6.25-inch and 9-inch test block, the efficiency increase is not as significant.

Table III.11 lists the dimensions and thermal properties of the three proposed hybrid test blocks.

Table III.11 Hybrid Test Block Specifications

Test Block Size	Block Diameter (inches)	Block Height (inches)	Block Weight (pounds (lb))	Specific Heat (Btu/lb-°F)	Heat Capacity (Btu/°F)
Small Stainless Steel Base	6.25	0.25	2.15	0.11	0.24
Small Aluminum Body	6.25	2.5	7.46	0.23	1.72
Small Total	**6.25**	**2.75**	**9.61**	**0.20**	**1.96**
Medium Stainless Steel Base	9	0.25	4.28	0.11	0.47
Medium Aluminum Body	9	2.72	16.85	0.23	3.87
Medium Total	**9**	**2.97**	**21.13**	**0.21**	**4.34**
Large Stainless Steel Base	10.5	0.25	6.09	0.11	0.67
Large Aluminum Body	10.5	3.48	29.39	0.23	6.76
Large Total	**10.5**	**3.73**	**35.48**	**0.21**	**7.43**

DOE also investigated how test block size might affect surface unit power during the test to determine if surface unit input rate was dependent on test block diameter. By testing certain surface units with both the 6.25-inch and 9-inch test blocks, DOE was able to compare the average energy input rate and maximum power during the heat-up period (i.e., the period at the maximum setting) for the different block sizes. Table III.12 compares the average and maximum power during the heat-up period for the two current test block sizes on four surface units.

Table III.12 Energy Input rate at the Maximum Setting

Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Diameter (inches)	Test Block Size	Average Power at Max Setting (W)	Maximum Power (W)
A	Smooth – Electric Resistance	BL	6	6.25-inch	1211.3	1344
A	Smooth – Electric Resistance	BL	6	9-inch	1065.0	1317.6
A	Smooth – Electric Resistance	FR	9	6.25-inch	2894.6	3218
A	Smooth – Electric Resistance	FR	9	9-inch	2644.2	3210
D*	Induction	BR	6	6.25-inch	1878.5	2052
D*	Induction	BR	6	9-inch	1458.6	2105

*Cooking Top D was tested with thermal grease, which is discussed further in section III.C.5, to determine a more representative maximum power level for induction cooking tops. For smooth

– electric resistance cooking tops, based on DOE’s testing, the maximum power level for the smooth cooking top was not affected by the presence of thermal grease.

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These test results show that for each surface unit tested, the average power during the heat-up period for the 6.25-inch test block is higher than for the 9-inch test block, even when the test block is significantly undersized. However, the maximum instantaneous power measured at the maximum setting on average shows no significant difference between the two test block sizes. Based on these results showing that both test block sizes allow surface units to reach the same maximum power, DOE determined that the proposed test block sizes are appropriate.

4. Non-Circular and Flexible Surface Units

In the January 2013 NOPR, DOE proposed that for non-circular surface units, the appropriate test block size would be determined based on the surface unit’s shortest dimension. 78 FR 6232, 6241 (Jan. 30, 2103). AHAM asked whether DOE had conducted any testing on the non-circular types of surface units or considered how different sizes of hybrid test blocks might impact the results. (AHAM, Public Meeting Transcript, TP No. 5 at p. 41) AHAM and BSH also stated that while DOE’s test block proposal would address rectangular or oval-shaped surface units, it would not address surface elements that are not clearly defined. According to these commenters, there is a current trend in the market to have flexible cooking zones—i.e., those that do not have clearly defined edges. AHAM and BSH requested that DOE develop a procedure that would allow units with flexible cooking zones to be accurately tested. (AHAM, TP No. 7 at p. 6; BSH, TP No. 8 at p. 6)

Based on a review of products on the market, DOE is aware of full-surface induction cooking tops with no clearly defined cooking zones. These cooking tops have multiple smaller inductors underneath the cooking top surface, which are fully or partially energized depending on the size of the cookware. Because the inductors are typically all the same size and distributed evenly across the cooking surface, DOE does not expect efficiency to vary significantly with location on the cooking surface. However, efficiency may vary with the different test block sizes. For these units with no clear surface unit markings, consumers may use any size cookware on the cooking top. To ensure testing covers the range of heating loads that may be used, DOE proposes that these full-surface cooking tops be tested with each of the proposed hybrid test block sizes (6.25-inch, 9-inch, and 10.5-inch diameters). Each test block would be tested separately by placing the block in the center of the usable induction surface and following the same proposed test method for testing individual surface units. The center of the usable induction surface may be offset from the geometric center of the cooking top because full-surface controls and displays may be embedded in the surface of the cooking top, reducing the usable induction surface available for cooking. DOE proposes that each test block would be centered so that it is equidistant from any boundaries of the usable induction surface, including boundaries due to the placement of the controls or display. The efficiency of the cooking top would be the average of the measured efficiencies using each of test blocks.

DOE measured the efficiency of a single full-surface induction cooking top to evaluate the proposed test method. Table III.13 displays measured efficiency in the center of the cooking top as well as the standard deviation of four tests per test block, run at different positions on the cooking top (center, right of center, back left, and front left).

Table III.13 Full-surface induction cooking top measured efficiency

Hybrid Test Block Diameter	Measured Efficiency at the Center of the Cooking Top	Standard Deviation of Off-center Measurements
6.25-inch	65.84%	1.85%
9-inch	66.14%	2.77%
10.5-inch	71.32%	2.42%

Changing test block position did not have a significant effect on measured efficiency, but the standard deviations resulting from changing position were higher than the standard deviations measured with a hybrid test block on a standard induction cooking top. Specifying test block position is necessary to ensure repeatability. Furthermore, the average efficiency, as measured with the three test blocks, is 67.77 percent.

Many smooth – electric resistance cooking tops have “multi-ring” elements that have multiple concentric heating elements for a single surface unit. When a single ring is energized, this corresponds to the smallest diameter surface unit available. When two rings are energized, the diameter of the surface unit increases. This continues for as many concentric heating elements as are available for the surface unit. Multiple heating elements give the user flexibility to adjust the surface unit to fit a certain cookware size. Because each heating element can typically be controlled independently, DOE conducted tests on multi-ring elements to determine if the different control settings result in different measured efficiencies. Table III.14 lists the measured efficiencies for the multi-ring surface units on two smooth – electric resistance cooking tops.

Table III.14 Multi-Ring Smooth – Electric Resistance Cooking Top Efficiency

Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Size (inches)	# of Rings Energized	Size of Largest Energized Ring (inches)	Test Block Size (inches)	Cooking Efficiency
A	Smooth – Electric Resistance	FR	9	Dual	9	9	67.7%
				Single	6	6.25	59.2%
F	Smooth – Electric Resistance	FR	12	Triple	12	10.5	71.9%
				Dual	9	9	66.7%
				Single	6	6.25	57.8%
F	Smooth – Electric Resistance	BL	8	Dual	8	9	72.9%
				Single	5	6.25	62.8%

For each of the multi-ring surface units, the largest-diameter setting (i.e., the setting using all available rings) resulted in the highest measured efficiencies. Each surface unit showed a significant decrease in efficiency at the smaller-diameter settings, up to 14.1 percentage points. Because of the observed differences in efficiency at the different surface unit settings, DOE proposes that each distinct diameter setting for a multi-ring surface unit be tested as a separate surface unit. For example, if the surface unit has three settings with outer diameters of 12, 9, and 6 inches, each setting would be tested separately with the appropriately sized test block, and the results would be factored in to the overall cooking top efficiency calculation as if they were individual surface units.

DOE is aware of other non-circular electric cooking top elements such as bridge zones, warming plates, grills and griddles that are not intended for use with a typical circular piece of cookware. Appropriate test blocks for these heating elements would depend on the intended function of each surface unit. DOE expects that specifying and requiring additional test blocks for these specific heating elements would place an unreasonable burden on test laboratories and manufacturers. Additionally DOE expects use of these types of surface units to be much less frequent than the standard surface units used for circular pots and pans. DOE notes that some gas cooking tops may also be equipped with warming plates, grills and griddles that are not intended solely for use with a typical piece of circular cookware. As a result, DOE is not proposing to require testing of gas warming plates, grills, and griddles in determining cooking top efficiency.

5. Improved Heat Transfer within the Hybrid Test Block

In response to the January 2013 NOPR, AHAM and BSH commented that the proposed description of test block construction was ambiguous and requested that construction be clearly defined so as to limit laboratory-to-laboratory variation in test results. AHAM and BSH also asked whether a bonding agent should be used to join the aluminum and stainless steel pieces or if test technicians should layer one piece on top of the other without bonding. Furthermore, AHAM and BSH asked whether DOE had performed testing to see whether adding a bonding agent led to more repeatable and reproducible results. (AHAM, TP No. 7 at p.3; BSH, TP No. 8 at p. 3)

In addition to questions regarding the construction of the test block, AHAM and BSH asked whether DOE had examined the heat transfer between the stainless steel base and aluminum body of the hybrid test block. (AHAM, Public Meeting Transcript, TP No. 5 at p. 27; AHAM, TP No. 7 at pp. 2, 4; BSH, TP No. 8 at pp. 2, 4) During recent manufacturer interviews conducted as part of a separate rulemaking to consider amended energy conservation standards for conventional cooking products, manufacturers stated that any small imperfections in the contacting surfaces of the hybrid test block, due to warping or machining, leave an air gap between the base and body of the hybrid test block which may result in poor thermal contact between the two layers. According to manufacturers, the proposed test block construction may not produce test results that are typical of consumer use (e.g., boiling water).

For the January 2013 NOPR, the aluminum body and stainless steel base of the hybrid test blocks were machined from extruded bar stock, and the aluminum body was placed on top of the stainless steel base for each test. No bonding agent was used to join the base and body of the hybrid blocks because DOE observed that the weight and resulting friction kept the aluminum body firmly fixed to the base throughout the duration of the test. However, because stakeholders expressed concern over the thermal contact between the stainless steel base and aluminum body, DOE investigated the effect of applying a layer of thermal grease between the two pieces. Thermal grease is not a permanent bonding agent, but its high viscosity and thermal conductivity ensures good contact between the base and body of the hybrid test block, filling any surface imperfections.

DOE liberally applied a layer of silver-based thermal grease to the stainless steel base, using the aluminum body to apply pressure and spread the grease evenly across the surface of the base until there was complete coverage of the contacting surface of each piece. The thermal conductivity of the selected grease was approximately 1.73 Btu/hr-ft-°F (1.0 W/m-K).

Figure III.2 shows the initial temperature rise of the hybrid test block on an induction surface unit both with and without thermal grease when tested according to Appendix I. As noted above, Appendix I requires that the surface unit be set to its maximum power setting during the initial temperature rise. Once the test block temperature reaches 144 °F above the starting temperature, the control power setting is turned down. The turndown is reflected in the figure as a change in the rate of temperature increase[11]. Figure III.2 also includes the temperature rise of a boiling water load for comparison. All three tests were performed on the 6-inch diameter back right induction surface unit of cooking top D.

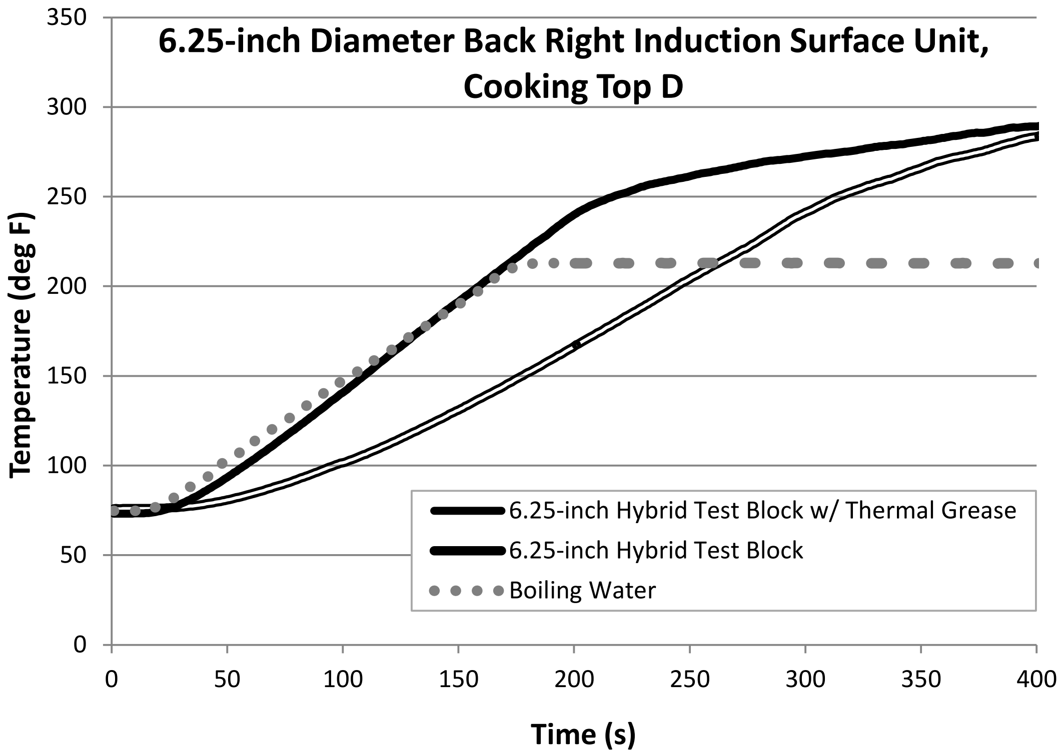

Figure III.2 Effect of Thermal Grease on Initial Test Block Temperature Rise

The rate of temperature increase during the initial temperature rise of the hybrid test block changes significantly with the addition of thermal grease and closely resembles the initial temperature rise of the water load as shown in Figure III.2. This change suggests that by adding thermal grease, the hybrid test block method may be more representative of actual cooking top

[11] The full turndown period is not shown in the Figure III.2. Only the beginning portion of the test cycle is shown to highlight the temperature profile for the heat-up phase of the test.

usage than the test block without thermal grease. DOE observed similar changes in the rate of temperature increase for larger test block sizes and for all types of cooking tops.

DOE investigated the impact on measured efficiency and repeatability of varying the quantity of thermal grease as well as varying the application technique. An example application technique included applying the grease in an “X” shape near the center of the stainless steel base and applying pressure with the aluminum body to spread the grease evenly across the base. Alternate techniques included applying the grease in a line and spreading the grease with a spackling knife. Table III.15 contains the average efficiency and standard deviation for multiple runs with each application technique. Regardless of the application technique or grease quantity, thick, even application of the grease yielded similar results. Nineteen investigative thermal grease tests performed on a single induction surface unit, 6 inches in diameter, resulted in an overall standard deviation of 1.43%.

Table III.15 Effect of Variation in Thermal Grease Application on Efficiency for Cooking Top D

Application Type	Number of Tests per Application	Average Efficiency	Standard Deviation
X-shape, 12 grams (g)	3	70.90%	0.75%
Spread evenly with spackling knife, 7g	2	68.94%	1.05%
X-shape, 10g	3	68.93%	0.08%
Spread evenly with spackling knife, 12g	6	69.99%	0.57%
Spread evenly with spackling knife, 10g	5	71.67%	0.08%
Average for all runs	19	70.30%	1.43%

After conducting these tests, DOE separated the hybrid test block pieces and observed that the amount of thermal grease listed in Table III.16 produced an even layer that fully covered the surface between the test blocks. After six tests with a test block, DOE also noted that the thermal grease had dried out and had to be removed and replaced.

Table III.16 Thermal Grease Quantity Required for Even Test Block Coverage

Hybrid Test Block Diameter (inches)	**Quantity of Thermal Grease** (g)
6.25	10-12
9	20-25
10.5	28-34

For the reasons discussed above, DOE proposes to amend Appendix I to require, in addition to the hybrid test block configuration proposed in the January 2013 NOPR, that a layer of thermal grease be applied to evenly cover the surface between the stainless steel base and the aluminum body of the hybrid test block for all test block sizes. The amount of thermal grease applied would be dependent on the test block diameter, according to the quantities listed in Table III.16. The thermal grease would be required to have a thermal conductivity of at least 1.73 Btu/hr-ft-°F (1.0 W/m-K). DOE also proposes to require the use of this modified hybrid test block for all conventional cooking tops and for the cooking top component of all conventional ranges. This will allow measured efficiency to be comparable across product classes and will also reduce manufacturer burden by not requiring additional test block configurations.

6. Expected Cooking Top Performance

AHAM and BSH commented that the test block method in general may not be representative of actual consumer use, especially for induction technology. AHAM and BSH requested that DOE consider the amount of time consumers typically spend cooking a food load to capture any potential energy efficiency benefits to induction technology in the short term (e.g., heating-up phase of cooking) that might even out across technologies as cooking time increases (e.g., simmering). According to AHAM and BSH, energy use and efficiency for cooking products is a function of a consumer's individual cooking behavior, and consumer use of cooking products varies from person to person. (AHAM, TP No. 7 at p.2; BSH, TP No. 8 at p. 2)

As discussed in section III.C.5, comparing the initial temperature rise of the hybrid test block with thermal grease to the initial temperature rise of water suggests that the test block method is representative of real-world cooking vessel heating. The initial heat-up period at the maximum energy input rate setting as specified in Appendix I is determined based on test block temperature, not a specified time, so if a certain technology achieves the initial temperature rise more quickly (e.g., with less energy to reach that state,) the test procedure would reflect that in a higher cooking efficiency. To examine performance of the heat-up period independent of the simmering period, DOE calculated surface unit efficiency for only the initial temperature rise of 144 °F. Due to changes in product availability over the course of the testing performed for the SNOPR, DOE selected additional cooking tops to evaluate with the thermal grease. Table III.17 provides an updated list of tested surface units for this investigation.

Table III.17 Cooking Top Surface Units Evaluated with Thermal Grease

Cooking Top Unit Designation	Heating Technology	Surface Unit Designation	Surface Unit Diameter (inches)	Surface Unit Max Rated Power (W)

D	Induction	FR	11	3700
D	Induction	BR	6	1800
F	Smooth – Electric Resistance	FR	12	3000
F	Smooth – Electric Resistance	BR	6	1200
G	Smooth – Electric Resistance	FR	12	3000
G	Smooth – Electric Resistance	BL	6	1200
H	Induction	FR	10	3400
H	Induction	BL	8	3200
H	Induction	FL	7	2600
I	Coil – Electric Resistance	BR	6	1250
I	Coil – Electric Resistance	FL	8	2100

Table III.18 disaggregates the results from the testing discussed in section III.C.5 to show the average surface unit performance during the initial heat-up period.

Table III.18 Hybrid Test Block Heat–Up Efficiency

Test Block Size	**Cooking Top Unit Designation**	**Heating Technology**	**Surface Unit Designation**	**Full Test Efficiency**	**Heat Up Efficiency**	**Heat Up Time** (min)
10.5-inch Hybrid Test Block	D	Induction	FR	78.18%	77.34%	6.33
	G	Smooth – Electric Resistance	FR	72.95%	66.12%	8.97
	H	Induction	FR	69.79%	67.48%	8.00
9-inch Hybrid Test Block	H	Induction	BL	73.78%	68.20%	5.05
	I	Coil – Electric Resistance	FR	68.86%	64.82%	8.06
6.25-inch Hybrid Test Block	D	Induction	BR	69.99%	72.30%	3.67
	G	Smooth – Electric Resistance	BL	66.94%	61.17%	6.37
	H	Induction	FL	69.38%	65.61%	2.97
	I	Coil – Electric Resistance	BR	73.54%	70.60%	5.43

Table III.18 shows that for all test block sizes, the measured efficiency during the heat-up period is generally higher for the induction surface units than for the coil – electric resistance, smooth – electric resistance, and gas surface units. Induction surface units also had the shortest heat-up times for each of the test block sizes Differentiation in efficiency between cooking top types decreases when examining the full test efficiency suggesting that while the test procedure captures the efficiency increase of induction during the initial heat up, induction cooking tops may be less efficient during simmering. Additionally, DOE is not aware of any data showing that consumers use induction cooking tops differently than conventional cooking tops to cook the same food load. Thus, DOE determined that the proposed test procedure, which measures cooking efficiency over an entire cooking process including heat-up and simmering periods, would be appropriate for all of the proposed covered product types.

AHAM and BSH commented that the test results presented in the January 2013 NOPR did not correspond with DOE's former conclusions regarding the efficiency of induction elements as discussed in Chapter 3 of the December 2009 Technical Support Document for residential dishwashers, dehumidifiers, cooking products, and commercial clothes washers, which found a cooking efficiency of 84 percent. Docket No. EERE-2006-STD-0127 (Dec. 2009). AHAM and BSH suggested that one reason why the efficiencies presented in the January 2013 NOPR might not match this earlier figure may be that the proposed test block procedure does not accurately capture induction element efficiency and requested an explanation for the difference. (AHAM, TP No. 7 at p. 3; BSH, TP No. 8 at p. 3)

The 84-percent efficiency listed for induction cooking tops in the December 2009 Technical Support Document was referenced from an external test study.[12] DOE notes that although the efficiencies presented in the January 2013 NOPR and in the SNOPR do not match the values determined in the external study for induction surface units, the study used a similar block-heating procedure. The study tested induction and other cooking tops using a 9-inch carbon steel test block with specifications similar to those used for the carbon steel test block testing conducted in support of the January 2013 NOPR. 78 FR 6232, 6237 (Jan. 30, 2013). The discrepancy in results between DOE's investigative testing and that of the external study is therefore not due to the proposed test block procedure. Based on the consistency of its test data from two test laboratories, DOE determined that the proposed test block-heating test procedure accurately reflects induction surface unit heating efficiencies. 78 FR 6232, 6237–40 (Jan. 30, 2013).

The Appliance Standards Awareness Project (ASAP) asked whether the DOE test results show a relative increase in efficiency for induction compared to electric resistance cooking tops. (ASAP, Public Meeting Transcript, TP No. 5 at p. 30) Based on the proposed hybrid test block results in the SNOPR, the tested induction surface units have an average efficiency of 72.2 percent, which is not significantly higher than the 69.9 average efficiency of smooth – electric resistance surface units or the 71.2-percent average electric coil surface unit efficiency.

[12] K.C. Datwyler and J.R. McFadden. 1992. "A Comparative Analysis of Performance Characteristics of Gas and Electric Cooktops." Proceedings of the 43rd Annual International Appliance Technical Conference, West Lafayette, IN, May, 1992, pp 485–496.

ASAP also asked whether the efficiency results measured with the hybrid test block serve as a good predictor of efficiency compared to measurements made by the water-heating test in terms of the relative ranking of units. (ASAP, Public Meeting Transcript, TP No. 5 at p. 38) Table III.19 provides a ranking of selected cooking top surface units by efficiency for each test method.

Table III.19 Hybrid Test Block and Water-Load Ranking of Surface Units by Efficiency

Rank	10.5-inch Hybrid		Large Water Load		6.25-inch Hybrid		Small Water Load	
1	I - Electric Coil*	70.89%	I – Electric Coil	85.54%	I - Electric Coil	73.54%	H – Induction	87.47%
2	D - Induction	73.59%	H – Induction	85.05%	D – Induction	69.99%	D – Induction	78.49%
3	H – Induction	70.74%	D - Induction	80.45%	H – Induction	69.38%	I – Electric Coil	76.80%
4	F – Smooth	69.69%	F – Smooth	79.65%	F – Smooth	64.06%	F – Smooth	74.87%

* Test performed with the 9-inch hybrid test block

The efficiency results in Table III.19 show that the hybrid test blocks resulted in a more consistent efficiency ranking for the different test block sizes as compared to the water heating test. Although different-sized surface units may have different cooking efficiencies, DOE expects that surface units within the same cooking top using the same heating technology would have similar cooking efficiencies, as observed in the hybrid test block results. The water-heating tests resulted in inconsistent rankings and efficiencies between the two test load sizes The higher test-to-test variability observed from these water heating tests could be one cause for the differences in efficiency rankings compared to the hybrid test block results.

Based on the further investigation of the test results in support of the SNOPR, as discussed above, DOE preliminarily concludes that the proposed test method using hybrid test blocks with thermal grease accurately reflects the performance of covered cooking tops.

7. Clarification of the Reduced Energy Input Setting

AHAM and BSH commented that it would be difficult to determine the turndown setting of the surface unit (25±5 percent of the maximum energy input rate) when using the proposed test block method. According to these commenters, preliminary testing or trial-and-error may be required to determine the appropriate turndown setting. (AHAM, TP No. 7 at p. 5; BSH, TP No. 8 at p. 5)

DOE agrees that a set of preliminary tests are required to determine the correct turndown setting. However, DOE understands that the current test procedure already requires preliminary tests to determine the turndown setting because the power level for each control setting of a given surface unit may not be explicitly stated and may not correspond to an exact percentage of the total power. As a result, this requirement does not increase burden. DOE notes that the preliminary tests to determine appropriate reduced settings are not unique to block-heating tests; the IEC 60350-2 CD procedure requires an initial test to determine when the control setting shall be reduced based on temperature of the water. Test technicians may limit the burden associated with determining the correct setting by using the manufacturer's power rating of the surface unit to make an initial guess at the turndown setting and then making adjustments to the selected setting so that in subsequent tests, the turndown setting corresponds to the 25±5 percent requirement.

Additionally, AHAM and BSH commented that each cooking top has a different maximum energy input rate per surface unit depending on the manufacturer, and the power at the turndown setting can differ significantly between cooking tops. AHAM and BSH noted that while a cooking top requiring a higher power to maintain the 25 percent of the maximum energy input rate during the 15-minute reduced setting period might suggest higher energy losses to the room's ambient air, a higher maximum energy input rate does not necessarily mean that the cooking top is less efficient. AHAM and BSH suggested that a better approach is to control the steady-state temperature of the block, as is done for the water in the IEC water-heating method, instead of the power level. (AHAM, TP No. 7 at p. 5; BSH, TP No. 8 at p. 5)

Although surface units with higher power ratings would be expected to reach higher maximum temperatures throughout testing, Figure III.1 in section III.C.1 shows that power rating and maximum test block temperature are not necessarily correlated. Both test block sizes and a range of surface unit rated powers all resulted in similar maximum temperatures. DOE also notes that requiring a constant test block temperature at the reduced setting would likely result in even greater test burden in determining the reduced control setting. If the energy into the test block did not exactly equal losses to the ambient air, the test block would continue to heat up or cool down at the reduced setting. Finding the appropriate setting to maintain the test block temperature within a reasonable tolerance would likely require more trial-and-error tests than determining the current reduced setting at 25±5 percent of the maximum energy input rate. For these reasons, DOE proposes to maintain its test block-heating procedure requiring a reduced setting at 25±5 percent of the test unit's maximum energy input rate.

DOE also notes that the test procedure does not currently specify the period over which the maximum energy input rate is determined; it could be an instantaneous energy input rate measurement or the average energy consumption rate determined over the entire period at the maximum setting. DOE has observed that the instantaneous maximum energy input rate for electric units may vary from test to test based on instantaneous supply voltage. A spike in voltage within the allowable tolerance at the maximum setting could result in testing at a higher reduced setting, impacting test-to-test repeatability. DOE also notes that at the reduced setting, electric resistance heating elements typically cycle off and on, which results in lower average energy input rates over the entire period compared to the maximum setting, but similar instantaneous energy input rates when the heating element is energized. To improve test-to-test repeatability, and to better reflect typical cooking top operation, DOE is proposing to clarify in section 3.1.2 of Appendix I that the maximum energy input rate be determined as the total energy consumed at the maximum setting divided by the time operated at the maximum setting. Similarly, DOE is proposing to clarify that the energy input rate at the reduced setting be calculated as the total energy consumed at the reduced setting divided by the time operated at the reduced setting; this value shall be 25±5 percent of the maximum energy input rate.

D. Gas Cooking Products with High Input Rates

As discussed in section I.B, as part of the February 2014 RFI, DOE stated that it tentatively plans to consider energy conservation standards for all consumer conventional cooking products, including commercial-style gas cooking products and standard surface units with higher input rates. 79 FR 8337, 8340 (Feb. 12, 2014).

The test procedure for gas cooking tops is currently based on measuring temperature rise in an aluminum block with a single diameter for all burner input rates. In the previous energy conservation standards rulemaking, DOE concluded that the diameter of the test block is sufficient to measure consumer cooking top burners with high input rates. For cooking tops that may have high input rate burners with larger diameters to accomplish complete combustion, however, DOE noted that this test block diameter may be too small to achieve proper heat transfer and may not be representative of the dimensions of suitable cookware. DOE further stated that it was not aware of any data to determine the measurement of energy efficiency or energy efficiency characteristics for those products. 72 FR 64432, 64444 (Nov. 15, 2007).

DOE also noted in its previous rulemaking that the test procedure may not adequately measure performance of gas ovens with high input rates. DOE stated that the single oven test block may not adequately measure the temperature distribution that is inherent with the larger cavity volumes and higher input rates typically found in these products. DOE stated that it was not aware of any data upon which to determine the measurement of energy efficiency or energy efficiency characteristics for gas ovens with high input rates. 72 FR 64432, 64445 (Nov. 15, 2007).

Because DOE is tentatively planning to consider energy conservation standards for all consumer gas cooking products and has observed performance differences between standard gas surface units and units with higher input rates, DOE evaluated the appropriateness of the existing test methods in Appendix I for use with these high input rate products and is proposing to amend test methods for measuring the energy consumption of such gas surface units in this SNOPR. These amendments would apply to all consumer cooking tops with high input rate surface units, including those marketed as commercial-style. Additionally, DOE determined that the existing test methods in Appendix I are appropriate for testing ovens with high input rates, including gas ovens marketed as commercial-style. The proposed amendments are discussed in the following sections.

1. Surface Units with Input Rates Greater than 14,000 Btu/h

In a response to the February 2014 RFI, Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas and Electric, and Southern California Edison (hereinafter referred to as the California Investor Owned Utilities (IOUs)) suggested that DOE consider ASTM F1521-12 – "Standard Test Method for Performance of Range Tops" when developing a test procedure for "commercial-style" cooking tops or standard consumer gas cooking tops with higher burner input rates. The California IOUs stated that they believe the ASTM test procedure is applicable for higher burner input rates because the energy input rate of the equipment does not significantly impact the measured cooking energy efficiency under this test procedure. (California IOUs, STD No. 11 at p. 2) [13] Additionally, Whirlpool stated that the current test block in Appendix I would not be appropriate for large burners with high burner input rates, as the diameter of the burner flame would be larger than the diameter of the 9-inch test block. Whirlpool also stated that for safety and energy efficiency reasons, consumers are instructed to match the pot size to the burner. (Whirlpool, STD No. 13 at p.2) Both AHAM and Whirlpool commented that a test procedure should be developed to address commercial-style cooking products if DOE plans to evaluate them in a standards analysis. (AHAM, STD No. 9 at p.2; Whirlpool, STD No. 13 at p.1)

The ASTM F1521-12 test method for commercial cooking tops, suggested for use by the California IOUs, is similar to the IEC 60350-2 CD test method DOE considered in the January

[13] A notation in this form provides a reference for information that is in the docket of DOE's rulemaking to develop energy conservation standards for residential conventional cooking products (Docket No. EERE–2014–BT–STD–0005), which is maintained in the Resource Room of the Building Technologies Program. This notation identifies a written comment: (1) made by Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas and Electric, and Southern California Edison (the California Investor Owned Utilities (IOUs)); (2) recorded in document number 11 in the docket for the residential conventional cooking products energy conservation standards rulemaking; and (3) which appears at page 2 of that document.

2013 NOPR. The primary difference between the ASTM and IEC test methods is that the ASTM method only includes measurement at the full-energy input rate of the surface unit while the IEC water heating method also includes measurement during a simmering period at a calculated turndown temperature. In addition, ASTM F1521-12 specifies a water load that is approximately two times heavier than the largest test load specified in IEC 60350-2 CD. Based on DOE's evaluation of the IEC water heating test method for cooking tops as discussed in section III.C.2, DOE is not considering a water-heating test method for gas surface units with higher input rates because this test method has been shown to be less repeatable and reproducible than DOE's proposed hybrid test block test method.

In a review of consumer gas cooking products on the market, DOE found that the majority of surface units on cooking tops or ranges marketed as commercial-style were rated higher than 14,000 Btu/h. Typical ratings for commercial-style gas surface units ranged from 15,000 Btu/h to 30,000 Btu/h. Conversely, the majority of surface units on standard gas cooking tops or ranges were rated below 14,000 Btu/h. However, many of the surveyed standard gas cooking tops and ranges had a single surface unit rated at a higher input rate (i.e., above 14,000 Btu/h) to be used for rapid boiling or cooking of a larger food load. DOE also noted that manufacturer product literature for all gas cooking tops and ranges reviewed specifies that the surface unit gas flame be adjusted to the size of the pot or pan.

Considering these factors, DOE decided to evaluate the effects of different test block sizes on the efficiency and combustion completion of surface units with high input rates using the test methods and hybrid test block configuration described in section III.C. Table III.20 lists the diameters, heights, weights, and heat capacities of the four hybrid test block sizes DOE considered for this testing. DOE evaluated the surface units with the proposed 9-inch test block as described in section III.C.3 and derived the larger investigative test block dimensions and heat capacities from the range of larger-sized cookware specified in IEC 60350-2 CD. The test block diameters were those specified in IEC 60350-2 CD, and the heights of the test blocks were calculated so that the overall heat capacities matched those of the water loads.

Table III.20 Hybrid Test Block Sizes Investigated for Gas Cooking Tops with High Surface Unit Input Rates

Test Block Component	Diameter (inches)	Height (inches)	Weight (lbs)	Specific Heat (Btu/lb-°F)	Heat Capacity (Btu/°F)
Stainless Steel Base	9	0.25	4.28	0.11	0.47
Aluminum Body	9	2.72	16.85	0.23	3.87
Total	9	2.97	21.13	0.21	4.34
Stainless Steel Base	10.6	0.25	6.21	0.11	0.65
Aluminum Body	10.6	3.48	29.95	0.23	6.89
Total	10.6	3.73	36.16	0.21	7.54
Stainless Steel Base	11.8	0.25	7.90	0.11	0.87
Aluminum Body	11.8	3.49	37.13	0.23	8.54
Total	11.8	3.74	45.03	0.21	9.41
Stainless Steel Base	13	0.25	9.27	0.11	1.02
Aluminum Body	13	3.48	45.04	0.23	10.36
Total	13	3.73	54.31	0.21	11.38

To select the appropriate block diameter for testing gas surface units with higher input rates, DOE evaluated cooking efficiency and the carbon monoxide (CO) emitted during the heating-up period of the test (i.e., when the surface unit was set to its maximum setting). A high concentration of CO would indicate incomplete combustion and suggest that the test block was improperly sized. DOE also evaluated the quality[14] of the flame, the size of the flame in relation to the test block, and the degree to which the flames impinged on the block in order to determine

[14] Flame quality refers to the shape of the flame, its sharpness, and its color. Mostly yellow, soft, flickering flame tips may indicate insufficient secondary air and incomplete combustion.

the appropriate test block size for gas surface units with high input rates. DOE conducted testing on the highest-rated surface unit for four commercial-style gas cooking tops and one standard gas cooking top with a single higher-input rate surface unit. The cooking efficiency was measured using the same proposed test method described in section III.C, but with the test block sizes listed in Table III.20. The CO sample was collected using the test method specified in the American National Standards Institute (ANSI) Standard Z21.1-2010, "Household Cooking Gas Appliances" (ANSI Z21.1-2010), which measures the percent of CO in an air-free sample. The CO sample was measured at 5 minutes after the surface unit was first set at its maximum setting and loaded with the relevant test block.

Based on this testing, DOE initially eliminated the 13-inch test block from consideration because the block overhung the grates of the tested units and significantly limited secondary airflow to the burner ports. As a result, DOE focused its investigation on cooking efficiency and CO emissions for the 9-inch, 10.6-inch and 11.8-inch test blocks. Figure III.3 shows measured cooking efficiency and Figure III.4 shows the measured CO emissions during the initial heating phase of the test for each gas surface unit tested.

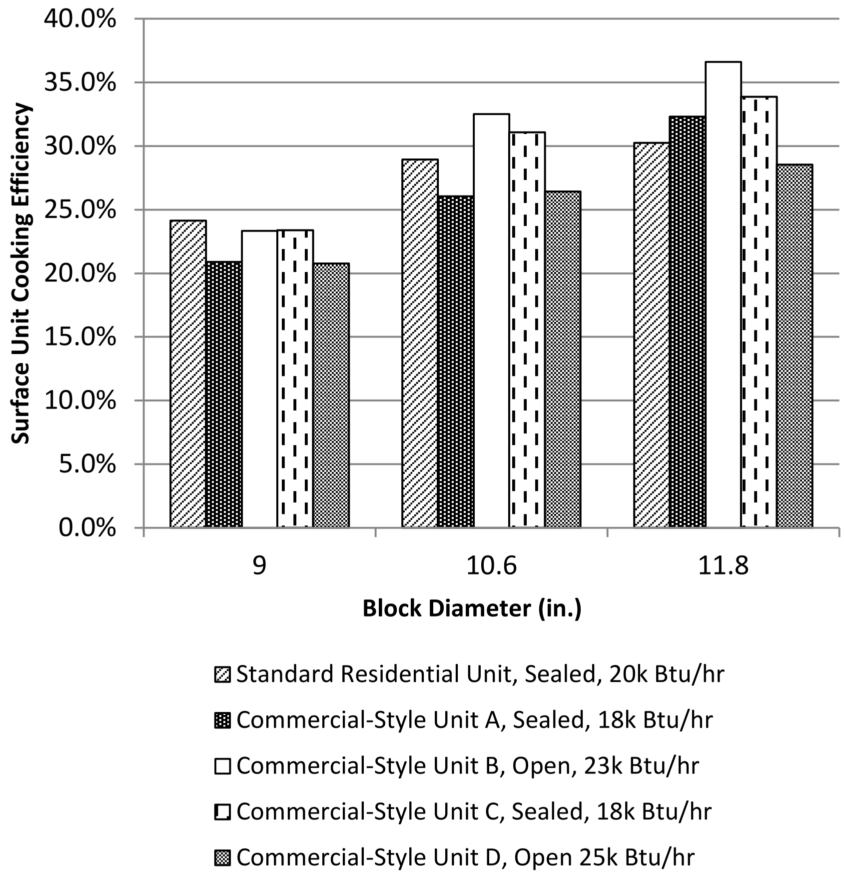

Figure III.3 Gas Surface Unit Cooking Efficiency by Test Block Diameter

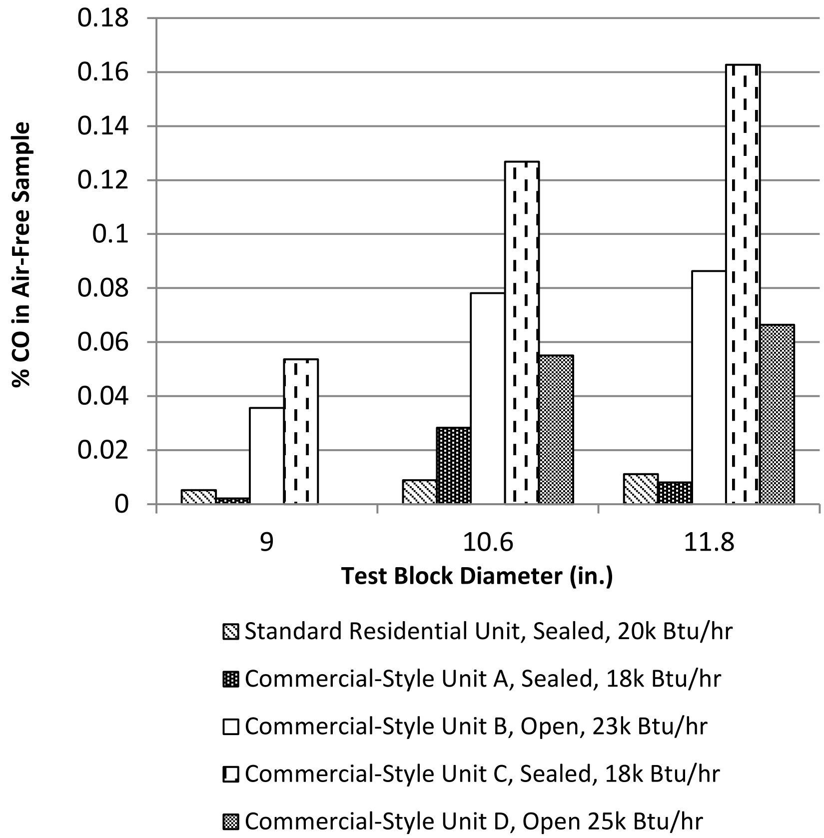

Figure III.4 CO Emissions by Test Block Diameter

The test results demonstrate that efficiency alone is not a good indicator of the suitability of a test block for a given gas surface unit input rate, as efficiency increases consistently with increasing test block size. However, the low efficiency measured with the 9-inch test block for each surface unit also suggests that surface units with high input rates are designed to be used with cookware of a larger diameter when at the maximum setting. For two of the sealed surface units, during tests with the 9-inch test block, flames impinged on the sides of the test block when the surface unit was set at the maximum setting. According to the user manuals, the setting should be adjusted so that the flame only impinges on the bottom of the test block.

CO levels also generally increased with increasing test block diameter, suggesting that the 11.8-inch test block was not representative of a food load designed to be used with cooking tops having surface units with higher input rates. The maximum concentration of carbon monoxide allowed by ANSI Z21.1-2010 is 0.08 percent in an air-free sample. One cooking top exhibited lower CO levels with the 11.8-inch block, but this is likely related to the low profile and configuration of the particular cooking top's grates. Considering the efficiency results, CO emissions, and flame characteristics, as discussed above, DOE concluded that the 10.6-inch test block was most representative of a food load designed to be used with a high input rate surface unit.

DOE also examined the typical diameters of cookware items that are compatible with use on higher input rate gas burners. These cookware items are generally higher-cost products designed with thicker gauge material and often heavier-duty disk bases to prevent scorching. Based on DOE's review of 100 "premium" cookware diameters currently available on the market, the average diameter is between 10 and 11 inches. Because a 10.5-inch diameter is a standard size in the United States, DOE decided to reduce the 10.6-inch test block diameter to 10.5 inches.[15]

For the reasons discussed above, DOE is proposing to amend sections 2.7 and 3.1.2 of Appendix I in the SNOPR to require a 10.5-inch hybrid test block, with the dimensions and heat capacities listed in Table III.21, for use with gas surface units having burner input rates greater than 14,000 Btu/h. Although DOE's investigative testing was performed without the use of

[15] Measured cooking efficiencies with the 10.5-inch test block were, on average, 0.78 percentage points less than efficiencies measured with the 10.6-inch test block.

thermal grease, DOE is also proposing to amend Appendix I to require the use of thermal grease with the hybrid test block for all cooking top product classes, including gas. Preliminary tests conducted by DOE suggest that measured efficiency for gas cooking products will not significantly change with the addition of thermal grease.

Table III.21 Proposed Test Block Parameters for Gas Surface Units with High Input Rates

Test Block Component	**Diameter** (inches)	**Height** (inches)	**Weight** (lbs)	**Specific Heat** (Btu/lb-°F)	**Heat Capacity** (Btu/°F)
Stainless Steel Base	10.5	0.25	6.09	0.11	0.67
Aluminum Body	10.5	3.48	29.39	0.23	6.76
Total	10.5	3.73	35.48	0.21	7.43

2. Gas Ovens with Input Rates Greater than 22,500 Btu/h

The current active mode test procedure for conventional ovens involves setting the temperature control for the normal baking cooking cycle such that the temperature inside the oven is 325 ± 5 °F higher than the room ambient air temperature (77 ± 9 °F). An 8.5 pound (6.25-inch diameter) cylindrical anodized aluminum test block is then heated in the oven from ambient room air temperature ± 4 °F until the test block temperature has increased 234 °F above its initial temperature. If an oven permits baking by either forced convection by using a fan, or without forced convection, the oven is tested using the procedure described above in each of those two cooking modes. After the baking test(s), if the oven is equipped with a self-cleaning function, the oven is additionally set for the self-cleaning process in accordance with manufacturer's instruction and allowed to run until completion. The measured energy consumption during these test cycles is used to calculate the cooking efficiency and energy factor.[16]

In response to the February 2014 RFI, the California IOUs recommended that DOE refer to ASTM F1496-13, "Standard Test Method for Performance of Convection Ovens" when developing a test procedure for commercial-style gas ovens or standard gas ovens with higher input rates. California IOUs stated that this test method is applicable to half-size commercial convection ovens. According to the California IOUs, a half-size commercial convection oven may be similar to a standard, consumer gas oven with a higher burner input rate. (California IOUs, STD No. 11 at p. 2)

The ASTM F1496-13 test method for convection ovens involves calibrating the temperature control for the normal bake cooking cycle such that the average temperature inside the oven is 350 ± 5 °F. Once the oven is preheated, the energy consumption to heat a test load to 205 °F is recorded and used to calculate a cooking efficiency. DOE noted that the test load specified in ASTM F1496-13 consists of a food-based test load (potatoes) that varies with oven capacity. The number of pans of potatoes could potentially increase or decrease depending on the number of racks and thus, capacity of the oven. For half-size commercial convection ovens, ASTM F1496-13 requires a smaller pan and fewer potatoes. DOE notes that potatoes and other food loads may be produced in different geographical regions and in different conditions, such as climate, growing conditions (i.e., soil conditions, watering frequency, harvesting time, etc.) that

[16] For ovens that can be operated with or without forced convection, the average of the energy consumption for these two modes is used. For self-clean mode, the test procedure in Appendix I assumes an average of 4 self-cleaning operations per year.

may vary throughout the growing seasons even within specific geographic regions. DOE tentatively concludes, therefore, that a food-based test load would not produce repeatable and reproducible test results. As a result, DOE is not considering incorporating test methods based on ASTM F1496-13.

In a review of the consumer gas ovens available on the U.S. market, DOE observed that standard gas ovens typically have an input rate of 16,000 to 18,000 Btu/h. Gas ovens marketed as commercial-style typically have input rates ranging from 22,500 to 30,000 Btu/h.[17] Additional review of both the standard and commercial-style gas oven cavities indicated that there is significant overlap in oven cavity volume between the two oven types. Standard (single) gas oven cavities ranged from 2.5 to 5.6 cubic feet and commercial-style gas oven (single) cavities ranged from 3.0 to 6.0 cubic feet. Sixty percent of the commercial-style models surveyed had cavity volumes between 4.0 and 5.0 cubic feet while fifty percent of the standard models had cavity volumes between 4.0 and 5.0 cubic feet. The primary differentiating factor between the two oven types was burner input rate, which is greater than 22,500 Btu/h for commercial-style gas ovens. In order to develop an appropriate test block size for gas ovens with higher input rates, DOE investigated the effect of increasing oven test block size on oven cooking efficiency. DOE sought to determine whether a larger test block might be more representative of the type of loads used with gas ovens with higher input rates.

DOE evaluated two test block sizes for use with the high input rate gas ovens: the 6.25-inch aluminum test block used in the existing DOE test procedure and a 9-inch diameter

[17] However, DOE noted that many gas ranges, while marketed as commercial- or professional-style and having multiple surface units with high input rates, did not have a gas oven with a high input rate.

aluminum test block, approximately 3 inches high and weighing 19 pounds. Each test block was finished with an anodic black coating with a minimum thickness of 0.001 inch, as specified in the existing DOE test procedure in Appendix I. DOE selected three gas ovens marketed as commercial-style for testing as well as a standard gas oven for comparison. Each oven was tested twice, once with the 6.25-inch test block and once with the 9-inch test block using the test methods specified in the existing DOE test procedure. The resulting cooking efficiencies are presented in Table III.22.

Table III.22 Gas Oven Cooking Efficiency for Multiple Test Block Sizes

Type	**Input Rate** (Btu/h)	**Width** (inches)	**Cavity Volume** (cubic feet)	**6.25-inch Test Block – Cooking Efficiency** (%)	**9-inch Test Block – Cooking Efficiency** (%)	**Ratio of Efficiencies**
Commercial-Style Oven A	28000	36	5.3	4.3%	8.1%	1.86
Commercial-Style Oven B	30000	36	5.4	3.9%	7.7%	1.98
Commercial-Style Oven C	23500	30	4.4	5.2%	9.5%	1.85
Standard	18000	30	5	7.6%	14.1%	1.87

While cooking efficiency did increase with the larger test block, it scaled by approximately the same factor (1.9) regardless of input rate or capacity, or whether the oven was marketed as commercial-style. The relatively low cooking efficiencies for ovens indicate that the thermal energy required to heat the test block is only a small percentage of the overall energy input to the oven. Other thermal losses in the cavity are large enough that they account for much of the additional oven energy input and are not greatly affected by test block size. Thus, cooking efficiency measured with the larger test block also scales relatively closely with the test block heat capacity. The ratio of the heat capacity of the 9-inch test block to the 6.25-inch test block is

2.2. To minimize the burden of purchasing new test blocks, DOE proposes to use the 6.25-inch test block specified in the existing test procedure to test all gas ovens, including gas ovens with input rates exceeding 22,500 Btu/h.

E. Incorporating by Reference AHAM-OV-1-2011 for Determination of the Volume of Conventional Ovens

As discussed above in section I.D, DOE has initiated an effort to determine whether to amend the current energy conservation standards for conventional cooking products. As part of any amended standards for ovens, if DOE determines that cooking efficiency varies as a function of oven cavity volume, DOE may consider proposing standards as a function of oven cavity volume. Therefore, DOE is proposing in the SNOPR to amend section 3.1.1 of Appendix I to include a method for determining oven cavity volume.

In order to develop test methods for measuring the oven cavity volume, DOE reviewed the industry test standard AHAM-OV-1-2011. DOE believes that Section 3, “Definition,” section 5.1, “General Principles,” and section 5.2 “Overall Volume” of AHAM-OV-1-2011 provides a repeatable and reproducible method to measure cavity dimensions and calculate overall volume because it provides clear definitions of oven characteristics and provides tolerances for dimensional measurements. Section 5.1 of AHAM-OV-1-2011 specifies that if depressions or cutouts exist in the cavity wall, dimensions are taken from the plane representing the largest area of the surface. Section 5.1 of AHAM-OV-1-2011 also specifies that oven lights, racks, and other removable features shall be ignored in the overall volume calculation, and the volume of non-rectangular cavities is calculated by measuring the rectangular portion of the cavity and non-rectangular cavity separately and adding their volumes together.

The procedure also includes a measurement of the oven's usable space, which is the volume inside the oven cavity available for the placement of food. The usable space is oven-specific and determined by measuring either the size of the cavity door aperture or the distance between barriers, racks, and rack supports inside the cavity or on the cavity walls. The lesser of these dimensions is used to calculate the volume of the usable space. DOE is not proposing to include the usable space measurements (section 5.3 of AHAM-OV-1-2011) because the overall cavity volume measurement provides a more accurate representation of the relationship between cavity volume and cooking efficiency as measured by the DOE test procedure in Appendix I.

DOE notes that manufacturers may already be using AHAM-OV-1-2011 to measure the oven cavity volume published in marketing materials. Additionally, manufacturers provide exterior dimensions in the installation instructions. Incorporating a cavity measurement into Appendix I would, in most circumstances, add only the three additional measurements of cavity height, width, and depth. AHAM-OV-1-2011 also gives manufacturers the flexibility of selecting measurement equipment because the device used for measurement is not specified. Therefore, DOE expects that measuring oven volume according to AHAM-OV-1-2011 would not place any significant burden on manufacturers. For the reasons discussed above, DOE proposes to amend section 3.1.1 of Appendix I to incorporate by reference Sections 3, 5.1, and 5.2 of AHAM-OV-1-2011 for measuring the overall oven cavity volume.

F. Conventional Oven Separator

As part of DOE's review of products available on the market, DOE observed one conventional electric oven equipped with an oven separator that allows for cooking using the entire oven cavity in the absence of the separator or, if the separator is installed, splitting the oven into two smaller cavities that may be operated individually with independent temperature controls. DOE notes that the current test procedure in Appendix I includes provisions for measuring the energy consumption and cooking efficiency of single ovens and multiple (separate) ovens[18], but does not include provisions for how to test a single oven that can be configured as a full oven or as two separate smaller cavities. As a result, DOE conducted testing on this product in each possible oven configuration and evaluated the cooking efficiency results. The results from this testing are presented in Table III.23.

Table III.23 Oven Cooking Efficiency Results for Oven Separator Configurations

Oven Configuration	Cooking Modes	Cavity Volume (cubic feet)	Cooking Efficiency (%)
Full Oven (No Oven Separator)	Normal Bake, Forced Convection	5.9	10.5
Oven Separator - Upper Cavity	Forced Convection[1]	2.7	16.7
Oven Separator - Bottom Cavity	Normal Bake, Forced Convection	3.0	13.2

[1] Upper cavity configuration is only capable of operation in forced convection mode. Normal bake function is not available.

The test results show that the cooking efficiencies in each possible oven configuration were measurably different, ranging from 10.5 percent for the full oven to 16.7 percent for the smaller upper cavity. As a result, DOE is proposing in the SNOPR that conventional ovens equipped with an oven separator shall be tested in each possible oven configuration (i.e., full oven cavity, upper cavity, and lower cavity) with the cooking efficiency and total annual energy consumption averaged.

[18] For multiple ovens, Appendix I specifies that the energy consumption and cooking efficiency be calculated as the average of each individual oven.

G. Standby and Off Mode Test Procedure

EPCA requires that DOE amend its test procedures for all covered consumer products, including cooking products, to include measures of standby mode and off mode energy consumption, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) Accordingly, DOE conducted a rulemaking for conventional cooking products, dishwashers, and dehumidifiers to address standby and off mode energy consumption.[19] In the October 2012 Final Rule, DOE addressed standby mode and off mode energy consumption, as well as active mode fan-only operation, for conventional cooking products. 77 FR 65942 (Oct. 31, 2012).

As part of the January 2013 NOPR, DOE proposed a change to the definition of "conventional cooking top" to include induction technologies. DOE noted that under this proposed definition, induction cooking tops would be covered by the standby and off mode test procedures adopted in the separate test procedure rulemaking. DOE did not observe any standby mode or off mode operation or features unique to induction cooking tops that would warrant any changes to the standby mode and off mode test methods adopted by the October 2012 Final Rule for conventional cooking tops. 78 FR 6232, 6241 (Jan. 30, 2013).

AHAM and BSH commented that they are not aware of any additional features or operational modes for induction cooking products and, thus, agree that the definitions of standby mode and off mode do not require revision. (AHAM, TP No. 7 at p. 6; BSH, TP No. 8 at p. 6) Because DOE did not receive any comments objecting to the proposed determination not to

[19] DOE pursued amendments to Appendix I addressing standby and off mode energy for microwave ovens as part of a separate rulemaking. The final rule for this microwave oven rulemaking published on January 18, 2013. 78 FR 4015.

amend the standby mode and off mode test methods, and for the reasons discussed above, DOE is maintaining this determination in the SNOPR.

Similarly, DOE notes that because gas cooking products with higher input rates are covered under the definition of "cooking products" in 10 CFR 430.2, these products are covered by the standby and off mode test procedures discussed above. DOE conducted standby mode and off mode testing on commercial-style units and standard units with higher input rates in its test sample. Based on this testing, DOE did not observe any standby mode or off mode operation or features unique to these products that would warrant any changes to the standby mode and off mode test methods established in Appendix I section 3.1 by the October 2012 Final Rule for conventional cooking products.

H. Technical Corrections to the Calculation of Derived Results from Test Measurements

DOE notes that section 4 in Appendix I, regarding the calculation of derived results from test measurements, contains a number of references to incorrect units of measurement. For example, section 4.1.2.1.1 incorrectly provides that the annual primary energy consumption for cooking, E_{CO}, should be expressed in Btus per year for gas ovens, instead of kBtu per year. DOE proposes in the SNOPR to correct the following sections of Appendix I to reference the appropriate units: 4.1.2.1.1, 4.1.2.2.1, 4.1.2.4.3, 4.1.2.5.3, 4.1.4.1, 4.1.4.2, 4.2.1.2, 4.2.2.2.1, and 4.2.2.2.2.

DOE also notes that section 4.2.3.2 in Appendix I, regarding the calculation of the integrated energy factor for conventional electric cooking tops, IR_{CT}, uses an incorrect value for the annual useful cooking energy output, O_{CT}, of 527.6 kBtu per year, which is the annual useful cooking energy output for gas cooking tops. The value of the annual useful cooking energy output for electric cooking tops should instead be 173.1 kWh per year. DOE is proposing to correct this error in the NOPR.

I. Headings for Conventional Cooking Top Calculations

DOE notes that the headings for sections 4.2 and 4.2.1 in Appendix I regarding the calculations for conventional cooking tops were inadvertently removed. As a result, DOE is proposing to add the headings for section 4.2 "Conventional cooking top," and section 4.2.1, "Surface unit cooking efficiency" to appropriately describe these sections.

J. Compliance with Other EPCA Requirements

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

As part of the January 2013 NOPR, DOE tentatively concluded that the amended test procedures would produce test results that measure the energy consumption of cooking tops during representative use, and that the test procedures would not be unduly burdensome to conduct. 78 FR 6232, 6242 (Jan. 30, 2013).

For cooking tops, the test procedure proposed in January 2013 NOPR and this SNOPR follows the same method currently included in Appendix I, but would replace the aluminum test blocks with hybrid test blocks having thermal grease that joins the stainless steel base and aluminum body. The SNOPR also includes an additional test block size to be used for electric cooking top surface units with large diameters and gas cooking top surface units with higher input rates. In the January 2013 NOPR, DOE estimated that current testing represents a cost of approximately $500 per test for labor, with a one-time investment of $2,000 for test equipment ($1,000 for test blocks and $1,000 for instrumentation). 78 FR 6232, 6242 (Jan. 30, 2013). The proposed reusable test blocks in the SNOPR would represent an expense of approximately $500 for each test block, or $1500 for a set of large, medium, and small diameter test blocks. DOE estimated that the thermal grease necessary for a set of three tests blocks would cost approximately $100 but due to the need for frequent reapplication of the grease, DOE increased this estimate to $2000 resulting in a total updated one-time investment of $4,500 for test equipment. Test blocks would need to be replaced when they are no longer in tolerance. However DOE observed that the test blocks were still within the proposed tolerance after approximately 100 tests. No additional instrumentation would be required beyond what is required in the current test procedure. DOE stated that it does not believe this additional cost represents an excessive burden for test laboratories or manufacturers given the significant investments necessary to manufacture, test and market consumer appliances. The only additional time burden associated with the proposed test method is the time required to weigh the stainless steel base in addition to the aluminum body and to apply the thermal grease. This additional step in the test procedure would increase the test duration by about 5 minutes per surface unit.

AHAM and BSH commented in response to the January 2013 NOPR that with only one set of test blocks, laboratories may only be able to perform two surface unit tests per day because of the time required to cool the test blocks. Accordingly, AHAM and BSH stated that it is likely that manufacturers and third-party laboratories will purchase multiple sets of test blocks to be able to run more tests per day. AHAM and BSH encouraged DOE to ask individual manufacturers and third-party test laboratories how many sets of test blocks they expect to need in order to more fully understand the actual burden imposed by the amended regulation. (AHAM, TP No. 7 at p. 6; BSH, TP No. 8 at p. 6) AHAM and BSH also commented that DOE's test burden analysis is based only on certification and does not account for the required audit testing manufacturers would need to do to ensure that certification remains representative of production. (AHAM, TP No. 7 at p. 6; BSH, TP No. 8 at p. 6) AHAM asked DOE to elaborate more on the estimates for some of the costs, including whether the costs assume each manufacturer would only be requiring one set of test blocks. (AHAM, Public Meeting Transcript, TP No. 5 at p. 46)

DOE's estimates of manufacturer test burden in the January 2013 NOPR were based on a purchase of a single set of test blocks. Manufacturers have the option to purchase multiple sets of test blocks to be able to run more tests per day, but purchasing even four sets would entail a onetime expense of approximately $10,000. Purchasing multiple sets may also extend the lifetime of the test blocks because a single set would not be used for every test. During DOE's testing and testing at a third-party lab, test technicians were able to run between five and seven tests per day. Given that many cooking tops have surface units of varying sizes and multiple cooking tops may be set up for test in a given day, the test technician could alternate which size surface unit was tested to allow time for a test block to cool, i.e., the technician could test a small surface unit with the small test block on a different cooking top while the large test block is cooling. While DOE did not account for any audit testing in the SNOPR, issues regarding compliance certification testing may be addressed as part of any energy conservation standards rulemaking. For the reasons discussed above, DOE concludes, given the small magnitude of the proposed changes (both in terms of the proposed test blocks, including the large test block included in the SNOPR, and the time needed for the test), that the newly proposed amended test procedure for cooking tops will not be unreasonably burdensome to conduct.

As discussed in section III.D.2, DOE is proposing for gas ovens to require that the existing test block be used for all ovens, including both standard residential ovens and ovens with high input rates. As a result, DOE does not expect any increase in testing burden compared to the existing test procedure. As discussed in section III.E, DOE is also proposing to incorporate by reference AHAM-OV-1-2011 for measuring the overall oven cavity volume. DOE estimates that it would take on the order of one-half to one hour to conduct the cavity volume measurement for a single oven, and $50 to $100 per test for labor. Additionally, because manufacturers may already be using the AHAM procedure to measure oven cavity volume and because manufacturers already provide exterior dimensions in the installation instructions, DOE does not anticipate this measurement to be unduly burdensome to conduct. As discussed in section III.F, DOE is also proposing that conventional ovens equipped with an oven separator be tested in each possible oven configuration. DOE notes, based on its testing, that this may add two oven tests for the additional cavity configurations, and add approximately $2,750 for labor. DOE does not believe this additional cost represents an excessive burden for test laboratories or manufacturers given the significant investments necessary to manufacture, test and market consumer appliances.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

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

B. Review under the Regulatory Flexibility Act

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

DOE reviewed this proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. The proposed rule would amend the test method for measuring the energy efficiency of conventional cooking tops and ranges to include test methods applicable to induction cooking products and gas cooking products with higher input rates. The proposed rule would also include a test method for conventional ovens with oven separators and incorporate by reference a test method to measure oven cavity volume.

The Small Business Administration (SBA) considers a business entity to be a small business, if, together with its affiliates, it employs less than a threshold number of workers or earns less than the average annual receipts specified in 13 CFR part 121. The threshold values set forth in these regulations use size standards and codes established by the North American Industry Classification System (NAICS) that are available at: http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf. The threshold number for NAICS classification code 335221, titled "Household Cooking Appliance Manufacturing," is 750 employees; this classification includes manufacturers of residential conventional cooking products.

Most of the manufacturers supplying conventional cooking products are large multinational corporations. DOE surveyed the AHAM member directory to identify manufacturers of residential conventional cooking products. DOE then consulted publicly-available data, purchased company reports from vendors such as Dun and Bradstreet, and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a "small business manufacturing facility" and have their manufacturing facilities located within the United States. Based on this analysis, DOE estimates that there are nine small businesses that manufacture conventional cooking products covered by the proposed tests procedure amendments.

For the reasons stated in the preamble, DOE has tentatively concluded that the proposed rule would not have a significant impact on small manufacturers under the applicable provisions of the Regulatory Flexibility Act. The proposed rule would amend DOE's test procedures for cooking products by incorporating testing provisions to address active mode energy consumption for induction surface units and surface units with higher input rates that will be used to develop and test compliance with any future energy conservation standards that may be established by DOE. The proposed test procedure amendments involve the measurement of active mode energy consumption through the use of a different metal test block than is currently specified for conventional cooking tops. The proposed amendments would also apply for testing products currently considered conventional cooking tops. DOE estimates a cost for this new equipment of approximately $4,500–$10,000. Additionally, DOE estimates a cost of approximately $23,900 for an average small manufacturer to test a full product line of induction surface units and surface units with high input rates not currently covered by the test procedure. This estimate assumes $500 per test, as described in section III.J, with up to 48 total tests per manufacturer needed, assuming 11 models[20] with either four or six individual tests per cooking top model. This cost is small (0.15 percent) compared to the average annual revenue of the nine identified small businesses, which DOE estimates to be over $16 million.[21] These tests follow the same methodology and can be conducted in the same facilities used for the current energy testing of conventional cooking tops, so there would be no additional facilities costs required by the proposed rule.

The incorporation by reference of AHAM-OV-1-2011 to measure oven cavity volume

[20] DOE considered different configurations of the same basic model (where surface units were placed in different positions on the cooking top) as unique models.
[21] Estimated average revenue is based on financial information provided for the small businesses in reports provided by Dun and Bradstreet.

and the addition of a test method to measure conventional ovens with an oven separator will not significantly impact small manufacturers under the applicable provisions of the Regulatory Flexibility Act. DOE estimates a cost of $4,500 for an average small manufacturer to measure the cavity volume of its entire product offerings which is only 0.03 percent of the average annual revenue of the nine identified small businesses. This estimate assumes $100 per test as described in section III.1 with up to 44 tests per manufacturer. Additionally, no small conventional cooking product manufacturer, as defined by the SBA, offers a product with an oven separator.

For these reasons, DOE tentatively concludes and certifies that the proposed rule would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will transmit the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

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

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

D. Review Under the National Environmental Policy Act of 1969

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

E. Review Under Executive Order 13132

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

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. No. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at http://energy.gov/gc/office-general-counsel. DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

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

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

I. Review Under Executive Order 12630

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

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

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

K. Review Under Executive Order 13211

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

The regulatory action to amend the test procedure for measuring the energy efficiency of conventional cooking products 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 proposed rule incorporates test methods contained in the AHAM OV-1-2011 standard, "Procedures for the Determination and Expression of the Volume of Household Microwave and Conventional Ovens". DOE has evaluated this standard and is unable to conclude whether this industry standard fully complies with the requirements of section 32(b) of the FEAA, (i.e., that it was developed in a manner that fully provides for public participation, comment, and review). DOE will consult with the Attorney General and the Chairman of the

FTC concerning the impact on competition of using the methods contained in this standard prior to prescribing a final rule.

V. Public Participation

A. Submission of Comments

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

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

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

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

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

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

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

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

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

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

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

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

B. Issues on Which DOE Seeks Comment

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

1.Hybrid Test Blocks

DOE seeks comment on its proposal to require the use of hybrid test blocks with a layer of thermal grease for testing all cooking tops, including the potential burden associated with the requirement for such new test equipment. (See section III.C.1 and III.C.5)

2. Typical Cookware Thickness

DOE seeks comment on the typical thickness of cookware compatible with induction cooking tops and gas cooking tops with high surface unit input rates. (See section III.C.1)

3. Additional Test Block Size for Electric Resistance and Induction Surface Units

DOE invites comment on whether the proposed addition of a test block size of 10.5 inches in diameter for larger-diameter electric cooking tops will be sufficient to capture the range of surface unit diameters currently available on the market. (See section III.C.3)

4. Non-Circular and Flexible Electric Surface Units

DOE invites comments on whether using the smallest dimension of a non-circular electric surface unit is appropriate for determining the proper test block size. DOE also invites comments on its proposal to test surface units with flexible concentric sizes at each unique size setting and full-surface induction cooking tops using each of three test block sizes, with the test block placed in the center of the usable cooking surface during each test. DOE also welcomes comments on its proposal to not require testing of electric and gas cooking top surface units, such as bridge zones, warming plates, grills and griddles, in determining cooking top efficiency. (See section III.C.4)

5. Thermal grease characteristics

DOE seeks comment on the amount, application technique, and thermal properties of the thermal grease specified for use between the stainless steel base and aluminum body of the hybrid test blocks. Specifically, DOE seeks comment on its proposal to require a thermal grease having a thermal conductivity of at least 1.73 Btu/hr-ft-°F (1.0 W/m-K), applied evenly to the contacting surfaces of the base and body. (See section III.C.5)

6. Clarification of the Reduced Energy Input Setting

DOE requests comment on the proposal to clarify the "maximum energy input rate" specified in the cooking tops test procedure in Appendix I for determining the reduced energy input setting. (See section III.C.7)

7. Gas Cooking Top Surface Units with Input Rates >14,000 Btu/h

DOE seeks comment on its proposal to require the use of a 10.5-inch hybrid test block for testing all gas surface units rated above 14,000 Btu/h, including additional data on the efficiency and combustion characteristics of cooking top surface units with high input rates. (See section III.D.1)

8. Gas Ovens with High Input Rates

DOE seeks comment on its proposal to require the use of the test block currently specified in Appendix I for testing all ovens that are covered by the definition of conventional ovens, including commercial-style ovens or any ovens rated above 22,500 Btu/h. (See section III.D.2)

9. Test Method to Measure Oven Cavity Volume

DOE seeks comment on its proposal to incorporate by reference AHAM-OV-1-2011 to measure the overall oven cavity volume. (See section III.E).

10. Test Method for Conventional Ovens with an Oven Separator

DOE seeks comment on the proposed amendments to require that conventional ovens equipped with an oven separator be tested in each possible oven configuration (i.e., full oven cavity, upper cavity, and lower cavity) with the results averaged. (See section III.F).

11. Technical Corrections

DOE seeks comment on the proposed amendments to correct the units of measurement in sections 4.1.2.1.1, 4.1.2.2.1, 4.1.2.4.3, 4.1.2.5.3, 4.1.4.1, 4.1.4.2, 4.2.1.2, 4.2.2.2.1, and 4.2.2.2.2. DOE also requests comment on the proposed amendments to correct the value of the annual useful cooking energy output for electric cooking tops referenced in section 4.2.3.2. (See section III.H)

VI. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 430

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

Issued in Washington, DC, on November 24, 2014

Kathleen B. Hogan
Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

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

PART 430--ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Section 430.2 is amended by revising the definition for "conventional cooking top" to read as follows:

§ 430.2 Definitions.

* * * * *

Conventional cooking top means a class of kitchen ranges and ovens which is a household cooking appliance consisting of a horizontal surface containing one or more surface units which utilize a gas flame, electric resistance heating, or electric inductive heating.

* * * * *

3. Section 430.3 is amended by redesignating paragraph (h)(7) as (h)(8) and adding new paragraph (h)(7) to read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(h) * * *

(7) AHAM OV-1-2011, ("AHAM OV-1"), Procedures for the Determination and Expression of the Volume of Household Microwave and Conventional Ovens, (2011), IBR approved for appendix I to subpart B.

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Appendix I—[Amended]

4. Appendix I to subpart B of part 430 is amended:

a. By revising the Note;

b. In section 1. Definitions, by:

1. Revising section 1.1;

2. Redesignating sections 1.2 through 1.19 as sections 1.3 through 1.20, respectively; and

3. Adding section 1.2;

c. In section 2. Test Conditions, by:

1. Revising sections 2.6, 2.7, 2.7.2 and 2.7.3;

2. Redesignating sections 2.7.4 and 2.7.5 as sections 2.7.5 and 2.7.6, respectively; and

3. Adding sections 2.7.4 and 2.7.7;

d. By revising section 3. Test Methods and Measurements

e. In section 4. Calculation of Derived Results From Test Measurements, by:

1. Revising sections 4.1.2.1.1, 4.1.2.2.1, 4.1.2.4.3, 4.1.2.5, 4.1.2.5.1, 4.1.2.5.2, 4.1.2.5.3. 4.1.3.2, 4.1.4.1, 4.1.4.2, 4.2.1.1, 4.2.1.2, 4.2.1.3, 4.2.2.2.1,

4.2.2.2.2, and 4.2.3.2 and

2. Adding sections 4.2 and 4.2.1.

The revisions and additions read as follows:

APPENDIX I TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF CONVENTIONAL RANGES, CONVENTIONAL COOKING TOPS, CONVENTIONAL OVENS, AND MICROWAVE OVENS

Note: Any representation related to active mode energy consumption of conventional ranges, conventional cooking tops (except for induction cooking products), and conventional ovens must be based upon results generated under this test procedure. Any representation related to standby mode and off mode energy consumption of conventional ranges, conventional cooking tops (except for induction cooking products), conventional ovens, and microwave ovens, and any representation made after [**Insert date 180 days after the final rule is published in the Federal Register**] related to any energy consumption of induction cooking products, must be based upon results generated under this test procedure.

Upon the compliance date(s) of any energy conservation standard(s) for conventional ranges, conventional cooking tops, conventional ovens, and microwave ovens, use of the applicable provisions of this test procedure to demonstrate compliance with the energy conservation standard will also be required.

1. Definitions

1.1 Active mode means a mode in which the product is connected to a mains power source, has been activated, and is performing the main function of producing heat by means of a gas flame, electric resistance heating, electric inductive heating, or microwave energy, or circulating air internally or externally to the cooking product. Delay start mode is a one-off, user-initiated, short-duration function that is associated with an active mode.

1.2 AHAM-OV-1 means the test standard published by the Association of Home Appliance Manufacturers titled, "Procedures for the Determination and Expression of the Volume of Household Microwave and Conventional Ovens," Standard OV-1-2011 (incorporated by reference; see §430.3).

* * * * *

2. Test Conditions

* * * * *

2.6 Normal nonoperating temperature. All areas of the appliance to be tested shall attain the normal nonoperating temperature, as defined in section 1.13 of this appendix, before any testing begins. The equipment for measuring the applicable normal nonoperating temperature shall be as described in sections 2.9.3.1, 2.9.3.2, 2.9.3.3, and 2.9.3.4 of this appendix, as applicable.

2.7 Test blocks for conventional oven and cooking top. The test blocks for conventional ovens and the test block bodies for conventional cooking tops shall be made of aluminum alloy No. 6061, with a specific heat of 0.23 Btu/lb- °F (0.96 kJ/[kg ÷ °C]) and with any temper that will give a coefficient of thermal conductivity of 1073.3 to 1189.1 Btu-in/h-ft^2 -°F (154.8 to 171.5 W/[m ÷ °C]). Each test block and test block body shall have a hole at its top. The hole shall be 0.08 inch (2.03 mm) in diameter and 0.80 inch (20.3 mm) deep. Other means may be provided which will ensure that the thermocouple junction is installed at this same position and depth.

The test block bases for conventional cooking tops shall be made of stainless steel grade 430, with a specific heat of 0.11 Btu/lb- °F (0.46 kJ/[kg ÷ °C]) and with coefficient of thermal conductivity of 172.0 to 190.0 Btu-in/h-ft2 - °F (24.8 to 27.4 W/[m ÷ °C]).

The bottom of each test block and test block body, and top and bottom of each test block base, shall be produced to be flat to within 0.002 inch (0.051 mm) TIR (total indicator reading). The bottom of the test block body and top and bottom of the test block base shall not exceed .004 (0.102 mm) TIR at the start of testing. Determine the actual weight of each test block, test block body, and test block base with a scale with an accuracy as indicated in section 2.9.5 of this appendix.

* * * * *

2.7.2 <u>Small test block for conventional cooking top</u>. The small test block shall comprise a body and separate base, between which a 10-12 g layer of thermally conductive grease shall be applied. The small test block body, W_2, shall be 6.25±0.05 inches (158.8±1.3 mm) in diameter, approximately 2.5 inches (64 mm) high and shall weigh 7.5±0.1 lbs (3.40±0.05 kg). The small test block base, W_3, shall be 6.25±0.05 inches (158.8±1.3 mm) in diameter, approximately 0.25 inches (6.4 mm) high and shall weigh 2.2±0.1 lbs (1.00±0.05 kg). The small test block body shall not be fixed to the base, and shall be centered over the base for testing.

2.7.3 <u>Medium test block for conventional cooking top</u>. The large test block shall comprise a body and separate base, between which a 20-25 g layer of thermally conductive grease shall be applied. The medium test block body for the conventional cooking top, W_4, shall be 9±0.05 inches (228.6±1.3 mm) in diameter, approximately 2.7 inches (69 mm) high and shall weigh 16.9±0.1 lbs (7.67±0.05 kg). The medium test block base, W_5, shall be 9±0.05 inches (228.6±1.3 mm) in diameter, approximately 0.25 inches (6.4 mm) high and shall weigh 4.3±0.1 lbs (1.95±0.05 kg). The medium test block body shall not be fixed to the base, and shall be centered over the base for testing.

2.7.4 Large test block for conventional cooking top. The large test block shall comprise a body and separate base, between which a 28-34 g layer of thermally conductive grease shall be applied. The large test block body for the conventional cooking top, W_6, shall be 10.5±0.05 inches (266.7±1.3 mm) in diameter, approximately 3.5 inches (88.9 mm) high and shall weigh 29.4±0.1 lbs (13.33±0.05 kg). The large test block base, W_7, shall be 10.5±0.05 inches (266.7±1.3 mm) in diameter, approximately 0.25 inches (6.4 mm) high and shall weigh 6.1±0.1 lbs (2.77±0.05 kg). The large test block body shall not be fixed to the base, and shall be centered over the base for testing.

*   *   *   *   *

2.7.7 Thermal grease. The thermal grease used for each test block shall have a thermal conductivity of greater than or equal to 1.73 Btu/hr-ft-°F (1.0 W/m-K). The thermal grease shall be applied evenly so that it covers the contacting surfaces of the body and base completely. Pressure shall be applied when joining the two pieces together. After six tests, the layer of thermal grease shall be removed and a new layer shall be reapplied. If the aluminum body slides off the stainless steel base during the test, the test shall be terminated and thermal grease shall be reapplied to the test block.

*   *   *   *   *

3. Test Methods and Measurements

3.1. Test methods.

3.1.1 Conventional oven. Perform a test by establishing the testing conditions set forth in section 2, Test Conditions, of this appendix and turn off the gas flow to the conventional cooking top, if so equipped. Before beginning the test, the conventional oven shall be at its normal non-operating temperature as defined in section 1.13 and described in section 2.6 of this appendix. Set the conventional oven test block W_1 approximately in the center of the usable baking space. If there is a selector switch for selecting the mode of operation of the oven, set it for normal baking. If an oven permits baking by either forced convection by using a fan, or without forced convection, the oven is to be tested in each of those two modes. The oven shall remain on for one complete thermostat "cut-off/cut-on" of the electrical resistance heaters or gas burners after the test block temperature has increased 234 °F (130 °C) above its initial temperature.

3.1.1.1 Self-cleaning operation of a conventional oven. Establish the test conditions set forth in section 2, Test Conditions, of this appendix. Turn off the gas flow to the conventional cooking top. The temperature of the conventional oven shall be its normal non-operating temperature as defined in section 1.13 and described in section 2.6 of this appendix. Then set the conventional oven's self-cleaning process in accordance with the manufacturer's instructions. If the self-cleaning process is adjustable, use the average time recommended by the manufacturer for a moderately soiled oven.

3.1.1.2 Conventional oven standby mode and off mode power. Establish the standby mode and off mode testing conditions set forth in section 2, Test Conditions, of this appendix. For conventional ovens that take some time to enter a stable state from a higher power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301 (Second Edition) (incorporated by reference; see §430.3), allow sufficient time for the conventional oven to reach the lower power state before proceeding with the test measurement. Follow the test procedure as specified in Section 5, Paragraph 5.3.2 of IEC 62301 (Second Edition) for testing in each possible mode as described in 3.1.1.2.1 and 3.1.1.2.2 of this appendix. For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition), and use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition), but with a single test period of 10 minutes +0/−2 sec after an additional stabilization period until the clock time reaches 3:33.

3.1.1.2.1 If the conventional oven has an inactive mode, as defined in section 1.12 of this appendix, measure and record the average inactive mode power of the conventional oven, P_{IA}, in watts.

3.1.1.2.2 If the conventional oven has an off mode, as defined in section 1.14 of this appendix, measure and record the average off mode power of the conventional oven, P_{OM}, in watts.

3.1.1.3 Conventional oven cavity volume. Measure the oven cavity volume according to the test procedure specified in Sections 3, 5.1 and 5.2 of AHAM-OV-1 (incorporated by reference; see §430.3).

3.1.2 Conventional cooking top. Establish the test conditions set forth in section 2, Test Conditions, of this appendix. Turn off the gas flow to the conventional oven(s), if so equipped. The temperature of the conventional cooking top shall be its normal nonoperating temperature as defined in section 1.13 and described in section 2.6 of this appendix. Set the test block in the center of the surface unit under test. The small test block, W_2 and W_3, shall be used on electric surface units with a smallest dimension of 7 inches (178 mm) or less. The medium test block, W_4 and W_5, shall be used on electric surface units with a smallest dimension over 7 inches (178 mm) but less than 10 inches and on gas surface units with input rates less than 14,000 Btu/h. The large test block, W_6 and W_7, shall be used on electric surface units with a smallest dimension of 10 inches or greater and on gas surface units with input rates greater than or equal to 14,000 Btu/h. Each surface unit shall be tested separately. For electric surface units with flexible concentric sizes, each unique size setting must be tested individually with the appropriate test block based on the outer dimensions of the surface unit corresponding to that particular setting.

Full-surface induction cooking tops must be tested three times, once with each test block size (small, medium, and large). For each test, the test block shall be placed in the center of the usable area of the cooking surface, equidistant from any cooking top boundaries. The center of the usable cooking surface may be offset from the geometric center of the cooking top due to surface unit controls or a display.

Turn on the surface unit under test and set its energy input rate to the maximum setting. When the test block reaches 144 °F (80 °C) above its initial test block temperature, immediately reduce the energy input rate to 25±5 percent of the maximum energy input rate. The energy input rate at the reduced setting is calculated as the total energy consumed at the reduced setting divided by the time operated at the reduced setting. The maximum energy input rate is the total energy consumed at the maximum setting divided by the time operated at the maximum setting. After 15±0.1 minutes at the reduced energy setting, turn off the surface unit under test.

3.1.2.1 Conventional cooking top standby mode and off mode power. Establish the standby mode and off mode testing conditions set forth in section 2, Test Conditions, of this appendix. For conventional cooktops that take some time to enter a stable state from a higher power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301 (Second Edition) (incorporated by reference; see §430.3), allow sufficient time for the conventional cooking top to reach the lower power state before proceeding with the test measurement. Follow the test procedure as specified in Section 5, Paragraph 5.3.2 of IEC 62301 (Second Edition) for testing in each possible mode as described in sections 3.1.2.1.1 and 3.1.2.1.2 of this appendix. For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition), and use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition), but with a single test period of 10 minutes +0/-2 sec after an additional stabilization period until the clock time reaches 3:33.

3.1.2.1.1 If the conventional cooking top has an inactive mode, as defined in section 1.12 of this appendix, measure and record the average inactive mode power of the conventional cooking top, P_{IA}, in watts.

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

3.1.3 <u>Conventional range standby mode and off mode power</u>. Establish the standby mode and off mode testing conditions set forth in section 2, Test Conditions, of this appendix. For conventional ranges that take some time to enter a stable state from a higher power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301 (Second Edition) (incorporated by reference; see §430.3), allow sufficient time for the conventional range to reach the lower power state before proceeding with the test measurement. Follow the test procedure as specified in Section 5, Paragraph 5.3.2 of IEC 62301 (Second Edition) for testing in each possible mode as described in sections 3.1.3.1 and 3.1.3.2 of this appendix. For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 at the end of the stabilization period specified in Section 5, Paragraph 5.3 of IEC 62301 (First Edition), and use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition), but with a single test period of 10 minutes +0/−2 sec after an additional stabilization period until the clock time reaches 3:33.

3.1.3.1 If the conventional range has an inactive mode, as defined in section 1.12 of this appendix, measure and record the average inactive mode power of the conventional range, P_{IA}, in watts.

3.1.3.2 If the conventional range has an off mode, as defined in section 1.14 of this appendix, measure and record the average off mode power of the conventional range, P_{OM}, in watts.

3.1.4 Microwave oven.

3.1.4.1 Microwave oven test standby mode and off mode power. Establish the testing conditions set forth in section 2, Test Conditions, of this appendix. For microwave ovens that drop from a higher power state to a lower power state as discussed in Section 5, Paragraph 5.1, Note 1 of IEC 62301 (Second Edition) (incorporated by reference; see §430.3), allow sufficient time for the microwave oven to reach the lower power state before proceeding with the test measurement. Follow the test procedure as specified in Section 5, Paragraph 5.3.2 of IEC 62301 (Second Edition). For units in which power varies as a function of displayed time in standby mode, set the clock time to 3:23 and use the average power approach described in Section 5, Paragraph 5.3.2(a) of IEC 62301 (First Edition), but with a single test period of 10 minutes +0/−2 sec after an additional stabilization period until the clock time reaches 3:33. If a microwave oven is capable of operation in either standby mode or off mode, as defined in sections 1.18 and 1.14 of this appendix, respectively, or both, test the microwave oven in each mode in which it can operate.

3.2 Test measurements.

3.2.1 Conventional oven test energy consumption. If the oven thermostat controls the oven temperature without cycling on and off, measure the energy consumed, E_O, when the temperature of the block reaches T_O (T_O is 234 °F (130 °C) above the initial block temperature, T_I). If the oven thermostat operates by cycling on and off, make the following series of measurements: Measure the block temperature, T_A, and the energy consumed, E_A, or volume of gas consumed, V_A, at the end of the last "ON" period of the conventional oven before the block reaches T_O. Measure the block temperature, T_B, and the energy consumed, E_B, or volume of gas consumed, V_B, at the beginning of the next "ON" period. Measure the block temperature, T_C, and the energy consumed, E_C, or volume of gas consumed, VC, at the end of that "ON" period. Measure the block temperature, T_D, and the energy consumed, E_D, or volume of gas consumed, V_D, at the beginning of the following "ON" period. Energy measurements for E_O, E_A, E_B, E_C, and E_D should be expressed in watt-hours (kJ) for conventional electric ovens, and volume measurements for V_A, V_B, V_C, and V_D should be expressed in standard cubic feet (L) of gas for conventional gas ovens. For a gas oven, measure in watt-hours (kJ) any electrical energy, EIO, consumed by an ignition device or other electrical components required for the operation of a conventional gas oven while heating the test block to T_O.

3.2.1.1 Conventional oven average test energy consumption. If the conventional oven permits baking by either forced convection or without forced convection and the oven thermostat does not cycle on and off, measure the energy consumed with the forced convection mode, $(E_O)_1$, and without the forced convection mode, $(E_O)_2$, when the temperature of the block reaches T_O (T_O is 234 °F (130 °C) above the initial block temperature, T_I). If the conventional oven permits baking by either forced convection or without forced convection and the oven thermostat operates by cycling on and off, make the following series of measurements with and without the forced convection mode: Measure the block temperature, T_A, and the energy consumed, E_A, or volume of gas consumed, V_A, at the end of the last "ON" period of the conventional oven before the block reaches T_O. Measure the block temperature, T_B, and the energy consumed, E_B, or volume of gas consumed, V_B, at the beginning of the next "ON" period. Measure the block temperature, T_C, and the energy consumed, E_C, or volume of gas consumed, V_C, at the end of that "ON" period. Measure the block temperature, T_D, and the energy consumed, E_D, or volume of gas consumed, V_D, at the beginning of the following "ON" period. Energy measurements for E_O, E_A, E_B, E_C, and E_D should be expressed in watt-hours (kJ) for conventional electric ovens, and volume measurements for V_A, V_B, V_C, and V_D should be expressed in standard cubic feet (L) of gas for conventional gas ovens. For a gas oven that can be operated with or without forced convection, measure in watt-hours (kJ) any electrical energy consumed by an ignition device or other electrical components required for the operation of a conventional gas oven while heating the test block to T_O using the forced convection mode, $(E_{IO})_1$, and without using the forced convection mode, $(E_{IO})_2$.

3.2.1.2 <u>Conventional oven fan-only mode energy consumption</u>. If the conventional oven is capable of operation in fan-only mode, measure the fan-only mode energy consumption, E_{OF}, expressed in kilowatt-hours (kJ) of electricity consumed by the conventional oven for the duration of fan-only mode, using a watt-hour meter as specified in section 2.9.1.1 of this appendix. Alternatively, if the duration of fan-only mode is known, the watt-hours consumed may be measured for a period of 10 minutes in fan-only mode, using a watt-hour meter as specified in section 2.9.1.1 of this appendix. Multiply this value by the time in minutes that the conventional oven remains in fan-only mode, t_{OF}, and divide by 10,000 to obtain E_{OF}. The alternative approach may be used only if the resulting E_{OF} is representative of energy use during the entire fan-only mode.

3.2.1.3 Energy consumption of self-cleaning operation. Measure the energy consumption, ES, in watt-hours (kJ) of electricity or the volume of gas consumption, V_S, in standard cubic feet (L) during the self-cleaning test set forth in section 3.1.1.1 of this appendix. For a gas oven, also measure in watt-hours (kJ) any electrical energy, E_{IS}, consumed by ignition devices or other electrical components required during the self-cleaning test.

3.2.1.4 Standby mode and off mode energy consumption. Make measurements as specified in section 3.1.1.2 of this appendix. If the conventional oven is capable of operating in inactive mode, as defined in section 1.12 of this appendix, measure the average inactive mode power of the conventional oven, P_{IA}, in watts as specified in section 3.1.1.2.1 of this appendix. If the conventional oven is capable of operating in off mode, as defined in section 1.14 of this appendix, measure the average off mode power of the conventional oven, P_{OM}, in watts as specified in section 3.1.1.2.2 of this appendix.

3.2.1.5 Conventional oven cavity volume. Measure the oven cavity volume, CV_O, in cubic feet (L), as specified in section 3.1.1.3 of this appendix.

3.2.2 Conventional surface unit test energy consumption.

3.2.2.1 Conventional surface unit average test energy consumption. For the surface unit under test, measure the energy consumption, E_{CT}, in watt-hours (kJ) of electricity or the volume of gas consumption, V_{CT}, in standard cubic feet (L) of gas and the test block temperature, T_{CT}, at the end of the 15 minute (reduced input setting) test interval for the test specified in section 3.1.2 of this appendix and the total time, t_{CT}, in hours, that the unit is under test. Measure any electrical energy, E_{IC}, consumed by an ignition device of a gas heating element or other electrical components required for the operation of the conventional gas cooking top in watt-hours (kJ). For full-surface induction cooking tops, the values described above shall be measured for each test block.

3.2.2.2 Conventional surface unit standby mode and off mode energy consumption. Make measurements as specified in section 3.1.2.1 of this appendix. If the conventional surface unit is capable of operating in inactive mode, as defined in section 1.12 of this appendix, measure the average inactive mode power of the conventional surface unit, $P_{IA,}$ in watts as specified in section 3.1.2.1.1 of this appendix. If the conventional surface unit is capable of operating in off mode, as defined in section 1.14 of this appendix, measure the average off mode power of the conventional surface unit, P_{OM}, in watts as specified in section 3.1.2.1.2 of this appendix.

3.2.3 Conventional range standby mode and off mode energy consumption. Make measurements as specified in section 3.1.3 of this appendix. If the conventional range is capable of operating in inactive mode, as defined in section 1.13 of this appendix, measure the average inactive mode power of the conventional range, $P_{IA,}$ in watts as specified in section 3.1.3.1 of this appendix. If the conventional range is capable of operating in off mode, as defined in section 1.14 of this appendix, measure the average off mode power of the conventional range, P_{OM}, in watts as specified in section 3.1.3.2 of this appendix.

3.2.4 Microwave oven test standby mode and off mode power. Make measurements as specified in Section 5, Paragraph 5.3 of IEC 62301 (Second Edition) (incorporated by reference; see §430.3). If the microwave oven is capable of operating in standby mode, as defined in section 1.18 of this appendix, measure the average standby mode power of the microwave oven, P_{SB}, in watts as specified in section 3.1.4.1 of this appendix. If the microwave oven is capable of operating in off mode, as defined in section 1.14 of this appendix, measure the average off mode power of the microwave oven, P_{OM}, as specified in section 3.1.4.1.

3.3 Recorded values.

3.3.1 Record the test room temperature, T_R, at the start and end of each range, oven or cooktop test, as determined in section 2.5 of this appendix.

3.3.2 Record the measured test block, test block body, and test block base weights W_1, W_2, W_3, W_4, W_5, W_6, and W_7 in pounds (kg).

3.3.3 Record the initial temperature, T_1, of the test block under test.

3.3.4 For a conventional oven with a thermostat which operates by cycling on and off, record the conventional oven test measurements T_A, E_A, T_B, E_B, T_C, E_C, T_D, and E_D for conventional electric ovens or T_A, V_A, T_B, V_B, T_C, V_C, T_D, and V_D for conventional gas ovens. If the thermostat controls the oven temperature without cycling on and off, record E_O. For a gas oven which also uses electrical energy for the ignition or operation of the oven, also record E_{IO}.

3.3.5 For a conventional oven that can be operated with or without forced convection and the oven thermostat controls the oven temperature without cycling on and off, measure the energy consumed with the forced convection mode, $(E_O)_1$, and without the forced convection mode, $(E_O)_2$. If the conventional oven operates with or without forced convection and the thermostat controls the oven temperature by cycling on and off, record the conventional oven test measurements T_A, E_A, T_B, E_B, T_C, E_C, T_D, and E_D for conventional electric ovens or T_A, V_A, T_B, V_B, T_C, V_C, T_D, and V_D for conventional gas ovens. For a gas oven that can be operated with or without forced convection, measure any electrical energy consumed by an ignition device or other electrical components used during the forced convection mode, $(E_{IO})_1$, and without using the forced convection mode, $(E_{IO})_2$.

3.3.6 Record the measured energy consumption, E_S, or gas consumption, V_S, and for a gas oven, any electrical energy, E_{IS}, for the test of the self-cleaning operation of a conventional oven.

3.3.7 For conventional ovens, record the conventional oven standby mode and off mode test measurements P_{IA} and P_{OM}, if applicable. For conventional cooktops, record the conventional cooking top standby mode and off mode test measurements P_{IA} and P_{OM}, if applicable. For conventional ranges, record the conventional range standby mode and off mode test measurements P_{IA} and P_{OM}, if applicable.

3.3.8 For conventional ovens, record the measured oven cavity volume, CV_O, in cubic feet (L), rounded to the nearest tenth of a cubic foot (nearest L).

3.3.9 For the surface unit under test, record the electric energy consumption, E_{CT}, or the gas volume consumption, V_{CT}, the final test block temperature, TCT, and the total test time, t_{CT}. For a gas cooking top which uses electrical energy for ignition of the burners, also record EIC.

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

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

3.3.12 Record the average standby mode power, P_{SB}, for the microwave oven standby mode, as determined in section 3.2.4 of this appendix for a microwave oven capable of operating in standby mode. Record the average off mode power, P_{OM}, for the microwave oven off mode power test, as determined in section 3.2.4 of this appendix for a microwave oven capable of operating in off mode.

4. Calculation of Derived Results From Test Measurements

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4.1.2.1.1 Annual primary energy consumption. Calculate the annual primary energy consumption for cooking, E_{CO}, expressed in kilowatt-hours (kJ) per year for electric ovens and in kBtus (kJ) per year for gas ovens, and defined as:

$$E_{CO} = \frac{E_O \times K_e \times O_O}{W_1 \times C_p \times T_S}$$

for electric ovens,

Where:

E_O = test energy consumption as measured in section 3.2.1 or as calculated in section 4.1.1 or section 4.1.1.1 of this appendix.

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

O_O = 29.3 kWh (105,480 kJ) per year, annual useful cooking energy output of conventional electric oven.

W_1 = measured weight of test block in pounds (kg).

C_p = 0.23 Btu/lb-°F (0.96 kJ/kg ÷ °C), specific heat of test block.

T_S = 234 °F (130 °C), temperature rise of test block.

$$E_{CO} = \frac{E_O \times O_O}{W_1 \times C_p \times T_S}$$

for gas ovens,

Where:

E_O = test energy consumption as measured in section 3.2.1. or as calculated in section 4.1.1 or section 4.1.1.1 of this appendix.

O_O = 88.8 kBtu (93,684 kJ) per year, annual useful cooking energy output of conventional gas oven.

W_1, C_p and T_S are the same as defined above.

*   *   *   *   *

4.1.2.2.1 Annual primary energy consumption. Calculate the annual primary energy consumption for conventional oven self-cleaning operations, E_{SC}, expressed in kilowatt-hours (kJ) per year for electric ovens and in kBtus (kJ) for gas ovens, and defined as:

$E_{SC} = E_S \times S_e \times K$, for electric ovens,

Where:

E_S = energy consumption in watt-hours, as measured in section 3.2.1.3 of this appendix.

S_e = 4, average number of times a self-cleaning operation of a conventional electric oven is used per year.

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

or

$E_{SC} = V_S \times H \times S_g \times K$, for gas ovens,

Where:

V_S = gas consumption in standard cubic feet (L), as measured in section 3.2.1.3 of this appendix.

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

S_g = 4, average number of times a self-cleaning operation of a conventional gas oven is used per year.

K = 0.001 kBtu/Btu conversion factor for Btus to kBtus

*   *   *   *   *

4.1.2.4.3 Conventional gas oven energy consumption. Calculate the total annual gas energy consumption of a conventional gas oven, E_{AOG}, expressed in kBtus (kJ) per year and defined as:

$$E_{AOG} = E_{CO} + E_{SC},$$

Where:

E_{CO} = annual primary cooking energy consumption as determined in section 4.1.2.1.1 of this appendix.

E_{SC} = annual primary self-cleaning energy consumption as determined in section 4.1.2.2.1 of this appendix.

If the conventional gas oven uses electrical energy, calculate the total annual electrical energy consumption, E_{AOE}, expressed in kilowatt-hours (kJ) per year and defined as:

$$E_{AOE} = E_{SO} + E_{SS},$$

Where:

E_{SO} = annual secondary cooking energy consumption as determined in section 4.1.2.1.2 of this appendix.

E_{SS} = annual secondary self-cleaning energy consumption as determined in section 4.1.2.2.2 of this appendix.

If the conventional gas oven uses electrical energy, also calculate the total integrated annual electrical energy consumption, IE_{AOE}, expressed in kilowatt-hours (kJ) per year and defined as:

$$IE_{AOE} = E_{SO} + E_{SS} + E_{OTLP} + (E_{OF} \times N_{OG}),$$

Where:

E_{SO} = annual secondary cooking energy consumption as determined in section 4.1.2.1.2 of this appendix.

E_{SS} = annual secondary self-cleaning energy consumption as determined in section 4.1.2.2.2 of this appendix.

E_{OTLP} = annual combined low-power mode energy consumption as determined in section 4.1.2.3 of this appendix.

E_{OF} = fan-only mode energy consumption as measured in section 3.2.1.2 of this appendix.

N_{OG} = representative number of annual conventional gas oven cooking cycles per year, which is equal to 183 cycles for a conventional gas oven without self-clean capability and 197 cycles for a conventional gas oven with self-clean capability.

4.1.2.5 Total annual energy consumption of multiple conventional ovens and conventional ovens with an oven separator. If the cooking appliance includes more than one conventional oven or consists of a conventional oven equipped with an oven separator that allows for cooking using the entire oven cavity or, if the separator is installed, splitting the oven into two smaller cavities, calculate the total annual energy consumption of the conventional oven(s) using the following equations:

4.1.2.5.1 Conventional electric oven energy consumption. Calculate the total annual energy consumption, E_{TO}, in kilowatt-hours (kJ) per year and defined as:

$$E_{TO} = E_{ACO} + E_{ASC}$$

Where:

$$E_{ACO} = \frac{1}{n}\sum_{i=1}^{n}(E_{CO})_i$$

is the average annual primary energy consumption for cooking, and where:

n = number of conventional ovens in the basic model or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

E_{CO} = annual primary energy consumption for cooking as determined in section 4.1.2.1.1 of this appendix.

$$E_{ASC} = \frac{1}{n}\sum_{i=1}^{n}(E_{SC})_i$$

is the average annual self-cleaning energy consumption,

Where:

n = number of self-cleaning conventional ovens in the basic model.

E_{SC} = annual primary self-cleaning energy consumption as determined according to section 4.1.2.2.1 of this appendix.

4.1.2.5.2 Conventional electric oven integrated energy consumption. Calculate the total integrated annual energy consumption, IE_{TO}, in kilowatt-hours (kJ) per year and defined as:

$$IE_{TO} = E_{ACO} + E_{ASC} + E_{OTLP} + (E_{OF} \times N_{OE})$$

Where

$$E_{ACO} = \frac{1}{n}\sum_{i=1}^{n}(E_{CO})_i$$

is the average annual primary energy consumption for cooking, and where:

n = number of conventional ovens in the basic model or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

E_{CO} = annual primary energy consumption for cooking as determined in section 4.1.2.1.1 of this appendix.

$$E_{ASC} = \frac{1}{n}\sum_{i=1}^{n}(E_{SC})_i$$

is the average annual self-cleaning energy consumption,

Where:

n = number of self-cleaning conventional ovens in the basic model.

E_{SC} = annual primary self-cleaning energy consumption as determined according to section 4.1.2.2.1 of this appendix.

E_{OTLP} = annual combined low-power mode energy consumption for the cooking appliance as determined in section 4.1.2.3 of this appendix.

E_{OF} = fan-only mode energy consumption as measured in section 3.2.1.2 of this appendix.

N_{OE} = representative number of annual conventional electric oven cooking cycles per year, which is equal to 219 cycles for a conventional electric oven without self-clean capability and 204 cycles for a conventional electric oven with self-clean capability.

4.1.2.5.3 Conventional gas oven energy consumption. Calculate the total annual gas energy consumption, E_{TOG}, in kBtus (kJ) per year and defined as:

$$E_{TOG} = E_{ACO} + E_{ASC}$$

Where:

E_{ACO} = average annual primary energy consumption for cooking in kBtus (kJ) per year and is calculated as:

$$E_{ACO} = \frac{1}{n}\sum_{i=1}^{n}(E_{CO})_i$$

Where:

n = number of conventional ovens in the basic model or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

E_{CO} = annual primary energy consumption for cooking as determined in section 4.1.2.1.1 of this appendix.

and,

E_{ASC} = average annual self-cleaning energy consumption in kBtus (kJ) per year and is calculated as:

$$E_{ASC} = \frac{1}{n}\sum_{i=1}^{n}(E_{SC})_i$$

Where:

n = number of self-cleaning conventional ovens in the basic model.

E_{SC} = annual primary self-cleaning energy consumption as determined according to section 4.1.2.2.1 of this appendix.

If the oven also uses electrical energy, calculate the total annual electrical energy consumption, E_{TOE}, in kilowatt-hours (kJ) per year and defined as:

$$E_{TOE} = E_{ASO} + E_{AAS}$$

Where:

$$E_{ASO} = \frac{1}{n}\sum_{i=1}^{n}(E_{SO})_i$$

is the average annual secondary energy consumption for cooking,

Where:

n = number of conventional ovens in the basic model or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

E_{SO} = annual secondary energy consumption for cooking of gas ovens as determined in section 4.1.2.1.2 of this appendix.

$$E_{AAS} = \frac{1}{n}\sum_{i=1}^{n}(E_{SS})_i$$

is the average annual secondary self-cleaning energy consumption,

Where:

n = number of self-cleaning ovens in the basic model.

E_{SS} = annual secondary self-cleaning energy consumption of gas ovens as determined in section 4.1.2.2.2 of this appendix.

If the oven also uses electrical energy, also calculate the total integrated annual electrical energy consumption, IE_{TOE}, in kilowatt-hours (kJ) per year and defined as:

$$IE_{TOE} = E_{ASO} + E_{AAS} + E_{OTLP} + (E_{OF} \times N_{OG})$$

Where:

$$E_{ASO} = \frac{1}{n}\sum_{i=1}^{n}(E_{SO})_i$$

is the average annual secondary energy consumption for cooking,

Where:

n = number of conventional ovens in the basic model or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

E_{SO} = annual secondary energy consumption for cooking of gas ovens as determined in section 4.1.2.1.2 of this appendix.

$$E_{AAS} = \frac{1}{n}\sum_{i=1}^{n}(E_{SS})_i$$

is the average annual secondary self-cleaning energy consumption,

Where:

n = number of self-cleaning ovens in the basic model.

E_{SS} = annual secondary self-cleaning energy consumption of gas ovens as determined in section 4.1.2.2.2 of this appendix.

E_{OTLP} = annual combined low-power mode energy consumption as determined in section 4.1.2.3 of this appendix.

E_{OF} = fan-only mode energy consumption as measured in section 3.2.1.2 of this appendix.

N_{OG} = representative number of annual conventional gas oven cooking cycles per year, which is equal to 183 cycles for a conventional gas oven without self-clean capability and 197 cycles for a conventional gas oven with self-clean capability.

* * * * *

4.1.3.2 Multiple conventional ovens and conventional ovens with an oven separator. If the cooking appliance includes more than one conventional oven or consists of a conventional oven equipped with an oven separator that allows for cooking using the entire oven cavity or, if the separator is installed, splitting the oven into two smaller cavities, calculate the cooking efficiency of the conventional oven(s), Eff_{TO}, using the following equation:

$$Eff_{TO} = \frac{n}{\sum_{i=1}^{n}\left(\frac{1}{Eff_{AO}}\right)_i}$$

Where:

n = number of conventional ovens in the cooking appliance or, if the cooking appliance is equipped with an oven separator, the number of oven cavity configurations.

Eff_{AO} = cooking efficiency of each oven determined according to section 4.1.3.1 of this appendix.

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4.1.4.1 Conventional oven energy factor. Calculate the energy factor, or the ratio of useful cooking energy output to the total energy input, R_O, using the following equations:

$$R_O = \frac{O_O}{E_{AO}}$$

For electric ovens,

Where:

O_O = 29.3 kWh (105,480 kJ) per year, annual useful cooking energy output.

E_{AO} = total annual energy consumption for electric ovens as determined in section 4.1.2.4.1 of this appendix.

For gas ovens:

$$R_O = \frac{O_O}{E_{AOG} + (E_{AOE} \times K_e)}$$

Where:

O_O = 88.8 kBtu (93,684 kJ) per year, annual useful cooking energy output.

E_{AOG} = total annual gas energy consumption for conventional gas ovens as determined in section 4.1.2.4.3 of this appendix.

E_{AOE} = total annual electrical energy consumption for conventional gas ovens as determined in section 4.1.2.4.3 of this appendix.

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

4.1.4.2 Conventional oven integrated energy factor. Calculate the integrated energy factor, or the ratio of useful cooking energy output to the total integrated energy input, IR_O, using the following equations:

$$IR_O = \frac{O_O}{IE_{AO}}$$

For electric ovens,

Where:

O_O = 29.3 kWh (105,480 kJ) per year, annual useful cooking energy output.

IE_{AO} = total integrated annual energy consumption for electric ovens as determined in section 4.1.2.4.2 of this appendix.

For gas ovens:

$$IR_O = \frac{O_O}{E_{AOG} + (IE_{AOE} \times K_e)}$$

Where:

O_O = 88.8 kBtu (93,684 kJ) per year, annual useful cooking energy output.

E_{AOG} = total annual gas energy consumption for conventional gas ovens as determined in section 4.1.2.4.3 of this appendix.

IE_{AOE} = total integrated annual electrical energy consumption for conventional gas ovens as determined in section 4.1.2.4.3 of this appendix.

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

4.2 Conventional cooking top.

4.2.1 Surface unit cooking efficiency.

4.2.1.1 Electric surface unit cooking efficiency. Calculate the cooking efficiency, Eff_{SU}, of the electric surface unit or surface unit size setting under test, defined as:

$$Eff_{SU} = \frac{\left(W_{TB} \times C_{p,TB} + W_B \times C_{p,B}\right) \times T_{SU}}{K_e \times E_{CT}}$$

Where:

W_{TB}=measured weight of test block body, W_2, W_4, or W_6 expressed in pounds (kg).

$C_{p,TB}$=0.23 Btu/lb-°F (0.96 kJ/kg÷ °C), specific heat of test block body.

W_B=measured weight of test block base, W_3, W_5, or W_7 expressed in pounds (kg).

$C_{p,B}$=0.11 Btu/lb-°F (0.46 kJ/kg÷ °C), specific heat of test block base.

T_{SU}=temperature rise of the test block: final test block temperature, T_{CT}, as determined in section 3.2.2 of this appendix, minus the initial test block temperature, T_I, expressed in °F (°C) as determined in section 2.7.5 of this appendix.

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

E_{CT}=measured energy consumption, as determined according to section 3.2.2 of this appendix, expressed in watt-hours (kJ).

4.2.1.2 Gas surface unit cooking efficiency. Calculate the cooking efficiency, Eff_{SU}, of the gas surface unit under test, defined as:

$$Eff_{SU} = \frac{(W_{TB} \times C_{p,TB} + W_B \times C_{p,B}) \times T_{SU}}{E}$$

Where:

W_{TB}=measured weight of test block body, W_4 or W_6, expressed in pounds (kg).

W_B=measured weight of test block base, W_5 or W_7, expressed in pounds (kg).

$C_{p,TB}$, $C_{p,B}$, and T_{SU} are the same as defined in section 4.2.1.1 of this appendix.

and,

$E=(V_{CT} \times H) + (E_{IC} \times K_e)$,

Where:

V_{CT}=total gas consumption in standard cubic feet (L) for the gas surface unit test as measured in section 3.2.2.1 of this appendix.

E_{IC}=electrical energy consumed in watt-hours (kJ) by an ignition device of a gas surface unit as measured in section 3.2.2.1 of this appendix.

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

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

4.2.1.3 Conventional cooking top cooking efficiency. Calculate the conventional cooking top cooking efficiency Eff_{CT} using the following equation:

$$Eff_{CT} = \frac{1}{n}\sum_{i=1}^{n}(Eff_{SU})_i$$

Where:

n=number of cooking top surface units tests. For a full-surface induction cooking top, n = 3.

Eff_{SU}=the efficiency determined during each surface unit test, as determined according to section 4.2.1.1 of this appendix or section 4.2.1.2 of this appendix.

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4.2.2.2.1 Annual cooking energy consumption. Calculate the annual energy consumption for cooking, E_{CC}, in kBtus (kJ) per year for a gas cooking top, defined as:

$$E_{CC} = \frac{O_{CT}}{Eff_{CT}}$$

Where:

O_{CT} = 527.6 kBtu (556,618 kJ) per year, annual useful cooking energy output.

Eff_{CT} = the gas cooking top efficiency as defined in Section 4.2.1.3.

4.2.2.2.2 Total integrated annual energy consumption of a conventional gas cooking top. Calculate the total integrated annual energy consumption of a conventional gas cooking top, IE_{CA}, in kBtus (kJ) per year, defined as:

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

Where:

E_{CC} = energy consumption for cooking as determined in section 4.2.2.2.1 of this appendix.

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

Where:

P_{IA} = conventional cooking top inactive mode power, in watts, as measured in section 3.1.2.1.1 of this appendix.

P_{OM} = conventional cooking top off mode power, in watts, as measured in section 3.1.2.1.2 of this appendix.

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

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

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

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

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

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4.2.3.2 Conventional cooking top integrated energy factor. Calculate the integrated energy factor or ratio of useful cooking energy output for cooking to the total integrated energy input, IR_{CT}, as follows:

For electric cooking tops,

$$IR_{CT} = \frac{O_{CT}}{IE_{CA}}$$

Where:

O_{CT} = 173.1 kWh (623,160 kJ) per year, annual useful cooking energy output of cooking top.

IE_{CA} = total annual integrated energy consumption of cooking top determined according to section 4.2.2.1.2 of this appendix.

For gas cooking tops,

$$IR_{CT} = \frac{O_{CT}}{IE_{CA}}$$

Where:

O_{CT} = 527.6 kBtu (556,618 kJ) per year, annual useful cooking energy output of cooking top.

IE_{CA} = total integrated annual energy consumption of cooking top determined according to section 4.2.2.2.2 of this appendix.

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