DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EERE–2013–BT–TP–0004]

RIN 1904–AC94

Energy Conservation Program for Consumer Products: Test Procedures for Direct Heating Equipment and Pool Heaters

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

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy (DOE) is amending its test procedures for vented home heating equipment and pool heaters established under the Energy Policy and Conservation Act. This rulemaking fulfills DOE's statutory obligation to review its test procedures for covered products at least once every seven years. The amendments add provisions for testing vented home heating equipment that utilizes condensing technology, and incorporate by reference six industry test standards to replace the outdated test standards referred to in the existing DOE test procedure. For pool heaters, the amendments incorporate by reference Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1160–2009, "Performance Rating of Heat Pump Pool Heaters," and ANSI/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 146–2011, "Method of Testing and Rating Pool Heaters," to establish a test method for electric pool heaters (including heat pump pool heaters). The amendments also clarify the test procedure's applicability to oil-fired pool heaters.

DATES: The effective date of this rule is February 5, 2015. Compliance will be mandatory starting July 6, 2015.

The incorporation by reference of certain publications listed in this rule is approved by the Director of the Federal Register as of February 5, 2015. Other publications referenced were approved on January 3, 2014.

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

A link to the docket Web page can be found at: *http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-TP-0004.* This Web page contains a link to the docket for this rule on the *www.regulations.gov* site. The *www.regulations.gov* Web page contains simple instructions on how to access all documents, including public comments, in the docket.

For information on how to review the docket, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

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SUPPLEMENTARY INFORMATION: This final rule incorporates by reference into subpart B of 10 CFR part 430, the following industry standards:

AHRI Standard 1160–2009 ("AHRI 1160"), Performance Rating of Heat Pump Pool Heaters, 2009.

Copies of AHRI 1160 can be obtained from the Air-Conditioning, Heating, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, 703–524–8800, or go to *http://www.ahrinet.org.*

ANSI Z21.86–2008, ("ANSI Z21.86"), Vented Gas-Fired Space Heating Appliances, Fifth Edition.

Copies of ANSI Z21.86 can be obtained from American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, 212–642–4900, or go to *http://www.ansi.org.*

ANSI/ASHRAE Standard 103–2007, ("ASHRAE 103–2007"), Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers, ANSI approved March 25, 2008.

Copies of ASHRAE 103–2007 can be obtained from American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Publication Sales, 1791 Tullie Circle, NE., Atlanta, GA 30329, 800–527–4723 or 404–636–8400, or go to *http://www.ashrae.org.*

ANSI/ASHRAE Standard 146–2011 ("ASHRAE 146"), Method of Testing and Rating Pool Heaters, ASHRAE approved February 2, 2011.

Copies of ASHRAE 146 can be obtained from American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Publication Sales, 1791 Tullie Circle, NE., Atlanta, GA 30329, 800–527–4723 or 404–636–8400, or go to *http://www.ashrae.org.*

ASTM D2156–09, ("ASTM D2156"), Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels, ASTM approved December 1, 2009.

Copies of ASTM D2156 can be obtained from American Society for Testing and Materials International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959, or go to *http://www.astm.org.*

UL 729–2003 ("UL 729"), Standard for Safety for Oil-Fired Floor Furnaces, Sixth Edition, dated August 29, 2003, including revisions through April 22, 2010.

Copies of UL 729 can be obtained from Underwriters Laboratories, Inc., 2600 NW. Lake Rd., Camas WA 98607–8542, or go to *http://www.UL.com.*

UL 730–2003 ("UL 730"), Standard for Safety for Oil-Fired Wall Furnaces, Fifth Edition, dated August 29, 2003, including revisions through April 22, 2010.

Copies of UL 730 can be obtained from Underwriters Laboratories, Inc., 2600 NW. Lake Rd., Camas WA 98607–8542, or go to *http://www.UL.com.*

UL 896–1993 ("UL 896"), Standard for Safety for Oil-Burning Stoves, Fifth Edition, dated July 29, 1993, including revisions through May 7, 2010.

Copies of UL 896 can be obtained from Underwriters Laboratories, Inc., 2600 NW. Lake Rd., Camas WA 98607–8542, or go to *http://www.UL.com.*

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I. Authority and Background

Title III, Part B [1] of the Energy Policy and Conservation Act of 1975 (''EPCA'' or ''the Act''), Public Law 94–163 (*codified at* 42 U.S.C. 6291–6309) sets forth a variety of provisions designed to improve energy efficiency and establishes the Energy Conservation Program for Consumer Products Other Than Automobiles.[2] These include two covered products that are the subject of this rule: direct heating equipment (DHE) and pool heaters. (42 U.S.C. 6292(a)(9) and (11))

Under EPCA, the energy conservation program generally consists of four parts: (1) Testing; (2) labeling; (3) establishing 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 making representations about the efficiency of those products, including representations to DOE of compliance with applicable energy conservation standards adopted pursuant to EPCA. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s)) Similarly, DOE must use these test requirements to determine whether the products comply with any relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

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

In 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 product's measured energy efficiency. (42 U.S.C. 6293(e)(1))

Further, the Energy Independence and Security Act of 2007 (EISA 2007) amended EPCA to require that at least once every seven years, DOE must review test procedures for all covered products and either amend test procedures (if the Secretary determines that amended test procedures would more accurately or fully comply with the requirements of 42 U.S.C. 6293(b)(3)), or publish notice in the **Federal Register** of any determination not to amend a test procedure. (42 U.S.C. 6293(b)(1)(A)) Under this requirement, DOE must review the test procedures for direct heating equipment and pool heaters not later than December 19, 2014 (*i.e.,* seven years after the enactment of EISA 2007). This final rule satisfies this requirement.

This rulemaking covers two types of direct heating equipment: vented home heating equipment and unvented home heating equipment. For vented home heating equipment, the test procedure is located at 10 CFR 430.23(o) and 10 CFR part 430, subpart B, appendix O (Appendix O). The vented home heating equipment test procedure includes provisions for determining energy efficiency (annual fuel utilization efficiency (AFUE)), as well as annual energy consumption. DOE's test procedures for unvented home heating equipment are located at 10 CFR 430.23(g) and 10 CFR 430, subpart B, appendix G (Appendix G). For unvented heaters that are used as the primary heating source for the home, there is a calculation of annual energy consumption based on a single assignment of active mode hours; there is no provision for calculation of energy efficiency. For unvented heaters that are not used as the primary heating source for the home, there are no provisions for calculating either the energy efficiency or annual energy consumption.

DOE's test procedure for pool heaters is found at 10 CFR 430.23(p) and 10 CFR part 430, subpart B, appendix P (Appendix P). The test procedure includes provisions for determining two energy efficiency descriptors (*i.e.,* thermal efficiency and integrated thermal efficiency), as well as annual energy consumption.

In addition to the test procedure review provision discussed above, EISA 2007 also amended EPCA to require DOE to amend its test procedures for all covered products to include measurement of standby mode and off mode energy consumption. (42 U.S.C. 6295(gg)(2)(A)) DOE published a final rule adopting standby mode and off mode provisions for heating products in the **Federal Register** on December 17, 2012. 77 FR 74559. That rulemaking

was limited to test procedure amendments to address standby mode and off mode requirements; it did not address non-standby/off mode issues in DOE's existing test procedures for the covered products. DOE addresses those issues separately in this final rule.

On October 12, 2011, DOE published in the **Federal Register** a request for information (RFI) that identified and requested comment on a number of issues regarding the test procedures for DHE (including both vented and unvented home heating equipment) and pool heaters (October 2011 RFI).[3] 76 FR 63211. DOE accepted comments and information on the October 2011 RFI until November 28, 2011, and considered all feedback received.

On October 24, 2013, DOE published a notice of proposed rulemaking (NOPR) to propose amendments for its test procedures for vented home heating equipment and pool heaters (October 2013 NOPR). 78 FR 63410. In the October 2013 NOPR, DOE proposed amending the test procedure to include provisions for condensing technology in vented home heating equipment, updating outdated references, and clarifying the pool heater test procedure as it applies to oil-fired products. DOE also proposed new test provisions for electric pool heaters, including electric heat pump pool heaters. DOE did not receive comments on the RFI relating to unvented home heating equipment and, after reviewing the test method, did not propose any changes to the test procedure for unvented home heating equipment in the October 2013 NOPR. Pursuant to 42 U.S.C. 6293(b)(1)(A)(ii), DOE has determined not to amend the test procedure for unvented home heating equipment.

The October 2013 NOPR serves as the basis for this final rule. On December 4, 2013, DOE held a public meeting to discuss the test procedure proposals outlined in the October 2013 NOPR. DOE accepted comments and information on the NOPR until January 7, 2014. DOE considered the feedback received from stakeholders, which is discussed in section III of this final rule.

II. Synopsis of the Final Rule

In this final rule, DOE amends its test procedures for vented home heating equipment and pool heaters. The vented

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

[2] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Pub. L. 112–210 (Dec. 18, 2012).

[3] The October 2011 RFI also requested information on the need to amend the test procedures for residential water heaters. However, because the American Energy Manufacturing and Technical Corrections Act amended EPCA to require that DOE develop a uniform efficiency descriptor for residential and commercial water heaters (42 U.S.C. 6295(e)(5)), DOE is addressing test procedure updates for that product in a separate rulemaking.

home heating equipment amendments add provisions for testing vented heaters that utilize condensing technology and update incorporations by reference in the existing test procedure. The pool heater amendments incorporate by reference Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1160–2009, ''Performance Rating of Heat Pump Pool Heaters'' (AHRI 1160) and American National Standards Insitute (ANSI)/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 146–2011, ''Method of Testing and Rating Pool Heaters'' (ASHRAE 146), to establish testing procedures for electric resistance and electric heat pump pool heaters. The amendments for pool heaters also clarify the test procedure's applicability to gas-fired and oil-fired pool heaters. The amendments and clarifications for both product types are summarized below.

DOE amends the test procedure for vented heaters to incorporate by reference the following six current industry standards to replace the outdated standards referenced in the existing DOE test procedure: (1) ANSI/ASHRAE Standard 103–2007, ''Method of Test for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers'' (ASHRAE 103–2007); (2) ANSI Z21.86–2008, ''Gas-Fired Space Heating Appliances'' (ANSI Z21.86); (3) ASTM D2156–09, ''Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels'' (ASTM D2156); (4) UL 729–2003, ''Standard for Safety for Oil-Fired Floor Furnaces'' (UL 729); (5) UL 730–2003, ''Standard for Safety for Oil-Fired Wall Furnaces'' (UL 730); and (6) UL 896–1993, ''Standard for Safety for Oil-Burning Stoves'' (UL 896). DOE also establishes a test method to determine the AFUE of vented heaters that use condensing technology.

DOE does not adopt as part of the final rule a proposal included in the October 2013 NOPR for a default jacket loss value for vented floor furnaces. DOE proposed a default value of one percent for floor furnace jacket loss (measured as a percentage of fuel input rate in Btu/h). However, subsequent DOE testing revealed an average jacket loss of 3.05 percent with a standard deviation of 0.45 percent. Because the results show jacket losses to be much higher than one percent, DOE will not adopt a default value. The test procedure continues to require the measurement of jacket losses for vented floor furnaces when determining the AFUE.

In addition, DOE corrects multiple clerical errors and clarifies sections that commenters identified as ambiguous or unclear in the test procedure for vented home heating equipment. These changes are identified and explained in section III.

In this final rule, DOE clarifies the applicability of the pool heater test method for oil-fired products. DOE also adopts new provisions for testing electric pool heaters, including electric heat pump pool heaters. DOE adopts test methods for electric pool heaters by incorporating by reference ASHRAE 146. In addition, DOE adopts test methods for electric heat pump pool heaters by incorporating by reference AHRI 1160, which provides a method to convert the coefficient of performance (COP) metric used in that standard to the thermal efficiency metric required by EPCA. (42 U.S.C. 6291(22)(E))

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 from that determined under the existing test procedure. (42 U.S.C. 6293(e)(1)) For both vented home heating equipment and pool heaters, DOE has determined that the proposed test procedure amendments would have a *de minimis* impact on the products' measured efficiency. A full discussion of the rationale for this conclusion is provided in section III.C.

III. Discussion

DOE received seven written comments in response to the October 2013 NOPR in addition to the comments received during the December 2013 public meeting. The commenters included: AHRI; ASHRAE; Empire Comfort Systems (ECS); Intertek; the Natural Resources Defense Council (NRDC); Raypak; and China WTO/TBT National Notification & Enquiry Center, Standard and Regulation Researching Center, AQSIQ, P.R. China (CWTO). These interested parties commented on a range of issues, including those DOE identified in the October 2013 NOPR, as well as several other pertinent issues. The issues on which DOE received comments, as well as DOE's responses to those comments and the resulting changes to the test procedures for vented home heating equipment and pool heaters, are discussed in the following subsections C and D.

DOE notes that the U.S. Court of Appeals for the District of Columbia (D.C. Circuit) on February 8, 2013, issued a decision vacating the DOE definition of ''Vented hearth heater'' at 10 CFR 430.2 and remanded the issue to DOE to interpret the challenged provisions consistent with the court's opinion.[4] As such, DOE amends the definition of ''vented home heating equipment'' at 10 CFR 430.2 to remove the term ''vented hearth heater.'' DOE did not receive comments related to the application of the test procedure to vented hearth heaters in response to the October 2013 NOPR. DOE plans to address the vented hearth heaters test procedure in a separate rulemaking.

A. Products Covered by This Final Rule

The amendments in this final rule cover those products that meet the definitions for vented home heating equipment and pool heaters, as codified in 10 CFR 430.2. DOE received no comment regarding unvented home heating equipment in response to the RFI and thus did not propose test procedure amendments for these products in the October 2013 NOPR. Likewise, DOE does not adopt any amendments to its test procedure for unvented home heating equipment in this final rule.

B. Dates for the Amended Test Procedure

This final rule amends 10 CFR 430.3, 10 CFR 430.23, Appendix O to subpart B of part 430, and Appendix P to subpart B of part 430. The amendments to 10 CFR 430.3 and 10 CFR 430.23 are effective 30 days after publication of this final rule. Pursuant to 42 U.S.C. 6293(c)(2), effective 180 days after DOE prescribes or establishes a new or amended test procedure, manufacturers must make representations of energy efficiency, including certifications of compliance, using that new or amended test procedure. Accordingly, all representations of energy efficiency, including certifications of compliance, must be based on testing conducted in accordance with the amended Appendix O and Appendix P as of 180 days after publication of the test procedure final rule.

C. Test Procedure for Direct Heating Equipment

This final rule amends DOE's test procedures for vented heaters to account for this condensing technology. Condensing technology is a design strategy that increases the efficiency of a heating appliance by extracting additional thermal energy from the flue gases, causing the water vapor created in the combustion process to condense. The provisions regarding condensing technology for vented home heating equipment are essentially the same as those contained in ASHRAE 103–2007.

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[4] *Hearth, Patio & Barbecue Ass'n* v. *U.S. Dep't of Energy,* 706 F.3d 499, 509 (D.C. Cir. 2013).

However, because of the numerous clarifications and modifications needed to apply the condensing technology provisions of the industry standard for furnaces and boilers to vented home heating equipment, DOE incorporates the condensing procedures as stand-alone amendments to DOE's vented home heating equipment test procedure, rather than incorporating by reference select provisions of ASHRAE 103–2007.

Consistent with 42 U.S.C. 6293(c), any representations of energy consumption of vented home heating equipment must be based on the final amended test procedures 180 days after the publication of this test procedure final rule in the **Federal Register.** Until that time, manufacturers must make such representations based either on the final amended test procedures or on the previous test procedures, set forth at 10 CFR part 430, subpart B, appendix O, revised as of January 1, 2014.

In response to the October 2013 NOPR and during the December 2013 public meeting, DOE received comments relating to vented home heating equipment from five interested parties (Intertek, ECS, AHRI, NRDC, and ASHRAE). The comments focused on: (1) condensate collection test procedures, (2) updating incorporations by reference to industry standards, and (3) other test procedure details. Regarding the first issue, commenters generally favored incorporating condensing technology into the test procedure, although some further clarifications were requested. Regarding the second issue, commenters generally favored updating incorporations by reference to more recent industry standards. As part of DOE's overall review of test procedures, these vented home heating equipment amendments include a complete updating of references to industry standards used in the vented home heating equipment test procedure and modifications to the test procedure as necessary. Finally, regarding the third issue, the comments primarily concerned clerical, typographical, and other minor issues present in the existing and proposed test procedures. These issues are discussed in greater detail below.

1. Vented Home Heating Equipment Employing Condensing Technology

DOE considered the possibility of minimizing the test burden by reducing the time required for measuring condensate mass during steady-state conditions. The test procedure section 3.8.1 requires that the measurement of condensate shall be conducted during the thirty-minute period after steady-state conditions have been established.

DOE received comments from four interested parties regarding the order of the condensate collection test procedures for vented home heating equipment. Comments from AHRI, ECS, Intertek, and NRDC were generally in favor of amending the test procedure to account for condensing technology, as the technology results in lower energy use. AHRI and Intertek both questioned the need for separate condensation testing as opposed to combining testing with current steady-state testing to decrease the test burden. (ECS, No. 7 at p.1; NRDC, No. 10 at p.1; Intertek, Public Meeting Transcript, No. 6 at p. 14; AHRI, No. 9 at p.1)

In order to reduce test burden, DOE allows for the measurement of condensate during the establishment of the steady-state conditions (10 CFR part 430, subpart B, App. O, section 3.8.1) rather than after establishing steady-state conditions (10 CFR part 430, subpart B, App. O, section 3.1). DOE investigated the difference in condensate mass collected and the rate of condensate production during the two separate periods (*i.e.,* during the establishment of steady-state conditions and once steady-state conditions have been reached). Based on the comparison of the measurements, DOE has determined that there is no significant difference in the mass of condensate collected or the rate of condensate production during the two separate periods. Therefore, DOE concurs with AHRI and Intertek's comments that the condensation collection may be performed during the steady-state test.

Accordingly, DOE adopts provisions that allow for performance of the steady-state condensate collection test set forth in section 3.8.1 during the steady-state test set out in section 3.1 of the test procedure. DOE amends Appendix O by adding section 3.8.1 to allow the option for condensate measurements either concurrently with or immediately after completion of the steady-state test.

AHRI commented that the margin of error for a measurement of condensate mass ($M_{C,SS}$) should not be more than ±0.5 percent and that section 2 of the existing test procedure should be modified to include this language. (AHRI, No.9 at p.1) DOE agrees with the comment from AHRI as this margin of error for the measurement of condensate mass is consistent with the margin of error provided in the residential furnace and boiler test procedures. DOE is using the language from section 6.6 of ASHRAE 103–2007 for this clarification. DOE placed this phrasing in section 3.8.1 of the new test procedure instead of in section 2.

Empire Comfort Systems and AHRI commented that there is no guidance in the existing test procedure specifying the mode in which to test units, especially condensing units, shipped with multiple control modes. Further, AHRI recommended that DOE add a provision specifying that models that provide consumers with the capability to operate the heater in more than one mode should be tested using the mode that represents the least efficient operation. AHRI specifically mentioned the need for clarification when a unit has a manual mode and a thermostat-controlled, step-modulating mode and stated that the selection of the operational mode for testing affects the AFUE rating. (AHRI, No.9 at p.3; ECS, No. 7 p.2; ECS, Public Meeting Transcript, No. 6, p.18–19)

DOE agrees that a clarification is necessary regarding in which control mode to test when multiple options are present, particularly when a unit is capable of both automatic and manual modes. Automatic mode indicates that the unit has thermostat control and operates using single-stage, two-stage, or step-modulating controls. In manual mode the unit is controlled by the user. Because these appliances are most often operated in automatic mode when both automatic and manual are available, DOE is requiring units capable of both automatic and manual control to be tested according to the provisions in the test procedure for units with automatic mode. DOE added section 2.11 to the test procedure to implement this change.

ECS and AHRI submitted comments in favor of adopting the ASHRAE 103 methodology to determine a default flue gas draft factor (D_F) value for condensing units with no off period flue losses. This method provides the option of testing or assigning a default draft factor of 0.05. (AHRI, No.9 at p.1; ECS, No. 7 at p.1)

DOE agrees to include the option of testing or assigning a default value for the draft factor for units with no measureable off period flue losses. Adopting this provision is in line with the general intent of adopting ASHRAE103–2007 methodologies when appropriate. It also reduces the testing burden by allowing the use of a default factor of 0.05 in some cases.

DOE incorporates a test method based on the use of a smoke stick device to establish the absence of flow through the heat exchanger of vented home heating equipment designed with no measurable airflow through the heat exchanger. This test is used only to determine whether the use of the default draft factor is appropriate (per sections

8.8.3 and 9.10 of ASHRAE 103–2007). This test is not intended to determine the volume of air moving through the heat exchanger. If the test confirms the absence of airflow, then the default draft factor of 0.05 may be used. If the test results indicate the presence of airflow, then the draft factor must be determined either through testing or as specified in Table 1 of 10 CFR part 430, subpart B, Appendix O. DOE has implemented these changes by adding sections 3.6.1 and 3.6.2 to the existing test procedure and modifying sections 4.1.2 and 4.5.2 of the existing test procedure by incorporating certain provisions from sections 8.8.3 and 9.10 of ASHRAE 103–2007.

2. Updating of Industry Reference Standards

ASHRAE commented in favor of the DOE proposal to include by reference ASHRAE 103–2007, as this standard best represents collective industry knowledge and best practices. (ASHRAE, No. 5 at p.1) Because all ASHRAE103–1993 sections referenced in this test procedure are identical to the 2007 version, DOE is incorporating those sections from the ASHRAE 103–2007 in the final rule in order to reference the most current version of the standard.

AHRI commented against the proposed change to section 2.1.3 of the test procedure, which would reference 37.1.1 of UL 896 for installing vented room heaters, because this reference is a standard for oil-fired heaters and makes no improvement to the current test procedure. AHRI stated the current language to use manufacturer's instructions is more appropriate for the overall body of units tested. This approach reflects the variety of oil- and gas-fired appliances and the nature of the testing conducted. (AHRI, No. 9 at p.2; AHRI, Public Meeting Transcript, No. 6 at p.21) DOE agrees that this reference change should not be adopted, but is adopting slight modifications to section 2.1.3 to provide that the unit under test must be installed in accordance with the manufacturer's installation and operations (I&O) manual provided with the unit.

AHRI commented against the proposed change to section 2.3.3 of the existing test procedure, which would reference Table 1 of ASHRAE 103–2007 instead of section 2.2, Table VII, of ANSI Standard Z21.11.1–1974. AHRI proposed instead to reference Table IV of ANSI Z21.86. AHRI's reasoning is that the Z21 series of safety standards are the source documents for general specifications on gases used during the testing of gas-fired appliances, including

Table 1 of ASHRAE 103–1993, which comes from Table XI in ANSI Z21.47. (AHRI, No. 9 at p.2) DOE agrees with this proposal since Z21.86has the advantages AHRI has mentioned. The reference in section 2.1.3 of the final rule is changed to Table IV of ANSI Z21.86.

DOE implements a number of additional changes in this final rule. In most cases, these changes consist of updating incorporations by reference to a more current version of industry standards. These updates allow for new users of the test procedures to execute the DOE test procedures without depending on outdated standards, which may be difficult to obtain.

In some cases, an update incorporates by reference a standard that, in its more current version, includes several of the standards that are incorporated by reference in the existing test procedure and used to be published separately, but are now combined under a new title. One such case is the standard that includes the ANSI standards for wall furnaces, floor furnaces, and room heaters, which were once separate standards but are now combined into a single standard. This new standard is titled, ''Vented Gas-Fired Space Heating Appliances'' and is referred to as ''ANSI Z21.86'' in this final rule. DOE is incorporating by reference ANSI Z21.86–2008 to specify the testing procedures related to circulating air adjustments, found in section 2.5 of the revised DOE test procedure, and location of temperature measuring instrumentation, found in section 2.6.1. In addition, DOE incorporates by reference ANSI Z21.86 to specify the installation instructions for direct vent (section 6.1.3 and figure 6) and non-direct vent (section 8.1.3 and figure 7 or figure 10) wall furnaces. ANSI Z21.86 does not include installation specifications for vented room heaters and vented floor furnaces. Accordingly, as discussed previously, for vented room heaters the manufacturer's recommendations as described in the installation and operations (I&O) manual provided with the units must be used for installation. For vented floor furnaces, the requirement in section 2.1.2 of the current test procedure to install vented floor furnaces for testing as specified in sections 35.1 through 35.5 of UL–729–1976 remains materially unchanged; the updated UL test methods are the same as those in the existing test procedure and reflect the specific installation requirements of each appliance. Although the UL standards typically are used for oil-fired equipment and the ANSI standards typically are used for gas-fired

equipment, in the existing DOE test procedure, where there is no distinction between installation provisions, the UL standards are cited in application to both gas and oil floor furnaces (i.e., section 2.1.2).

DOE incorporates by reference ASHRAE 103–2007 in three locations within the revised test procedure— sections 2.3 Fuel supply, 2.4 Burner adjustments, and 3.2 Jacket loss measurement—in lieu of three older standards incorporated by reference in the existing test procedure. DOE is updating these references to ASHRAE 103–2007 because this standard incorporates industry consensus without the need to depend on other references. It is not materially different from the test method used in the current vented home heating equipment test procedure (i.e., the AFUE test method). All referenced industry standards are listed in 10 CFR 430.3, *Materials incorporated by reference.* DOE concludes that these changes and updates to materials incorporated by reference will neither result in material differences in test results nor increase test procedure burden.

The following is a list of the shorthand titles and full titles of all the referenced standards used in the existing test procedure and those used in this vented home heating equipment test procedure.

Standards Used in the Existing Test Procedures for Vented Home Heating Equipment:

''ANSI Standard Z21.11.1–1974'' means the American National Standard for Gas-Fired Room Heaters.

''ANSI Standard Z21.44–1973'' means the American National Standard for Gas-Fired Gravity and Fan Type Direct Vent Wall Furnaces.

''ANSI Standard Z21.48–1976'' means the American National Standard for Gas-Fired Gravity and Fan Type Floor Furnaces.

''ANSI Standard Z21.49–1975'' means the American National Standard for Gas-Fired Gravity and Fan Type Vented Wall Furnaces.

''ANSI Standard Z91.1–1972'' means the American National Standard for Performance Standards for Oil-Powered Central Furnaces.

''ANSI Standard Z11.182–1965 (R1971) (ASTM D 2156–65 (1970))'' means the standard published by the American Society of Testing and Materials titled, ''Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels.''

''UL 729–1976'' means the Underwriters Laboratories standard for Oil-Fired Floor Furnaces.

''UL 730–1974'' means the Underwriters Laboratories standard for Oil-Fired Wall Furnaces.

''UL 896–1973'' means the Underwriters Laboratories standard for Oil-Burning Stoves.

Standards Used in the Amended Test Procedure for Vented Home Heating Equipment:

''ANSI/ASHRAE Standard 103–2007'' means the test standard published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers titled, ''Method of Test for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.''

''ANSI Z21.86–2008'' means the standard published by the American National Standards Institute titled, ''Vented Gas-Fired Space Heating Appliances.''

''ASTM D2156–09'' means the standard published by the American Society of Testing and Materials titled, ''Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels.''

''UL 729–2003'' means the test standard published by the Underwriters Laboratory, Inc. titled, ''Standard for Safety for Oil-Fired Floor Furnaces.''

''UL 730–2003'' means the test standard published by the Underwriters Laboratory, Inc. titled, ''Standard for Safety for Oil-Fired Wall Furnaces.''

3. Other Issues

AHRI and ECS commented on three typographical errors. First, in the October 2013 NOPR, the denominator of the equation for $L_{C,SS}$ in section 4.1.6.2 and the denominator of the equation for L_C in section 4.1.6.4 were supposed to read ''1053.3'' but instead read ''1053'' and the missing ''.3'' was erroneously placed at the end of the equation. Second, the variable C_{T*} had been replaced with the number ''100'' in the $M_{S,OFF}$ and $M_{F,OFF}$ equations in 4.3.3 and 4.5.1in the existing test procedure. Finally, values for D_S for system numbers 9 through 12 were omitted in Table 1 from the existing test procedure. (AHRI, No.9 at p.2; AHRI, Public Meeting Transcript, No. 6, p.27; ECS, No. 7 p.1–2; ECS Public Meeting Transcript, No. 6, p.17) DOE recognizes the errors as clerical. DOE found that the first error resulted from the conversion to publishing format and that the error is not present in the original document. DOE has corrected this error and to prevent future errors, DOE will submit equations as images and request the printing office review the document before publication. Regarding the second error, although C_{T*} equals 100 when the tracer gas is a single component gas, this is not always the case. Thus, DOE agrees that the ''100'' term should be ''C_{T*}'' to account for instances when the tracer gas is not a single component gas. DOE notes that this is consistent with the text following the equation. Regarding the third error, there is no value given for D_S for system numbers 9 through 12 as these systems are direct vent systems to which D_S does not apply. The value is intentionally omitted from subsequent calculations and has been changed to ''0'' for clarity.

ECS commented that the ANSI Z21.86, incorporated by reference in the revised test procedure, does not provide detailed information about the appropriate positioning of thermocouple(s) for measuring the flue exhaust temperature. (ECS, No. 7 p.1; ECS, Public Meeting Transcript, No. 6, p.22) DOE disagrees. These details are in section 2.6 of the existing test procedure.

ECS and AHRI submitted comments in favor of DOE's proposal to include the option to set a jacket loss value for vented floor furnaces at a default of one percent in lieu of testing. (AHRI, No.9 at p.2; ECS, No. 7 p.1) DOE is generally in favor of simplifying the test procedure where results would not be affected. In this case, DOE's testing revealed an average jacket loss of 3.05 percent with a standard deviation of 0.45 percent. DOE concluded from this testing that the proposed default jacket loss value of one percent for vented floor furnaces, while consistent with industry practices for other equipment, is too low for this product. However, adopting a higher default jacket loss value would significantly affect AFUE. Therefore, DOE does not introduce an optional default jacket loss value for vented floor furnaces and continues to require testing as described in section 3.2 of the existing test procedure.

Intertek and AHRI submitted comments in favor of removing the requirement to install simulated walls and floors for performance testing of floor furnaces. The comments argue that these requirements are driven by safety concerns and have no effect on the efficiency ratings, so removing the requirement will reduce test burden. (AHRI, Public Meeting Transcript, No. 6, p.23–25; Intertek Public Meeting Transcript, No. 6, p.23–25) DOE rejects this suggestion primarily because DOE has no data to confirm that the performance testing is not affected by the added walls and floors. Furthermore, in DOE's view, any decrease in test burden resulting from elimination of this requirement would be minimal. Manufacturers are already required to install these simulated floors and walls during safety testing. As a result, any decrease in test burden would affect only a small group of independent laboratories, if any, that only conduct performance testing and thus may not have an existing setup. Therefore, DOE is retaining these requirements in the test procedure.

DOE corrected other typographical errors that are present in the existing test procedure. In the equation in section 4.3.6 of appendix O, DOE has (1) added a missing minus (''-'') sign immediately to the right of the ''C_jL_j''; (2) replaced the plus (''+'') sign between the two bracketed parts of the equation with a multiplication (''X'') symbol; and (3) replaced the second ''$L_{s,OFF}$'' in the second bracketed part of the equation with ''$L_{I,OFF}$''. In section 4.1.15, DOE corrects ''equFipped'' to read ''equipped'' and corrects ''therostats'' to read ''thermostats.'' In section 4.1.8, DOE corrects ''drafthood'' to read ''draft hood.'' These and other typographical errors have been corrected in this final rule document. These errors are obviously typographical in nature, because similar efficiency equations in other parts of the test procedure, as well as those used in industry standards, do not include these errors. The relevant industry groups have determined the correct format of this equation since its adoption and have been utilizing the correct format when testing and rating product efficiency.

Another issue that was identified during DOE's review is the lack of a defining equation in the calculation procedures for manually controlled vented heaters in section 4.2.4 of the existing test procedure. To correct this omission, DOE adds an equation describing the weighted average steady-state efficiency (η_{SS-WT}) in terms of the latent and sensible losses to section 4.2.4.1.

DOE identified several additional sections of the existing test procedure that require clarification. Section 2.9 states, ''maintain the room temperature within ± 5 °F (±2.8°C) of the value T_{RA} measured during the steady-state performance test.'' However, while section 3.1.1 and 3.1.2 explain to establish steady state using three successive readings of the stack or flue gas temperature taken 15 minutes apart, it does not indicate at what time the variable T_{RA} is established (or whether it is an average). DOE clarifies that while the room temperature must be continuously monitored in order to meet the conditions specified in section 2.9, T_{RA} is to be measured in coincidence with the third of the three successive 15-minute interval readings of the stack or flue gas temperatures

taken during the steady-state tests (sections 3.1.1 and 3.1.2). Likewise, the measurement of additional variables ($T_{S,ss}$, X_{CO2S}, $T_{F,ss}$, X_{CO2F}) described in section 3.1 are to coincide with the third of these three successive 15-minute interval readings.

DOE also identified that the requirements in section 2.9 for combustion air and draft relief air temperatures require clarification. Section 2.9 states that the ''temperature of the air for combustion and the air for draft relief shall not differ more than ± 5 °F from room temperature as measured above.'' DOE clarifies that this means these temperatures shall not differ more than ± 5 °F from the room ambient temperature at any point in time; it does *not* mean ± 5 °F with respect to the measurement T_{RA}. DOE also clarifies that this requirement for the combustion air does not apply during the cool-down tests of sections 3.3 and 3.6. These tests are conducted during shut-down of the unit, when maintaining requirements for combustion air temperatures are unnecessary.

DOE clarifies in sections 4.1.2 and 4.1.3 that the flue and stack draft factors may be obtained through the test method and calculations in sections 3.6 and 4.5, respectively, or by using the appropriate default factors from Table 1.

The final issue identified by DOE was to clarify the applicability of the testing and calculation method in sections 3.3 and 4.3 (tracer gas method) for units without a thermal stack damper. The test procedure currently prescribes that units without thermal stack dampers be rated using the calculation method in section 4.1 or 4.2 depending on the control type. Section 4.3 incorrectly states that as an optional procedure all vented heaters without thermal stack dampers can elect to use the AFUE calculation method described in 4.3.

DOE reviewed the use of the tracer gas method as described in 4.3 for units without thermal stack dampers. DOE believes manufacturers do not use the tracer gas method to test units without thermal stack dampers and do not use such testing results to calculate the AFUE for such units. In previous rulemakings for vented home heating equipment, DOE did not receive public comments regarding the applicability of section 4.3, and DOE has not received waiver requests that would indicate that there are any instances in which the calculation methods of 4.1 cannot be used for units without thermal stack dampers, suggesting that an alternative test method is unnecessary for these units.

DOE performed testing on several representative units to determine the applicability of sections 4.1, 4.2, and 4.3 to units with and without stack dampers. The AFUE values were generated twice for each unit, once using the results from the tracer gas method, and once using the calculation method in 4.1 (for units equipped without manual controls or thermal stack dampers) or 4.2 (for models equipped with manual controls). The results are presented in Table 3.1 below and show an average 2.6 percent higher AFUE when using the tracer gas method in section 4.3 as opposed to the calculation method in 4.1.

TABLE 3.1—DIFFERENCE IN AFUE IN UNITS OF VENTED HOME HEATING EQUIPMENT WHEN TESTED USING TRACER GAS METHOD AND STANDARD METHOD

	Difference in AFUE
Unit A	3.3
Unit B	3.2
Unit C	1.2

The sign of the AFUE change is consistent with the operation of the system with the stack damper removed or forced open because the flue gases would more freely move with the damper open resulting in higher loss. This fundamental design difference along with the differences in AFUE values from the testing show that the calculation methods are not equivalent and so only one should be allowed for each design.

Further, 10 CFR 430.23, Test procedures for the measurement of energy and water consumption, states clearly that the tracer gas calculation method in section 4.3 applies to ''vented heaters equipped with thermal stack dampers,'' and that section 4.1 applies to vented heaters ''without either manual controls or thermal stack dampers.'' Thus, DOE considers this a clarification of, rather than a modification to, the current test procedure.

For the reasons described previously, DOE clarifies that the optional use of the tracer gas method does not apply to units without thermal stack dampers. DOE has determined this clarification will not impose any additional burden on manufacturers, since units without thermal stack dampers are already commonly rated using the calculation method in 4.1 or 4.2. Moreover, DOE has determined that disallowing the tracer gas method for units without thermal stack dampers will not affect

efficiency ratings, since it is highly unlikely that manufacturers have rated units without thermal stack dampers using the tracer gas test method previously.

D. Test Procedure for Pool Heaters

DOE's existing test procedure for pool heaters is found at 10 CFR 430.23(p) and 10 CFR part 430, subpart B, appendix P (existing test procedure).

In its definition of ''efficiency descriptor,'' EPCA specifies that for pool heaters, the efficiency descriptor shall be ''thermal efficiency'' (42 U.S.C. 6291(22)(E)). Current energy conservation standards for pool heaters do not account for standby mode and off mode energy use. As part of a recent test procedure rulemaking, DOE prescribed a new efficiency metric for pool heaters, titled ''integrated thermal efficiency.'' 77 FR 74559 (Dec. 17, 2012). This prescribed integrated thermal efficiency (TE_I) metric builds on the existing thermal efficiency metric to include electrical energy consumption during standby mode and off mode operation, as required by EISA 2007. (42 U.S C. 6295(gg)(2)(A))

Because certain types of pool heaters are powered by energy sources other than gas, DOE requested comments in the October 2011 RFI regarding the appropriateness of prescribing the currently incorporated ANSI Z21.56 test method, titled ''Gas-Fired Pool Heaters,'' for testing pool heaters that operate with electricity (including electric heat pump pool heaters) or oil. 76 FR 63211, 63215–16 (Oct. 12, 2011). In the October 2011 RFI, DOE tentatively concluded that the test procedure for pool heaters at 10 CFR part 430, subpart B, appendix P already contains provisions to allow the ANSI Z21.56 test method to be applied to oil-fired pool heaters, and, therefore, no further action is necessary for those products. DOE received no comments that were contrary to this conclusion.

Prior to the October 2011 RFI, in a December 2009 NOPR for energy conservation standards for heating products, DOE concluded that, as currently drafted, the DOE test procedure for pool heaters is not suitable for measuring energy efficiency for electric pool heaters (including electric heat pump pool heaters). 74 FR 65852, 65866–67 (Dec. 11, 2009). In the October 2011 RFI, DOE noted that for electric pool heaters (including those units using electric heat pump technology), the fuel source is electricity (measured in watts) instead of gas (measured in Btu/h), but ''thermal efficiency,'' as required under EPCA and determined using ANSI Z21.56, is a

measure of heat delivered to the water at the heater outlet (in Btu/h) divided by the heat input (in Btu/h) of the fuel. 76 FR 63211, 63215 16 (Oct. 12, 2011). It is technologically feasible to develop an integrated thermal efficiency rating for an electric heat pump pool heater by converting the power input in watts to the input in Btu/h (which can be done for both the power used during active mode and the power used during standby mode and off mode).

Currently, electric heat pumps for space heating are typically rated using industry standards for coefficient of performance (COP). DOE notes that when an integrated thermal efficiency metric as described above is applied to electric heat pump pool heaters, the calculated results are efficiency ratings of more than 100 percent. This may necessitate some reeducation among consumers to alleviate any confusion resulting from changing labeling from COP to integrated thermal efficiency. Furthermore, the test procedure still includes provisions for calculating heat pump pool heater COP. Another consideration for electric heat pump pool heaters is that performance depends upon the ambient temperature and humidity, so environmental conditions for testing are much more important for electric heat pump pool heaters than for gas-fired pool heaters, oil-fired pool heaters, or electric resistance pool heaters.

In response to the October 2013 NOPR and during the December 2013 public meeting, DOE received comments from four interested parties (Raypak, AHRI, NRDC, and CWTO). The comments focused primarily on the inclusion of electric resistance and electric heat pump pool heaters into the pool heater test procedure. The main issues of concern stem from implementing common metrics over all pool heater types. More specifically, the base operating hours, efficiency metrics, and different features of electric resistance and electric heat pump pool heaters as compared to traditional gas fired pool heaters drew comments and discussion.

1. Electric Pool Heaters

AHRI commented that the nomenclature in the proposed subsection 1.6, 'Hybrid Pool Heater,' in which the term 'hybrid' refers to a combination gas and electric pool heater, may cause confusion because hybrid is already used to refer to an electric heat pump for other product classes. (AHRI, Public Meeting Transcript, No. 6 at p. 33–34) DOE found that the term hybrid most commonly refers to pool heaters that use solar energy in conjunction with a

traditional gas or electric pool heater. In addition, certain electric heat pump pool heaters and combination electric heat pump and electric resistance heating pool heaters are referred to as hybrid heat pumps. DOE reviewed this issue and found that appliances that used the term hybrid or a variant of it have relatively low market penetration. Furthermore, other appliances that use the term ''hybrid,'' or a variant of it, generally have an additional qualifier such as ''hybrid solar pool heater'' or ''hybrid heat pump.'' Given that gas pool heaters and electric heat pump pool heaters comprise the large majority of pool heaters today, DOE believes that 'hybrid pool heater' is an intuitive name for a pool heater that combines the functionality of gas and electric heat pump pool heaters. Therefore, DOE is adopting this nomenclature.

In response to DOE's proposal to introduce the integrated thermal efficiency metric as an efficiency descriptor for pool heaters, Raypak commented that implementing a new metric has the potential to confuse customers and will create a significant burden on pool heater manufacturers, which are primarily small business entities. In addition, Raypak commented that thermal efficiency does not address energy prices. (Raypak, No. 8 at pp. 1–2)

DOE believes that the confusion to customers caused by the introduction of the new integrated thermal efficiency metric should be minimal, as other parameters such as COP can continue to be used in the manufacturers' literature if such parameters are determined pursuant to the applicable DOE test procedure. DOE does not believe that implementing the integrated thermal efficiency metric represents an undue burden on manufacturers. The integrated thermal efficiency metric incorporates the COP as determined by the current industry standard AHRI 1160 and therefore changes in test set-up or methods will be minimal. Also, DOE does not recognize the changes in labeling as unduly burdensome. DOE agrees that the new integrated thermal efficiency metric does not directly address energy price. However, it is DOE's intent for this metric to provide information about the unit's efficiency, not overall cost to the consumer. Therefore, DOE is not incorporating energy price into the integrated thermal efficiency metric.

AHRI and Raypak commented that the current burner operating hour (BOH) value of 104 hours is inappropriate for this test procedure as it is specific to gas-fired pool heaters. They further state that the current BOH value does not

apply to heat pump pool heaters because of typical industry sizing conventions, which are that gas-fired pool heaters have a significantly higher heating capacity than heat pump pool heaters sized for the same pool. (AHRI, No. 9 at p. 3; Raypak, No. 8 at p. 1)

Regarding the use of an average burner operating hours (BOH) value of 104 hours, DOE understands that the output capacity of the pool heater is typically selected based on the specific pool characteristics, namely pool size (surface area) and the ambient conditions.[5] DOE found that some pool heater sizing conventions list similar sizing guidelines for both gas-fired[6] and electric heat pump[7] pool heaters. Therefore, if a pool heater's output capacity is properly selected relative to the pool's load requirement, then the actual burner operating time will be similar whether gas-fired or electric. Therefore, DOE is not changing the BOH value for electric heat pump pool heaters.

AHRI commented that the integrated thermal efficiency metric is not appropriate for many reasons, including, primarily, that standby mode and off mode energy consumption in pool heaters provides no heating benefit and distorts the relevance of thermal efficiency ratings. AHRI also provided potential alternatives, such as using heating seasonal efficiency ($EFFY_{HS}$) or simply modifying the existing average annual electrical energy consumption (E_{AE}) calculation. (AHRI, No. 9 at pp. 5–6)

EPCA requires DOE to include the standby energy consumption in the existing metrics unless ''such an integrated test procedure is technically infeasible.'' (42 U.S.C. 6295(gg)(2)(A)) Previous test procedures also accounted for the standby energy consumption for pool heaters with continuous pilot lights in the $EFFY_{HS}$ term. However, $EFFY_{HS}$ is not appropriate as a naming convention for the new metric because it is specific to the heating season and the new metric also includes non-heating season effects.

AHRI's suggestion to modify the E_{AE} calculation is consistent with the test procedure in this final rule. The standby

[5] *See* Dep't of Energy, Heat Pump Swimming Pool Heaters (May 29, 2012), *http://energy.gov/ energysaver/articles/heat-pump-swimming-pool- heaters* Dep't of Energy, Gas Swimming Pool Heaters (June 10, 2014), *http://energy.gov/ energysaver/articles/gas-swimming-pool-heaters.*

[6] *See* In the Swim, Calculating Approximate Heater Size, *https://www.intheswim.com/landing/ whichsizeheater.aspx.*

[7] *See* AquaCal, How Can I Size My Swimming Pool Heat Pump? (July 22, 2013), *http:// www.aquacal.com/blog/post/127-How-Can-I-Size- My-Swimming-Pool-Heat-Pump-.*

and off mode electrical energy is accounted for in $E_{AE,Standby,off}$, which is a component of E_{AE}. However, E_{AE} does not include fuel energy consumption and is therefore not a comprehensive energy efficiency metric for all pool heaters. The TE_I metric is a more complete representation of the energy efficiency of pool heaters because it includes both fuel and electricity energy consumption.

AHRI also commented that the new integrated thermal efficiency metric cannot be used for sizing. (AHRI, No. 9 at pp. 3–6) DOE agrees that pool heaters should not be sized based on integrated thermal efficiency. Instead, pool heaters should be sized based on the pool heater capacity and the thermal efficiency (E_T), which is part of this test procedure, and can continue to be used for sizing. DOE also points out that the industry can use thermal efficiency in addition to integrated thermal efficiency when communicating marketing and sizing information to consumers.

AHRI further commented that prescribing TE_I as the new energy efficiency metric will impose an enormous and needless burden on manufacturers and disrupt the marketplace. (AHRI, No. 9 at pp. 3–6) DOE believes that the additional testing burdens of measuring standby are minimal. Specifically, the test procedure specifies monitoring the standby energy consumption for an additional 60 minutes using the existing set-up for other parts of the test procedures. In addition, AHRI commented that they recognize the 2007 amendments to EPCA allow DOE latitude and discretion to prescribe a separate test procedure to determine standby mode and off mode energy use, as well as a separate energy conservation standard for standby mode and off mode energy consumption. AHRI further interprets this to mean there is no mandate that DOE must integrate the standby and off mode consumption into the thermal efficiency, citing Sections 325(gg)(3)(B) and Subsection 325(gg)(2)(A)(ii). Lastly, AHRI suggested the possibility of using an annual consumption metric as a replacement for thermal efficiency. (AHRI, No. 9 at p. 5)

DOE reviewed this issue and reaffirms that in its definition of "efficiency descriptor," EPCA specifies that the efficiency descriptor for pool heaters shall be "thermal efficiency." (42 U.S.C. 6291(22)(E)) EPCA requires DOE to include the standby energy consumption in the existing metrics unless "such an integrated test procedure is technically infeasible." (42 U.S.C. 6295(gg)(2)(A)) DOE has the

option to create a separate standard for standby and off mode consumption only if incorporation into a standard is "not feasible." (42 U.S.C. 6295(gg)(3)(B)) In the case of pool heaters, DOE determined that it is technically feasible to measure standby and off mode consumption and incorporate those measurements into the thermal efficiency metric.

CWTO submitted two comments that concern the inclusion of electrical power (PE) in the seasonal useful output (E_{OUT}) equation. CWTO questioned applying thermal efficiency to rated fuel input capacity and electrical power in section 5.4.3 of the pool heater test procedure. CWTO stated that if E_{OUT} was only based on absorbed heat it would be more intuitive. (CWTO, No 11 at p.3) It is DOE's position that for all pool heaters, contrary to some other appliances, the electrical components in active mode provide useful energy that justifies including them into that equation in addition to the more familiar Q_{IN}. This is true for both gas-fired and electric pool heaters. In addition, because these components are present and active during thermal efficiency testing, including their energy use in the overall integrated thermal efficiency is necessary. This formulation also allows for the integration of standby and off mode energy consumption into the metric. Finally, this formulation applies equally to gas-fired, oil-fired, electric resistance, and electric heat pump pool heaters.

Through this final rule, DOE adds test methods that apply to electric heat pump and electric resistance pool heaters. DOE amends its pool heater test procedure by adding a test method for electric heat pump pool heaters that references AHRI Standard 1160–2009, "Performance Rating of Heat Pump Pool Heaters," and ANSI/ASHRAE Standard 146–2011, "Method of Testing and Rating Pool Heaters." In addition, DOE amends its pool heater test procedure by adding a test method for electric resistance pool heaters that references ASHRAE146. DOE concludes that incorporation of these industry test standards is appropriate as they represent current best practices for these pool heater products.

Although DOE prescribes amended test procedures in this final rule, manufacturers are not required to certify compliance for electric heat pump and electric resistance pool heaters until such time as DOE sets minimum energy conservation standards for those products (which would include energy consumption in active, standby, and off modes). Prior to DOE setting energy conservation standards for electric heat

pump and electric resistance pool heaters, any representations as to the energy efficiency or energy use of those products made after 180 days after the publication of this test procedure final rule must be based on this amended test procedure. Manufacturers of electric heat pump pool heaters may use the COP metric as measured by the DOE test procedure being adopted in this final rule in addition to the integrated thermal efficiency metric for making efficiency representations.

2. Other Issues

In addition to the changes for electric pool heaters described in the previous section, DOE also clarifies that the DOE test procedure is applicable to oil-fired pool heaters, despite the incorporation of a test method (ANSI Z21.56) titled "Gas-Fired Pool Heaters." Section 4.1.1 of that test method contains a provision to compute the energy used when oil is the fuel, as opposed to natural gas. In addition, DOE is clarifying the definition of the equilibrium term used in the active mode thermal efficiency testing. This clarification has been inserted into section 2.1 of existing test procedure, as listed in the regulatory text. Finally, DOE has added clarifications regarding burner input rate error, equilibrium conditions, water temperature rise, seasonal off switch, and recirculating pump to the existing test procedure as listed in the regulatory text.

E. Compliance With Other EPCA Requirements

As mentioned in the preamble at section II, in amending a test procedure, EPCA directs DOE to determine to what extent, if any, the amended test procedure would alter the measured energy efficiency or measured energy use of a covered product as determined under the current test procedure. (42 U.S.C. 6293(e)(1)) The current energy conservation standards for vented home heating equipment and pool heaters are based on existing test procedure efficiency metrics—AFUE and thermal efficiency (E_t), respectively.

The test procedure amendments for vented home heating equipment in this final rule do not contain changes that will alter the measured energy efficiency of equipment. Rather, the changes represent either clarifications that would improve the uniform application of the test procedures for certain product types or provisions to cover new product types. Any change in the reported efficiency of currently covered products that might be associated with these clarifications is expected to be *de minimis.*

Consistent with 42 U.S.C. 6293(c), any representations of energy consumption of vented home heating equipment must be based on any final amended test procedures no later than 180 days after the publication of the test procedure final rule in the **Federal Register.** Until that time, manufacturers must make such representations based either on the final amended test procedure or on the previous test procedure, set forth at 10 CFR part 430, subpart B, appendix O as contained in 10 CFR parts 200 to 499 edition revised as of January 1, 2014. Consistent with 42 U.S.C. 6291(8), representations of energy consumption includes representations regarding the measures of energy use (including, for this product, active mode, standby mode, and off mode energy use), annual operating cost, energy efficiency (including, for this product, AFUE), or other measure of energy consumption. DOE notes that manufacturers must use the same test procedure for all representations of energy efficiency, including certifications of compliance.

This final rule does not include any changes to the current standby mode and off mode testing procedures and calculations for vented home heating equipment as established in the December 2012 final rule. 77 FR 74559 (Dec. 17, 2012). Although fossil fuel standby mode and off mode energy consumption were already captured in the existing AFUE metric, the December 2012 final rule required manufacturers to use the new test procedures for determining electrical standby mode and off mode energy consumption in Appendix O beginning on June 17, 2013. Certifications of compliance with the electrical standby mode and off mode energy consumption standards are not required until the compliance date of DOE standards that include electrical standby mode and off mode energy consumption.

The test procedure amendments in this final rule for pool heaters do not alter the measured efficiency of equipment covered by the existing test procedure. This final rule provides a new test method for electric resistance and electric heat pump pool heaters. However, electric resistance and electric heat pump pool heaters are not currently subject to energy conservation standards by DOE. Therefore, DOE has concluded that there is no need to address the impact of these amendments on current energy conservation standards for pool heaters.

Consistent with 42 U.S.C. 6293(c), any representations of energy consumption of pool heaters must be based on any final amended procedures and calculations in appendix P starting 180

days after the publication of any final amended test procedures in the **Federal Register.** Until that time, manufacturers of gas-fired and oil-fired pool heaters may make such representations based either on the final amended test procedures or on the previous test procedures, set forth at 10 CFR part 430, subpart B, appendix P as contained in the 10 CFR parts 200 to 499 edition revised as of January 1, 2014. Consistent with 42 U.S.C. 6291(8), representations of energy consumption include representations of measures of energy use (including for this product, active mode, standby mode, and off mode energy use), annual operating cost, energy efficiency (including for this product, thermal efficiency (E_t), or integrated thermal efficiency (TE_I)), or other measure of energy consumption. Again, DOE notes that manufacturers must use the same test procedure for all representations of energy efficiency, including certifications of compliance.

There are currently no energy conservation standards for electric resistance pool heaters, electric heat pump pool heaters, or oil-fired pool heaters. Upon the compliance date of any final energy conservation standards for these types of pool heaters, use of any final test procedures in appendix P will be required to demonstrate compliance. There are also currently no energy conservation standards for the standby mode and off mode energy use of gas-fired pool heaters. Upon the compliance date of any energy conservation standards that incorporate standby mode and off mode energy consumption for gas-fired pool heaters (*i.e.,* for this product, a standard expressed as integrated thermal efficiency (TE_I)), use of any final test procedures in appendix P will be required to demonstrate compliance.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

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

B. Administrative Procedure Act

Pursuant to the decision in *Hearth, Patio & Barbecue Ass'n* v. *U.S. Dep't of Energy,* 706 F.3d 499 (D.C. Cir. 2013),

DOE removed the definition of "vented hearth heater" from 10 CFR 430.2 to reflect the Court's order vacating the regulatory definition of "vented hearth heater." 79 FR 43927 (July 29, 2014). As such, in this final rule, DOE is removing the cross references to "vented hearth heater" from the definition of "vented home heating equipment" at 10 CFR 430.2. DOE has determined, pursuant to 5 U.S.C. 553(b)(B), that prior notice and an opportunity for public comment on this final rule are unnecessary. DOE is not exercising any of the discretionary authority that the Congress has provided to the Secretary of Energy in EPCA. DOE, therefore, finds that good cause exists to waive prior notice and an opportunity to comment for this rulemaking.

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.,* as amended by the Small Business Regulatory Enforcement Fairness Act of 1996) requires preparation of an initial regulatory flexibility analysis (IFRA) for any rule that by law must be proposed for public comment and a final regulatory flexibility analysis (FRFA) for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative effects. Also, as required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site at: *www.energy.gov/ gc.*

This final rule amends DOE's test procedures that will be used to determine compliance with energy conservation standards for vented home heating equipment and pool heaters. For vented home heating equipment, the amendments add provisions for testing models that utilize condensing technology and incorporate by reference the most appropriate or recent versions of several industry standards referenced in the DOE test procedure for the purposes of test set-up and installation specifications. For pool heaters, the amendments incorporate by reference

AHRI 1160 and ASHRAE 146 to establish testing procedures for electric (including electric heat pump) pool heaters. The amendments for pool heaters also clarify the test procedure's applicability to oil-fired pool heaters. DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003. 68 FR 7990.

1. Reasons for, Objectives of, and Legal Basis for the Final Rule

The reasons for, objectives of, and legal basis for the final rule are stated elsewhere in the preamble and are not repeated here.

2. Description and Estimated Number of Small Entities Regulated

For the manufacturers of the covered products, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30848–49 (May 15, 2000), as amended at 65 FR 53533, 53544–45 (Sept. 5, 2000) and codified at 13 CFR part 121. The SBA size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/idc/ groups/public/documents/sba_ homepage/serv_sstd_tablepdf.pdf.* Vented home heating equipment and pool heater manufacturing are classified under NAICS 333414—''Heating Equipment (except Warm Air Furnaces) Manufacturing.'' The SBA sets a threshold of 500 employees or less for an entity to be considered as a small business for both of these categories.[8]

To estimate the number of companies that could be small business manufacturers of products covered by this rulemaking, DOE conducted a market survey using available public information to identify potential small manufacturers. DOE's research involved reviewing several industry trade association membership directories (*e.g.,* AHRI [9]), product databases (*e.g.,* AHRI [10] and CEC [11] databases), individual company Web sites, and

marketing research tools (*e.g.,* Hoovers [12] reports) to create a list of all domestic small business manufacturers of heating products covered by this rulemaking. DOE identified 2 manufacturers of vented home heating equipment and 5 manufacturers of pool heaters (including electric heat pump pool heater manufacturers) that can be considered small businesses.

3. Description and Estimate of Compliance Requirements

a. Vented Home Heating Equipment

DOE amends its test procedure for vented home heating equipment to incorporate by reference the most recent or appropriate version of six industry standards to replace the outdated standards referenced in the existing DOE test procedure as described in section III. C.2. of this document. These updates result in no material change to DOE's test procedure for vented home heating equipment.

In addition, DOE amends the test procedure to include a test method to determine the AFUE of vented home heating equipment that use condensing technology. The AFUE test method may add a modest cost to testing for manufacturers of such products. The test can be conducted in the same test facility and simultaneous to the former AFUE test requirements, but some additional testing and calculation is required to accurately determine AFUE. Specifically, this test procedure requires a condensate collection test to be conducted on vented heaters utilizing condensing technologies. The duration of the condensate collection test time would be 30 minutes for steady-state testing, if conducted subsequent to all other steady-state testing and 1–2 hours for cyclic testing. In some cases, only steady-state testing is required (*i.e.,* all manually-controlled vented heaters and those vented heaters not utilizing the optional tracer gas procedures). In such cases, the condensation test provisions would not require any additional time because the test procedure allows for the condensate collection to be conducted simultaneously with the other steady-state test requirements of section 3.1. Vented home heaters are tested utilizing the optional tracer gas procedures and are required to conduct both steady-state and cyclic condensate collection procedures. DOE estimates that the additional testing for condensing units adds a maximum of three hours to the AFUE test. DOE estimates that lab technicians on average, are paid at a rate of $27.50 per

hour.[13] Therefore, DOE estimates the added cost will be a maximum of $82.50 per test unit, which is modest in comparison to the overall cost of product development and certification.

b. Pool Heaters

DOE amends its test procedure for pool heaters to adopt provisions for testing electric pool heaters, including electric heat pump pool heaters. In addition, DOE amends the test procedure to incorporate by reference AHRI 1160 and ASHRAE 146 for both electric resistance and electric heat pump pool heaters. These pool heaters are not currently regulated by DOE, but DOE's research showed that all identified domestic small business manufacturers of electric heat pump pool heaters already rate COP and capacity according to the rating conditions specified in AHRI 1160 and typically at an additional rating point outside of the AHRI 1160 test conditions. In addition, DOE notes that ANSI/ASHRAE Standard 90.1–2010 contains efficiency levels for electric heat pump pool heaters and specifies AHRI 1160 as the test method. Several States (*e.g.,* Florida, California) also have minimum efficiency requirements for electric heat pump pool heaters, which is another factor that may drive manufacturers to rate their products for efficiency. Because manufacturers of electric heat pump pool heaters are already rating their products using AHRI 1160 due to the ANSI/ASHRAE Standard 90.1–2010 requirements and State efficiency requirements, DOE does not believe that including an electric heat pump pool heater test method that references the industry standard will cause significant, if any, additional burden to manufacturers. The additional burdens for measuring standby consist of one 60 minute period where the electricity use is metered. For a technician making an average of $37.50 per hour, this results in an added cost of $37.50, which is not significant in comparison to the overall cost of product development and certification.

For electric resistance pool heaters, the test method in ASHRAE 146—is comparable to that for gas-fired and oil-fired pool heaters in the existing DOE test method. Since the new test method in this final rule is essentially the same as the existing test method used by the industry and incorporated by reference, it is not expected that the new rule will add to the burden of manufacturers of electric resistance pool heaters.

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[8] In the December 2009 NOPR, DOE mistakenly listed gas-fired pool heater manufacturing under NAICS code 335228. 74 FR 65852, 65984 (Dec. 11, 2009). The correct classification for pool heater manufacturing is NAICS 333414. Both NAICS categories have the same 500 employee limit.

[9] See *http://www.ahrinet.org/ahri+members.aspx.*
[10] See *http://www.ahridirectory.org/ahriDirectory/ pages/home.aspx.*
[11] See *http://www.appliances.energy.ca.gov/.*

[12] See *http://www.hoovers.com/.*

[13] ''Lab Technician Salary.'' *Job Search.* N.p., n.d. Web. 22 Aug. 2014. *http://www.indeed.com/salary/ Lab-Technician.html.*

4. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the rule being adopted today.

5. Significant Alternatives to the Rule

As noted earlier in the preamble, this rule is largely based upon the industry testing procedures already in place for vented home heating equipment and pool heaters. DOE believes the amendments will be useful for both consumers and industry, and are consistent with the Department's goals and statutory requirements, while also minimizing the economic burden on manufacturers. After a full review of the test procedure and comments received from the NOPR and public meeting, DOE has incorporated changes to the vented home heating equipment test procedure as discussed in section III. and listed in the regulatory text, including adding a condensation collection test, adding a test to determine default draft factor eligibility, and updating references to the most recent or appropriate version. DOE has incorporated changes to the pool heater test procedure as listed in the regulatory text including adding test provisions for electric resistance and electric heat pump pool heaters and incorporating a new metric, integrated thermal efficiency, which incorporates standby losses. DOE has determined that there is no further need for alternative test methods for this test procedure.

D. Review Under the Paperwork Reduction Act of 1995

Manufacturers of vented home heating equipment and pool heaters must certify to DOE that their products comply with all applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for vented home heating equipment and pool heaters, including any amendments adopted for those test procedures, on the date that compliance is required. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including vented home heating equipment and pool heaters. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public

reporting burden for the certification is estimated to average 30 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

E. Review Under the National Environmental Policy Act of 1969

In this final rule, DOE is amending the test procedure that it expects will be used to develop and implement future energy conservation standards for vented home heating equipment and pool heaters. 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 final rule amends 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.

F. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 10, 1999), imposes certain requirements on Federal 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 final rule and has determined that it will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

G. 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. Regarding the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this final rule meets the relevant standards of Executive Order 12988.

H. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires

each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For regulatory actions 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 ''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 them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. (This policy is also available at *www.gc.doe.gov/gc/ office-general-counsel.*) This final rule, which modifies the test procedures for vented home heating equipment and for pool heaters, contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more in any year. Accordingly, no further assessment or analysis is required under UMRA.

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

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This final rule concerning test procedures 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.

J. Review Under Executive Order 12630

Pursuant to Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (March 18, 1988), DOE has determined that this final rule will not result in any takings that might

require compensation under the Fifth Amendment to the U.S. Constitution.

K. 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 Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed this final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

L. 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 OIRA at OMB, a Statement of Energy Effects for any significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates 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.

This regulatory action to amend the test procedure for measuring the energy efficiency of vented home heating equipment and pool heaters is not a significant regulatory action under Executive Order 12866 or any successor order. Moreover, it will 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 for this rulemaking.

M. 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 *et seq.*), DOE must comply with all laws applicable to the former Federal Energy Administration, including section 32 of the Federal Energy Administration Act of 1974 (Pub. L. 93–275), as amended by the Federal Energy Administration Authorization Act of 1977 (Pub. L. 95–70). (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.

This final rule incorporates testing methods contained in the following commercial standards: (1) ANSI/ASHRAE Standard 103–2007, ''Method of Test for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers''; (2) ANSI Z21.86–2008, ''Vented Gas-Fired Space Heating Appliances''; (3) ASTM D2156–09, ''Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels''; (4) UL 729–2003, ''Standard for Safety for Oil-Fired Floor Furnaces''; (5) UL 730–2003, ''Standard for Safety for Oil-Fired Wall Furnaces''; (6) UL 896–1993, ''Standard for Safety for Oil-Burning Stoves''; (7) AHRI 1160–2009, ''Performance Rating of Heat Pump Pool Heaters''; and (8) ANSI/ASHRAE Standard 146–2011, ''Method of Testing and Rating Pool Heaters.'' While the test procedures are not exclusively based on these standards, components of the test procedures are adopted directly from these standards without amendment. The Department has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA, (*i.e.,* that they were developed in a manner that fully provides for public participation, comment, and review). DOE has consulted with the Attorney General and the Chairman of the FTC concerning the impact on competition of requiring manufacturers to use the test methods contained in these standards, and neither recommended against incorporation of these standards.

N. Congressional Notification

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

V. Approval of the Office of the Secretary

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

List of Subjects in 10 CFR Part 430

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

Issued in Washington, DC, on December 23, 2014.

Kathleen B. Hogan,

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

For the reasons stated in the preamble, DOE amends part 430 of Chapter II, Subchapter D 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 of ''vented home heating equipment or vented heater'' to read as follows:

§ 430.2 Definitions.

* * * * *

Vented home heating equipment or vented heater means a class of home heating equipment, not including furnaces, designed to furnish warmed air to the living space of a residence, directly from the device, without duct connections (except that boots not to exceed 10 inches beyond the casing may be permitted) and includes: vented wall furnace, vented floor furnace, and vented room heater.

* * * * *

■ 3. Section 430.3 is amended by:
■ a. Redesignating paragraphs (d)(18) as (d)(19), (t) as (v), and (i) through (s) as (j) through (t), respectively; and
■ b. Adding paragraphs (b)(2), (d)(18), (f)(13), (i), and (u).
■ c. Revising paragraph (f)(11).

The revisions and additions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(b) * * *

(2) AHRI Standard 1160–2009 (''AHRI 1160''), Performance Rating of Heat Pump Pool Heaters, 2009, IBR approved for appendix P to subpart B.

* * * * *

(d) * * *

(18) ANSI Z21.86–2008, (''ANSI Z21.86''), Vented Gas-Fired Space Heating Appliances, Fifth Edition, approved March 28, 2008, IBR approved for appendix O to subpart B.

* * * * *

(f) * * *

(11) ANSI/ASHRAE Standard 103–2007, (''ASHRAE 103–2007''), Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers, ANSI approved March 25, 2008, IBR approved for appendices O and AA to subpart B.

* * * * *

(13) ANSI/ASHRAE Standard 146–2011 (''ASHRAE 146''), Method of Testing and Rating Pool Heaters, ASHRAE approved February 2, 2011, IBR approved for appendix P to subpart B.

* * * * *

(i) *ASTM.* American Society for Testing and Materials International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959 (*www.astm.org*)

(1) ASTM D2156–09, (''ASTM D2156''), Standard Test Method for Smoke Density in Flue Gases from Burning Distillate Fuels, ASTM approved December 1, 2009, IBR approved for appendix O to subpart B.

(2) [Reserved]

* * * * *

(u) *UL.* Underwriters Laboratories, Inc., 2600 NW. Lake Rd., Camas, WA 98607–8542 (*www.UL.com*)

(1) UL 729–2003 (''UL 729''), Standard for Safety for Oil-Fired Floor Furnaces, Sixth Edition, dated August 29, 2003, including revisions through April 22, 2010, IBR approved for appendix O to subpart B.

(2) UL 730–2003 (''UL 730''), Standard for Safety for Oil-Fired Wall Furnaces, Fifth Edition, dated August 29, 2003, including revisions through April 22, 2010, IBR approved for appendix O to subpart B.

(3) UL 896–1993 (''UL 896''), Standard for Safety for Oil-Burning Stoves, Fifth Edition, dated July 29, 1993, including revisions through May 7, 2010, IBR approved for appendix O to subpart B.

■ 4. Section 430.23 is amended by revising paragraphs (o) and (p) to read as follows:

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

* * * * *

(o) *Vented home heating equipment.* (1) When determining the annual fuel utilization efficiency (AFUE) of vented home heating equipment (see the note at the beginning of appendix O), expressed in percent (%), calculate AFUE in accordance with section 4.1.17 of appendix O of this subpart for vented heaters without either manual controls or thermal stack dampers; in accordance with section 4.2.6 of appendix O of this subpart for vented heaters equipped with manual controls; or in accordance with section 4.3.7 of appendix O of this subpart for vented heaters equipped with thermal stack dampers.

(2) When estimating the annual operating cost for vented home heating equipment, calculate the sum of:

(i) The product of the average annual fuel energy consumption, in Btus per year for natural gas, propane, or oil fueled vented home heating equipment, determined according to section 4.6.2 of appendix O of this subpart, and the representative average unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act; plus

(ii) The product of the average annual auxiliary electric energy consumption in kilowatt-hours per year determined according to section 4.6.3 of appendix O of this subpart, and the representative average unit cost in dollars per kilowatt-hours as provided pursuant to section 323(b)(2) of the Act. Round the resulting sum to the nearest dollar per year.

(3) When estimating the operating cost per million Btu output for gas or oil vented home heating equipment with an auxiliary electric system, calculate the product of:

(i) The quotient of one million Btu divided by the sum of:

(A) The product of the maximum fuel input in Btus per hour as determined in sections 3.1.1 or 3.1.2 of appendix O of this subpart times the annual fuel utilization efficiency in percent as determined in sections 4.1.17, 4.2.6, or 4.3.7 of this appendix (as appropriate) divided by 100, plus

(B) The product of the maximum electric power in watts as determined in section 3.1.3 of appendix O of this subpart times the quantity 3.412; and

(ii) The sum of:

(A) the product of the maximum fuel input in Btus per hour as determined in

sections 3.1.1 or 3.1.2 of this appendix times the representative unit cost in dollars per Btu for natural gas, propane, or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act; plus

(B) the product of the maximum auxiliary electric power in kilowatts as determined in section 3.1.3 of appendix O of this subpart times the representative unit cost in dollars per kilowatt-hour as provided pursuant to section 323(b)(2) of the Act. Round the resulting quantity to the nearest 0.01 dollar per million Btu output.

(p) *Pool heaters.* (1) Determine the thermal efficiency (E_t) of a pool heater expressed as a percent (%) in accordance with section 5.1 of appendix P to this subpart.

(2) Determine the integrated thermal efficiency (TE_I) of a pool heater expressed as a percent (%) in accordance with section 5.4 of appendix P to this subpart.

(3) When estimating the annual operating cost of pool heaters, calculate the sum of:

(i) The product of the average annual fossil fuel energy consumption, in Btus per year, determined according to section 5.2 of appendix P to this subpart, and the representative average unit cost in dollars per Btu for natural gas or oil, as appropriate, as provided pursuant to section 323(b)(2) of the Act; plus

(ii) The product of the average annual electrical energy consumption in kilowatt-hours per year determined according to section 5.3 of appendix P to this subpart and converted to kilowatt-hours using a conversion factor of 3412 Btus = 1 kilowatt-hour, and the representative average unit cost in dollars per kilowatt-hours as provided pursuant to section 323(b)(2) of the Act. Round the resulting sum to the nearest dollar per year.

*   *   *   *   *

■ 5. Appendix O to subpart B of part 430 is amended by:
■ a. Revising the note at the beginning of appendix O;
■ b. Redesignating section 1.33 (following 1.37) as 1.39;
■ c. Redesignating sections 1.5 through 1.37 as 1.6 through 1.38;
■ d. Adding section 1.5;
■ e. Revising sections 1.27, 2.1.1, 2.1.2, 2.1.3, 2.2.2;
■ f. Adding section 2.2.4;
■ g. Revising sections 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.4.2, 2.5.1;
■ h. Removing in section 2.6.1 in the last paragraph "ANSI Z21.49–1975, section 2.14." and adding in its place "Part VIII section 8.7 of ANSI Z21.86

(incorporated by reference, see § 430.3)";
■ i. Removing in section 2.6.2 in the first paragraph "Figure 34.4 of UL 730–1974, or Figures 35.1 and 35.2 of UL 729–1976" and adding in its place "Figure 36.4 of UL 730, or Figure 38.1 and 38.2 of UL 729 (incorporated by reference, see § 430.3)" and removing in the last paragraph "sections 35.12 through 35.17 of UL 730–1974" and adding in its place "sections 37.5.8 through 37.5.18 of UL 730 (incorporated by reference, see § 430.3)";
■ j. Revising section 2.9;
■ k. Adding section 2.11;
■ l. Revising sections 3.1.1, 3.1.2, 3.2, 3.3;
■ m. Adding sections 3.6.1, 3.6.2, 3.6.2.1, 3.6.2.2, 3.6.2.2.1, 3.6.2.2.2, 3.6.2.3, 3.6.2.4, 3.6.2.4.1, 3.6.2.4.2, 3.6.2.4.3, 3.8, 3.8.1, 3.8.2;
■ n. Revising sections 4.1, 4.1.2, 4.1.3, 4.1.6;
■ o. Adding sections 4.1.6.1, 4.1.6.2, 4.1.6.3, and 4.1.6.4;
■ p. Revising sections 4.1.8, 4.1.10, 4.1.15, 4.1.16, 4.2.1, 4.2.2, 4.2.4.1, 4.3, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.3.6, 4.5.1, 4.5.2, 4.5.3 and Table 1.

These additions and revisions read as follows:

Appendix O to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Vented Home Heating Equipment

Note: On and after July 6, 2015, any representations made with respect to the energy use or efficiency of vented home heating equipment must be made in accordance with the results of testing pursuant to this appendix. On and after this date, if a manufacturer makes representations of standby mode and off mode energy consumption, then testing must also include the provisions of this appendix related to standby mode and off mode energy consumption. Until July 6, 2015, manufacturers must test vented home heating equipment in accordance with this appendix or appendix O as it appeared at 10 CFR part 430, subpart B revised as of January 1, 2014. Any representations made with respect to the energy use or efficiency of such vented home heating equipment must be made in accordance with whichever version is selected. DOE notes that, because testing under this appendix O is required as of July 6, 2015, manufacturers may wish to begin using this test procedure immediately.

*   *   *   *   *

1.5 "Condensing vented heater" means a vented heater that, during the laboratory tests prescribed in this appendix, condenses part of the water vapor in the flue gases.

*   *   *   *   *

1.27 "Single-stage thermostat" means a thermostat that cycles a burner at the maximum heat input rate and off.

*   *   *   *   *

2.1.1 *Vented wall furnaces (including direct vent systems).* Install non-direct vent gas fueled vented wall furnaces as specified in section 8.1.3 and figure 7 or figure 10 of ANSI Z21.86 (incorporated by reference, see § 430.3). Install direct vent gas fueled vented wall furnaces as specified in section 6.1.3 and figure 6 of ANSI Z21.86 (incorporated by reference, see § 430.3). Install oil fueled vented wall furnaces as specified in section 36.1 of UL 730 (incorporated by reference, see § 430.3).

2.1.2 *Vented floor furnaces.* Install vented floor furnaces for test as specified in section 38.1 of UL 729 (incorporated by reference, see § 430.3).

2.1.3 *Vented room heaters.* Install vented room heaters for test in accordance with the manufacturer's installation and operations (I&O) manual provided with the unit.

*   *   *   *   *

2.2.2 *Oil fueled vented home heating equipment (excluding direct vent systems).* Use flue connections for oil fueled vented floor furnaces as specified in section 38.2 of UL 729, sections 36.2 of UL 730 for oil fueled vented wall furnaces, and sections 37.1.2 and 37.1.3 of UL 896 (all incorporated by reference, see § 430.3) for oil fueled vented room heaters.

*   *   *   *   *

2.2.4 *Condensing vented heater, additional flue requirements.* The flue pipe installation must not allow condensate formed in the flue pipe to flow back into the unit. An initial downward slope from the unit's exit, an offset with a drip leg, annular collection rings, or drain holes must be included in the flue pipe installation without disturbing normal flue gas flow. Flue gases should not flow out of the drain with the condensate. For condensing vented heaters that do not include means for collection of condensate, a means to collect condensate must be supplied by the test lab for the purposes of testing.

*   *   *   *   *

2.3.1 *Natural gas.* For a gas fueled vented heater, maintain the gas supply to the unit under test at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches water column. Maintain the regulator outlet pressure at normal test pressure approximately at that recommended by the manufacturer. Use natural gas having a specific gravity of approximately 0.65 and a higher heating value within ±5 percent of 1,025 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard cubic foot for the natural gas to be used in the test with an error no greater than one percent.

2.3.2 *Propane gas.* For a propane-gas fueled vented heater, maintain the gas supply to the unit under test at a normal inlet pressure of 11 to 13 inches water column and a specific gravity of approximately 1.53. Maintain the regulator outlet pressure, on units so equipped, approximately at that recommended by the manufacturer. Use propane having a specific gravity of approximately 1.53 and a higher heating value within ±5 percent of 2,500 Btu's per standard cubic foot. Determine the actual higher heating value in Btu's per standard

cubic foot for the propane to be used in the test

2.3.3 *Other test gas.* Use other test gases with characteristics as described in Table 4 of ANSI Z21.86 (incorporated by reference, see § 430.3). Use gases with a measured higher heating value within ±5 percent of the values specified in the Tables section of ANSI Z21.86. Determine the actual higher heating value of the gas used in the test with an error no greater than one percent.

2.3.4 *Oil supply.* For an oil fueled vented heater, use No. 1 fuel oil (kerosene) for vaporizing-type burners and either No. 1 or No. 2 fuel oil, as specified by the manufacturer in the I&O manual provided with the unit, for mechanical atomizing type burners. Use test fuel conforming to the specifications given in Tables 2 and 3 of ASHRAE 103–2007 (incorporated by reference, see § 430.3). Measure the higher heating value of the test fuel within ±1 percent.

*   *   *   *   *

2.4.2 *Oil burner adjustments.* Adjust the burners of oil fueled vented heaters to give the CO_2 reading recommended by the manufacturer and an hourly Btu input, during the steady-state performance test described below, which is within ±2 percent of the heater manufacturer's specified normal hourly Btu input rating. On units employing a power burner, do not allow smoke in the flue to exceed a No. 1 smoke during the steady-state performance test as measured by the procedure in ASTM D2156 (incorporated by reference, see § 430.3). If, on units employing a power burner, the smoke in the flue exceeds a No. 1 smoke during the steady-state test, readjust the burner to give a lower smoke reading, and, if necessary a lower CO_2 reading, and start all tests over. Maintain the average draft over the fire and in the flue during the steady-state performance test at that recommended by the manufacturer within ±0.005 inches of water gauge. Do not make additional adjustments to the burner during the required series of performance tests. The instruments and measuring apparatus for this test are described in section 6 and shown in Figure 8 of ASHRAE 103–2007 (incorporated by reference, see § 430.3).

*   *   *   *   *

2.5.1 *Forced air vented wall furnaces (including direct vent systems).* During testing, maintain the air flow through the heater as specified by the manufacturer in the I&O manual provided with the unit and operate the vented heater with the outlet air temperature between 80 °F and 130 °F above room temperature. If adjustable air discharge registers are provided, adjust them so as to provide the maximum possible air restriction. Measure air discharge temperature as specified in section 8.7 of ANSI Z21.86 (incorporated by reference, see § 430.3).

*   *   *   *   *

2.9 *Room ambient temperature.* The room ambient temperature shall be the arithmetic average temperature of the test area, determined by measurement with four No. 24 AWG bead-type thermocouples with junctions shielded against radiation, located

approximately at 90-degree positions on a circle circumscribing the heater or heater enclosure under test, in a horizontal plane approximately at the vertical midpoint of the appliance or test enclosure, and with the junctions approximately 24 inches from sides of the heater or test enclosure and located so as not to be affected by other than room air.

The value T_{RA} is the room ambient temperature measured at the last of the three successive readings taken 15 minutes apart described in section 3.1.1 or 3.1.2 as applicable. During the time period required to perform all the testing and measurement procedures specified in section 3.0 of this appendix, maintain the room ambient temperature within ±5 °F (±2.8 C) of the value T_{RA}. At no time during these tests shall the room ambient temperature exceed 100 °F (37.8 C) or fall below 65 °F (18.3 C).

Locate a thermocouple at each elevation of draft relief inlet opening and combustion air inlet opening at a distance of approximately 24 inches from the inlet openings. The temperature of the air for combustion and the air for draft relief shall not differ more than ±5 °F from the room ambient temperature as measured above at any point in time. This requirement for combustion air inlet temperature does not need to be met once the burner is shut off during the testing described in sections 3.3 and 3.6 of this appendix.

*   *   *   *   *

2.11 *Equipment with multiple control modes.* For equipment that has both manual and automatic thermostat control modes, test the unit according to the procedure for its automatic control mode, *i.e.* single-stage, two stage, or step-modulating.

*   *   *   *   *

3.1.1 *Gas fueled vented home heating equipment (including direct vent systems).* Set up the vented heater as specified in sections 2.1, 2.2, and 2.3 of this appendix. The draft diverter shall be in the normal open condition and the stack shall not be insulated. (Insulation of the stack is no longer required for the vented heater test.) Begin the steady-state performance test by operating the burner and the circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.1 and 2.5 of this appendix, until steady-state conditions are attained as indicated by three successive readings taken 15 minutes apart with a temperature variation of not more than ±3 °F (1.7 C) in the stack gas temperature for vented heaters equipped with draft diverters or ±5 °F (2.8 C) in the flue gas temperature for vented heaters equipped with either draft hoods or direct vent systems. The measurements described in this section are to coincide with the last of these 15 minute readings.

On units employing draft diverters, measure the room temperature (T_{RA}) as described in section 2.9 of this appendix and measure the steady-state stack gas temperature ($T_{S,SS}$) using the nine thermocouples located in the 5 foot test stack as specified in section 2.6.1 of this appendix. Secure a sample of the stack gases in the plane where $T_{S,SS}$ is measured or within 3.5 feet downstream of this plane. Determine the concentration by volume of carbon dioxide (X_{CO2S}) present in the dry stack gas. If the

location of the gas sampling differs from the temperature measurement plane, there shall be no air leaks through the stack between these two locations.

On units employing draft hoods or direct vent systems, measure the room temperature (T_{RA}) as described in section 2.9 of this appendix and measure the steady-state flue gas temperature ($T_{F,SS}$), using the nine thermocouples located in the flue pipe as described in section 2.6.1 of this appendix. Secure a sample of the flue gas in the plane of temperature measurement and determine the concentration by volume of CO_2 (X_{CO2F}) present in dry flue gas. In addition, for units employing draft hoods, secure a sample of the stack gas in a horizontal plane in the five foot test stack located one foot from the test stack inlet; and determine the concentration by volume of CO_2 (X_{CO2S}) present in dry stack gas.

Determine the steady-state heat input rate (Qin) including pilot gas by multiplying the measured higher heating value of the test gas by the steady-state gas input rate corrected to standard conditions of 60 °F and 30 inches of mercury. Use measured values of gas temperature and pressure at the meter and the barometric pressure to correct the metered gas flow rate to standard conditions.

After the above test measurements have been completed on units employing draft diverters, secure a sample of the flue gases at the exit of the heat exchanger(s) and determine the concentration of CO_2 (X_{CO2F}) present. In obtaining this sample of flue gas, move the sampling probe around or use a sample probe with multiple sampling ports in order to assure that an average value is obtained for the CO_2 concentration. For units with multiple heat exchanger outlets, measure the CO_2 concentration in a sample from each outlet to obtain the average CO_2 concentration for the unit. A manifold (parallel connected sampling tubes) may be used to obtain this sample.

For heaters with single-stage thermostat control (wall mounted electric thermostats), determine the steady-state efficiency at the maximum fuel input rate as specified in section 2.4 of this appendix.

For gas fueled vented heaters equipped with either two stage control or step-modulating control, determine the steady-state efficiency at the maximum fuel input rate and at the reduced fuel input rate, as specified in section 2.4.1 of this appendix.

For manually controlled gas fueled vented heaters with various input rates, determine the steady-state efficiency at a fuel input rate that is within ±5 percent of 50 percent of the maximum rated fuel input rate as indicated on the nameplate of the unit or in the manufacturer's installation and operation manual shipped with the unit. If the heater is designed to use a control that precludes operation at other than maximum rated fuel input rate (single firing rate) determine the steady state efficiency at the maximum rated fuel input rate only.

3.1.2 *Oil fueled vented home heating equipment (including direct vent systems).* Set up and adjust the vented heater as specified in sections 2.1, 2.2, and 2.3.4 of this appendix. Begin the steady-state performance test by operating the burner and the

circulating air blower, on units so equipped, with the adjustments specified by sections 2.4.2 and 2.5 of this appendix, until steady-state conditions are attained as indicated by a temperature variation of not more than ±5 °F (2.8 C) in the flue gas temperature in three successive readings taken 15 minutes apart. The measurements described in this section are to coincide with the last of these 15 minutes readings.

For units equipped with power burners, do not allow smoke in the flue to exceed a No. 1 smoke during the steady-state performance test as measured by the procedure described in ASTM D2156 (incorporated by reference, see § 430.3). Maintain the average draft over the fire and in the breeching during the steady-state performance test at that recommended by the manufacturer ±0.005 inches of water gauge.

Measure the room temperature (T_{RA}) as described in section 2.9 of this appendix. Measure the steady-state flue gas temperature ($T_{F,SS}$) using nine thermocouples located in the flue pipe as described in section 2.6.2 of this appendix. From the plane where $T_{F,SS}$ was measured, collect a sample of the flue gas and determine the concentration by volume of CO_2 (X_{CO2F}) present in dry flue gas. Measure and record the steady-state heat input rate (Q_{in}).

For manually controlled oil fueled vented heaters, determine the steady-state efficiency at a fuel input rate that is within ±5 percent of 50 percent of the maximum fuel input rate; or, if the design of the heater is such that the fuel input rate cannot be set to ±5 percent of 50 percent of the maximum rated fuel input rate, determine the steady-state efficiency at the minimum rated fuel input rate as measured in section 3.1.2 of this appendix for manually controlled oil fueled vented heaters.

* * * * *

3.2 *Jacket loss measurement.* Conduct a jacket loss test for vented floor furnaces. Measure the jacket loss (L_j) in accordance with ASHRAE 103–2007 section 8.6 (incorporated by reference, see § 430.3), applying the provisions for furnaces and not the provisions for boilers.

3.3 *Measurement of the off-cycle losses for vented heaters equipped with thermal stack dampers.* Unless specified otherwise, the thermal stack damper should be at the draft diverter exit collar. Attach a five foot length of bare stack to the outlet of the damper. Install thermocouples as specified in section 2.6.1 of this appendix.

For vented heaters equipped with single-stage thermostats, measure the off-cycle losses at the maximum fuel input rate. For vented heaters equipped with two stage thermostats, measure the off-cycle losses at the maximum fuel input rate and at the reduced fuel input rate. For vented heaters equipped with step-modulating thermostats, measure the off-cycle losses at the reduced fuel input rate.

Allow the vented heater to heat up to a steady-state condition. Feed a tracer gas at a constant metered rate into the stack directly above and within one foot above the stack damper. Record tracer gas flow rate and temperature. Measure the tracer gas concentration in the stack at several locations

in a horizontal plane through a cross-section of the stack at a point sufficiently above the stack damper to ensure that the tracer gas is well mixed in the stack.

Continuously measure the tracer gas concentration and temperature during a 10-minute cool-down period. Shut the burner off and immediately begin measuring tracer gas concentration in the stack, stack temperature, room temperature, and barometric pressure. Record these values as the midpoint of each one-minute interval between burner shut-down and ten minutes after burner shut-down. Meter response time and sampling delay time shall be considered in timing these measurements.

* * * * *

3.6.1 *Procedure for determining (*$D_{F \ and}$ D_P*) of vented home heating equipment with no measurable airflow.* On units whose design is such that there is no measurable airflow through the combustion chamber and heat exchanger when the burner(s) is off (as determined by the test procedure in section 3.6.2 of this appendix), D_F and D_P may be set equal to 0.05.

3.6.2 *Test Method to Determine Whether the Use of the Default Draft Factors (*$D_{F \ and}$ D_P*) of 0.05 is Allowed.* Manufacturers may use the following test protocol to determine whether air flows through the combustion chamber and heat exchanger when the burner(s) is off using a smoke stick device. The default draft factor of 0.05 (as allowed per section 3.6.1 of this appendix) may be used only for units determined pursuant to this protocol to have no air flow through the combustion chamber and heat exchanger.

3.6.2.1 *Test Conditions.* Wait for two minutes following the termination of the vented heater's on-cycle.

3.6.2.2 *Location of Test Apparatus*

3.6.2.2.1 After all air currents and drafts in the test chamber have been minimized, position the operable smoke stick/pencil as specified, based on the following equipment configuration: for horizontal combustion air intakes, approximately 4 inches from the vertical plane at the termination of the intake vent and 4 inches below the bottom edge of the combustion air intake, or for vertical combustion air intakes, approximately 4 inches horizontal from vent perimeter at the termination of the intake vent and 4 inches down (parallel to the vertical axis of the vent). In the instance where the boiler combustion air intake is closer than 4 inches to the floor, place the smoke device directly on the floor without impeding the flow of smoke.

3.6.2.2.2 Monitor the presence and direction of the smoke flow.

3.6.2.3 *Duration of Test.* Continue monitoring the release of smoke for no less than 30 seconds.

3.6.2.4 *Test Results*

3.6.2.4.1 During visual assessment, determine whether there is any draw of smoke into the combustion air intake.

3.6.2.4.2 If absolutely no smoke is drawn into the combustion air intake, the vented heater meets the requirements to allow use of the default draft factor of 0.05 pursuant to Section 8.8.3 and/or 9.10 of ASHRAE 103–2007 (incorporated by reference, see § 430.3).

3.6.2.4.3 If there is any smoke drawn into the intake, use of default draft factor of 0.05

is prohibited. Proceed with the methods of testing as prescribed in section 3.6 of this appendix, or select the appropriate default draft factor from Table 1.

* * * * *

3.8 *Condensing vented heaters—measurement of condensate under steady-state and cyclic conditions.* Attach condensate drain lines to the vented heater as specified in the manufacturer's I&O manual provided with the unit. The test unit shall be level prior to all testing. A continuous downward slope of drain lines from the unit shall be maintained. The drain lines must facilitate uninterrupted flow of condensate during the test. The condensate collection container must be glass or polished stainless steel to facilitate removal of interior deposits. The collection container shall have a vent opening to the atmosphere, be dried prior to each use, and be at room ambient temperature. The humidity of the room air shall at no time exceed 80 percent relative humidity. For condensing units not designed for collecting and draining condensate, drain lines must be provided during testing that meet the criteria set forth in this section 3.8. Units employing manual controls and units not tested under the optional tracer gas procedures of sections 3.3 and 3.6 of this appendix shall only conduct the steady-state condensate collection test.

3.8.1 *Steady-state condensate collection test.* Begin steady-state condensate collection concurrently with or immediately after completion of the steady-state testing of section 3.1 of this appendix. The steady-state condensate collection period shall be 30 minutes. Condensate mass shall be measured immediately at the end of the collection period to minimize evaporation loss from the sample. Record fuel input during the 30-minute condensate collection steady-state test period. Measure and record fuel higher heating value (HHV), temperature, and pressures necessary for determining fuel energy input ($Q_{c,ss}$). The fuel quantity and HHV shall be measured with errors no greater than ±1 percent. Determine the mass of condensate for the steady-state test ($M_{c,ss}$) in pounds by subtracting the tare container weight from the total container and condensate weight measured at the end of the 30-minute condensate collection test period. The error associated with the mass measurement instruments shall not exceed ±0.5 percent of the quantity measured.

For units with step-modulating or two stage controls, the steady-state condensate collection test shall be conducted at both the maximum and reduced input rates.

3.8.2 *Cyclic condensate collection tests.* If existing controls do not allow for cyclical operation of the tested unit, control devices shall be installed to allow cyclical operation of the vented heater. Run three consecutive test cycles. For each cycle, operate the unit until flue gas temperatures at the end of each on-cycle, rounded to the nearest whole number, are within 5°F of each other for two consecutive cycles. On-cycle and off-cycle times are 4 minutes and 13 minutes respectively. Control of ON and OFF operation actions shall be within ±6 seconds of the scheduled time. For fan-type vented heaters, maintain circulating air adjustments

as specified in section 2.5 of this appendix. Begin condensate collection at one minute before the on-cycle period of the first test cycle. Remove the container one minute before the end of each off-cycle period. Measure condensate mass for each test-cycle. The error associated with the mass measurement instruments shall not exceed ±0.5 percent of the quantity measured.

Fuel input shall be recorded during the entire test period starting at the beginning of the on-time period of the first cycle to the beginning of the on-time period of the second cycle, from the beginning of the on-time period of the second cycle to the beginning of the on-time period of the third cycle, etc., for each of the test cycles. Fuel HHV, temperature, and pressure necessary for determining fuel energy input, Q_c, shall be recorded. Determine the mass of condensate for each cycle, M_c, in pounds. If at the end of three cycles the sample standard deviation is within 20 percent of the mean value for three cycles, use total condensate collected in the three cycles as M_c; if not, continue collection for an additional three cycles and use the total condensate collected for the six cycles as M_c. Determine the fuel energy input, Q_c, during the three or six test cycles, expressed in Btu.

4.0   *Calculations*

4.1   *Annual fuel utilization efficiency for gas fueled or oil fueled vented home heating equipment equipped without manual controls or with multiple control modes as per 2.11 and without thermal stack dampers.* The following procedure determines the annual fuel utilization efficiency for gas

fueled or oil fueled vented home heating equipment equipped without manual controls and without thermal stack dampers.

*   *   *   *   *

4.1.2   *Off-cycle flue gas draft factor.* Based on the system number, determine the off-cycle flue gas draft factor (D_F) from Table 1 of this appendix or the test method and calculations of sections 3.6 and 4.5 of this appendix.

4.1.3   *Off-cycle stack gas draft factor.* Based on the system number, determine the off-cycle stack gas draft factor (D_s) from Table 1 of this appendix or from the test method and calculations of sections 3.6 and 4.5 of this appendix,.

*   *   *   *   *

4.1.6   *Latent heat loss.* For non-condensing vented heaters, obtain the latent heat loss ($L_{L,A}$) from Table 2 of this appendix. For condensing vented heaters, calculate a modified latent heat loss ($L_{L,A}$*) as follows:

For steady-state conditions:

$L_{L,A}$* = $L_{L,A}$ − $L_{G,SS}$ + $L_{C,SS}$

where:

$L_{L,A}$ = Latent heat loss, based on fuel type, from Table 2 of this appendix,
$L_{G,SS}$ = Steady-state latent heat gain due to condensation as determined in section 4.1.6.1 of this appendix, and
$L_{C,SS}$ = Steady-state heat loss due to hot condensate going down the drain as determined in 4.1.6.2 of this appendix.

For cyclic conditions: (only for vented heaters tested under the optional tracer gas procedures of section 3.3 or 3.6)

$L_{L,A}$* = $L_{L,A}$ − L_G + L_C

where:

$L_{L,A}$ = Latent heat loss, based on fuel type, from Table 2 of this appendix,
L_G = Latent heat gain due to condensation under cyclic conditions as determined in section 4.1.6.3 of this appendix, and
L_C = Heat loss due to hot condensate going down the drain under cyclic conditions as determined in section 4.1.6.4 of this appendix.

4.1.6.1   *Latent heat gain due to condensation under steady-state conditions.* Calculate the latent heat gain ($L_{G,SS}$) expressed as a percent and defined as:

$$L_{G,SS} = 100 \frac{(1053.3)M_{C,SS}}{Q_{C,SS}}$$

where:

100 = conversion factor to express a decimal as a percent,
1053.3 = latent heat of vaporization of water, Btu per pound,
$M_{c,ss}$ = mass of condensate for the steady-state test as determined in section 3.8.1 of this appendix, pounds, and
$Q_{c,ss}$ = fuel energy input for steady-state test as determined in section 3.8.1 of this appendix, Btu.

4.1.6.2   *Heat loss due to hot condensate going down the drain under steady-state conditions.* Calculate the steady-state heat loss due to hot condensate going down the drain ($L_{C,SS}$) expressed as a percent and defined as:

$$L_{C,SS} = L_{G,SS} \frac{1.0 \left(T_{F,SS} - 70 \right) - 0.45 \left(T_{F,SS} - 45 \right)}{1053.3}$$

where:

$L_{G,SS}$ = Latent heat gain due to condensation under steady-state conditions as defined in section 4.1.6.1 of this appendix,
1.0 = specific heat of water, Btu/lb − °F,
$T_{F,SS}$ = Flue (or stack) gas temperature as defined in section 3.1 of this appendix, °F,
70 = assumed indoor temperature, °F,
0.45 = specific heat of water vapor, Btu/lb − °F, and
45 = average outdoor temperature for vented heaters, °F.

4.1.6.3   *Latent heat gain due to condensation under cyclic conditions.* (only

for vented heaters tested under the optional tracer gas procedures of section 3.3 or 3.6 of this appendix) Calculate the latent heat gain (L_G) expressed as a percent and defined as:

$$L_G = 100 \frac{(1053.3)M_C}{Q_C}$$

where:

100 = conversion factor to express a decimal as a percent,
1053.3 = latent heat of vaporization of water, Btu per pound,

M_c = mass of condensate for the cyclic test as determined in 3.8.2 of this appendix, pounds, and
Q_c = fuel energy input for cyclic test as determined in 3.8.2 of this appendix, Btu.

4.1.6.4   *Heat loss due to hot condensate going down the drain under cyclic conditions. (only for vented heaters tested under the optional tracer gas procedures of section 3.3 or 3.6 of this appendix)* Calculate the cyclic heat loss due to hot condensate going down the drain (L_C) expressed as a percent and defined as:

$$L_C = L_G \frac{1.0 \left(T_{F,SS} - 70 \right) - 0.45 \left(T_{F,SS} - 45 \right)}{1053.3}$$

where:

L_G = Latent heat gain due to condensation under cyclic conditions as defined in section 4.1.6.3 of this appendix,
1.0 = specific heat of water, Btu/lb − °F,
$T_{F,SS}$ = Flue (or stack) gas temperature as defined in section 3.1 of this appendix,
70 = assumed indoor temperature, °F,

0.45 = specific heat of water vapor, Btu/lb − °F, and
45 = average outdoor temperature for vented heaters, °F.

*   *   *   *   *

4.1.8   *Ratio of combustion and relief air mass flow rate to stoichiometric air mass flow rate.* For vented heaters equipped with either

an integral draft diverter or a draft hood, determine the ratio of combustion and relief air mass flow rate to stoichiometric air mass flow rate ($R_{T,S}$), and defined as:

$R_{T,S}$ = A + [B/X_{CO2S}]

where:

A = as determined from Table 2 of this appendix,

B = as determined from Table 2 of this appendix, and

X_{CO2s} = as defined in section 3.1 of this appendix.

* * * * *

4.1.10 *Steady-state efficiency.* For vented heaters equipped with single-stage thermostats, calculate the steady-state efficiency (excluding jacket loss), η_{SS}, expressed in percent and defined as:

$\eta_{SS} = 100 - L_{L,A} - L_{S,SS,A}$

where:

$L_{L,A}$ = latent heat loss, as defined in section 4.1.6 of this appendix (for condensing vented heaters $L_{L,A}*$ for steady-state conditions), and

$L_{S,SS,A}$ = sensible heat loss at steady-state operation, as defined in section 4.1.9 of this appendix.

For vented heaters equipped with either two stage controls or with step-modulating controls, calculate the steady-state efficiency at the reduced fuel input rate, η_{SS-L}, expressed in percent and defined as:

$\eta_{SS-L} = 100 - L_{L,A} - L_{S,SS,A}$

where:

$L_{L,A}$ = latent heat loss, as defined in section 4.1.6 of this appendix (for condensing vented heaters $L_{L,A}*$ for steady-state conditions at the reduced firing rate), and

$L_{S,SS,A}$ = sensible heat loss at steady-state operation, as defined in section 4.1.9 of this appendix, in which $L_{S,SS,A}$ is determined at the reduced fuel input rate.

For vented heaters equipped with two stage controls, calculate the steady-state

efficiency at the maximum fuel input rate, η_{SS-H}, expressed in percent and defined as:

$\eta_{SS-H} = 100 - L_{L,A} - L_{S,SS,A}$

where:

$L_{L,A}$ = latent heat loss, as defined in section 4.1.6 of this appendix (for condensing vented heaters $L_{L,A}*$ for steady-state conditions at the maximum fuel input rate), and

$L_{S,SS,A}$ = sensible heat loss at steady-state operation, as defined in section 4.1.9 of this appendix, in which $L_{S,SS,A}$ is measured at the maximum fuel input rate.

For vented heaters equipped with step-modulating thermostats, calculate the weighted-average steady-state efficiency in the modulating mode, η_{SS-MOD}, expressed in percent and defined as:

$$\eta_{SS-MOD} = [\eta_{SS-H} - \eta_{SS-L}]\left[\frac{T_C - T_{OA*}}{T_C - 15}\right] + \eta_{SS-L}$$

where:

η_{SS-H} = steady-state efficiency at the maximum fuel input rate, as defined in section 4.1.10 of this appendix,

η_{SS-L} = steady-state efficiency at the reduced fuel input rate, as defined in section 4.1.10 of this appendix,

$T_{OA}*$ = average outdoor temperature for vented heaters with step-modulating thermostats operating in the modulating mode and is obtained from Table 3 or Figure 1 of this appendix, and

T_C = balance point temperature which represents a temperature used to apportion the annual heating load between the reduced input cycling mode and either the modulating mode or maximum input cycling mode and is obtained either from Table 3 of this appendix or calculated by the following equation:

$T_C = 65 - [(65 - 15)R]$

where:

65 = average outdoor temperature at which a vented heater starts operating,

15 = national average outdoor design temperature for vented heaters, and

R = ratio of reduced to maximum heat output rates, as defined in section 4.1.13 of this appendix.

* * * * *

4.1.15 *Fraction of heating load at maximum operating mode or noncycling*

mode. For vented heaters equipped with either two stage thermostats or step-modulating thermostats, determine the fraction of heating load at the maximum operating mode or noncycling mode (X_2) expressed as a decimal and listed in Table 3 of this appendix or obtained from Figure 2 of this appendix.

4.1.16 *Weighted-average steady-state efficiency.* For vented heaters equipped with single-stage thermostats, the weighted-average steady-state efficiency (η_{SS-WT}) is equal to η_{SS}, as defined in section 4.1.10 of this appendix. For vented heaters equipped with two stage thermostats, η_{SS-WT} is defined as:

$\eta_{SS-WT} = X_1\eta_{SS-L} + X_2\eta_{SS-H}$

where:

X_1 = as defined in section 4.1.14 of this appendix

η_{SS-L} = as defined in section 4.1.10 of this appendix

X_2 = as defined in section 4.1.15 of this appendix

η_{SS-H} = as defined in section 4.1.10 of this appendix

For vented heaters equipped with step-modulating controls, η_{SS-WT} is defined as:

$\eta_{SS-WT} = X_1\eta_{SS-L} + X_2\eta_{SS-MOD}$

where:

X_1 = as defined in section 4.1.14 of this appendix

η_{SS-L} = as defined in section 4.1.10 of this appendix

X_2 = as defined in section 4.1.15 of this appendix

η_{SS-MOD} = as defined in section 4.1.10 of this appendix

* * * * *

4.2.1 *Average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation.* For vented heaters equipped with either direct vents or direct exhaust or that are outdoor units, the average ratio of stack gas mass flow rate to flue gas mass flow rate at steady-state operation (S/F) shall be equal to unity. (S/F=1) For all other types of vented heaters, calculate (S/F) defined as:

$$\frac{S}{F} = 1.3\frac{R_{T,S}}{R_{T,F}}$$

where:

$R_{T,S}$ = as defined in section 4.1.8 of this appendix with X_{CO2s} as measured in section 3.1. of this appendix

$R_{T,F}$ = as defined in section 4.1.7 of this appendix with X_{CO2F} as measured in section 3.1. of this appendix

4.2.2 *Multiplication factor for infiltration loss during burner on-cycle.* Calculate the multiplication factor for infiltration loss during burner on-cycle ($K_{I,ON}$) defined as:

$$K_{I,ON} = 100(0.24)(S/F)(0.7)\frac{1 + R_{T,F}(A/F)}{HHV_A}$$

where:

100 = converts a decimal fraction into a percent

0.24 = specific heat of air

A/F = stoichiometric air/fuel ratio, determined in accordance with Table 2 of this appendix

S/F = as defined in section 4.2.1 of this appendix

0.7 = infiltration parameter

$R_{T,F}$ = as defined in section 4.1.7 of this appendix

HHV_A = average higher heating value of the test fuel, determined in accordance with Table 2 of this appendix

* * * * *

4.2.4.1 For manually controlled heaters with various input rates the weighted average

steady-state efficiency (η_{SS-WT}), is determined as follows:

$\eta_{SS-WT} = 100 - L_{L,A} - L_{S,SS,A}$

where:

$L_{L,A}$ = latent heat loss, as defined in section 4.1.6 of this appendix (for condensing vented heaters, $L_{L,A}^*$ for steady-state conditions), and

$L_{S,SS,A}$ = steady-state efficiency at the reduced fuel input rate, as defined in section 4.1.9 of this appendix and where $L_{L,A}$ and $L_{S,SS,A}$ are determined:

(1) at 50 percent of the maximum fuel input rate as measured in either section 3.1.1 of this appendix for manually controlled gas vented heaters or section 3.1.2 of this appendix for manually controlled oil vented heaters, or

(2) at the minimum fuel input rate as measured in either section 3.1.1 of this appendix for manually controlled gas vented heaters or section 3.1.2 of this appendix for manually controlled oil vented heaters if the design of the heater is such that the ±5 percent of 50 percent of the maximum fuel

input rate cannot be set, provided this minimum rate is no greater than ⅔ of the maximum input rate of the heater.

* * * * *

4.3 *Annual fuel utilization efficiency by the tracer gas method.* The annual fuel utilization efficiency shall be determined by the following tracer gas method for all vented heaters equipped with thermal stack dampers.

4.3.1 *On-cycle sensible heat loss.* For vented heaters equipped with single-stage thermostats, calculate the on-cycle sensible heat loss ($L_{S,ON}$) expressed as a percent and defined as:

$L_{S,ON} = L_{S,SS,A}$

where:

$L_{S,SS,A}$ = as defined in section 4.1.9 of this appendix

For vented heaters equipped with two stage thermostats, calculate $L_{S,ON}$ defined as:

$L_{S,ON} = X_1 L_{S,SS,A-red} + X_2 L_{S,SS,A-max}$

where:

X_1 = as defined in section 4.1.14 of this appendix

$L_{S,SS,A-red}$ = as defined as $L_{S,SS,A}$ in section 4.1.9 of this appendix at the reduced fuel input rate

X_2 = as defined in section 4.1.15 of this appendix

$L_{S,SS,A-max}$ = as defined as $L_{S,SS,A}$ in section 4.1.9 of this appendix at the maximum fuel input rate

For vented heaters with step-modulating controls, calculate $L_{S,ON}$ defined as:

$L_{S,ON} = X_1 L_{S,SS,A-red} + X_2 L_{S,SS,A-avg}$

where:

X_1 = as defined in section 4.1.14 of this appendix

$L_{LS,SS,A-red}$ = as defined in section 4.3.1 of this appendix

X_2 = as defined in section 4.1.15 of this appendix

$L_{S,SS,A-avg}$ = average sensible heat loss for step-modulating vented heaters operating in the modulating mode

$$L_{S,SS,A-avg} = \left[\left[L_{S,SS,A-max} - L_{S,SS,A-red} \right] \left[\frac{T_C - T_{OA*}}{T_C - 15} \right] \right] + L_{S,SS,A-red}$$

where:

$L_{S,SS,A-avg}$ = as defined in section 4.3.1 of this appendix

T_C = as defined in section 4.1.10 of this appendix

T_{OA*} = as defined in section 4.1.10 of this appendix

15 = as defined in section 4.1.10 of this appendix

4.3.2 *On-cycle infiltration heat loss.* For vented heaters equipped with single-stage thermostats, calculate the on-cycle infiltration heat loss ($L_{I,ON}$) expressed as a percent and defined as:

$L_{I,ON} = K_{I,ON}(70 - 45)$

where:

$K_{I,ON}$ = as defined in section 4.2.2 of this appendix

70 = as defined in section 4.2.3 of this appendix

45 = as defined in section 4.2.3 of this appendix

For vented heaters equipped with two stage thermostats, calculate $L_{I,ON}$ defined as:

$L_{I,ON} = X_1 K_{I,ON-Max}(70 - T_{OA*}) + X_2 K_{I,ON,red}(70 - T_{OA})$

where:

X_1 = as defined in section 4.1.14 of this appendix

$K_{I,ON-max}$ = as defined as $K_{I,ON}$ in section 4.2.2 of this appendix at the maximum heat input rate

70 = as defined in section 4.2.3 of this appendix

T_{OA*} = as defined in section 4.3.4 of this appendix

$K_{I,ON,red}$ = as defined as $K_{I,ON}$ in section 4.2.2 of this appendix at the minimum heat input rate

T_{OA} = as defined in section 4.3.4 of this appendix

X_2 = as defined in section 4.1.15 of this appendix

For vented heaters equipped with step-modulating thermostats, calculate $L_{I,ON}$ defined as:

$L_{I,ON} = X_1 K_{I,ON-avg}(70 - T_{OA*}) + X_2 K_{I,ON,red}(70 - T_{OA})$

where:

X_1 = as defined in section 4.1.14 of this appendix

$$K_{I,on,avg} = \frac{\left[K_{I,on,max} + K_{I,on,red} \right]}{2}$$

70 = as defined in section 4.2.3 of this appendix

T_{OA*} = as defined in section 4.3.4 of this appendix

X_2 = as defined in section 4.1.15 of this appendix

T_{OA} = as defined in section 4.3.4 of this appendix

4.3.3 *Off-cycle sensible heat loss.* For vented heaters equipped with single-stage thermostats, calculate the off-cycle sensible heat loss ($L_{S,OFF}$) at the maximum fuel input rate. For vented heaters equipped with step-modulating thermostats, calculate $L_{S,OFF}$ defined as:

$L_{S,OFF} = X_1 L_{S,OFF,red}$

where:

X_1 = as defined in section 4.1.14 of this appendix, and

$L_{S,OFF,red}$ = as defined as $L_{S,OFF}$ in section 4.3.3 of this appendix at the reduced fuel input rate.

For vented heaters equipped with two stage controls, calculate $L_{S,OFF}$ defined as:

$L_{S,OFF} = X_1 L_{S,OFF,red} + X_2 L_{S,OFF,Max}$

where:

X_1 = as defined in section 4.1.14 of this appendix,

$L_{S,OFF,red}$ = as defined as $L_{S,OFF}$ in section 4.3.3 of this appendix at the reduced fuel input rate,

X_2 = as defined in section 4.1.15 of this appendix, and

$L_{S,OFF,Max}$ = as defined as $L_{S,OFF}$ in section 4.3.3 of this appendix at the maximum fuel input rate.

Calculate the off-cycle sensible heat loss ($L_{S,OFF}$) expressed as a percent and defined as:

$$L_{S,OFF} = \frac{100 \, (0.24)}{Q_{in} t_{on}} \sum m_{s,OFF}(T_{s,OFF} - T_{RA})$$

where:

100 = conversion factor for percent,

0.24 = specific heat of air in Btu per pound—°F,

Q_{in} = fuel input rate, as defined in section 3.1 of this appendix in Btu per minute (as appropriate for the firing rate),

t_{on} = average burner on-time per cycle and is 20 minutes,

$\Sigma\, m_{S,OFF}\, (T_{S,OFF} - T_{RA})$ = summation of the ten values (for single-stage or step-modulating models) or twenty values (for two tage models) of the quantity, $m_{S,OFF}$ $(T_{S,OFF} - T_{RA})$, measured in accordance with section 3.3 of this appendix, and

$m_{S,OFF}$ = stack gas mass flow rate pounds per minute.

$$m_{S,OFF} = \frac{1.325 P_B V_T (C_{T*} - C_T)}{C_T (T_T + 460)}$$

$T_{S,OFF}$ = stack gas temperature measured in accordance with section 3.3 of this appendix,

T_{RA} = average room temperature measured in accordance with section 3.3 of this appendix,

P_B = barometric pressure in inches of mercury,

V_T = flow rate of the tracer gas through the stack in cubic feet per minute,

C_{T*} = concentration by volume of the active tracer gas in the mixture in percent and

is 100 when the tracer gas is a single component gas,

C_T = concentration by volume of the active tracer gas in the diluted stack gas in percent,

T_T = temperature of the tracer gas entering the flow meter in degrees Fahrenheit, and

$(T_T + 460)$ = absolute temperature of the tracer gas entering the flow meter in degrees Rankine.

4.3.4 *Average outdoor temperature.* For vented heaters equipped with single-stage thermostats, the average outdoor temperature (T_{OA}) is 45 °F. For vented heaters equipped with either two stage thermostats or step-modulating thermostats, T_{OA} during the reduced operating mode is obtained from Table 3 or Figure 1 of this appendix. For vented heaters equipped with two stage thermostats, T_{OA*} during the maximum operating mode is obtained from Table 3 or Figure 1 of this appendix.

4.3.5 *Off-cycle infiltration heat loss.* For vented heaters equipped with single stage thermostats, calculate the off-cycle infiltration heat loss $(L_{I,OFF})$ at the maximum fuel input rate. For vented heaters equipped

with step-modulating thermostats, calculate $L_{I,OFF}$ defined as:

$L_{I,OFF} = X_1 L_{I,OFF,red}$

where:

X_1 = as defined in section 4.1.14 of this appendix

$L_{I,OFF,red}$ = as defined in $L_{I,OFF}$ in section 4.3.5 of this appendix at the reduced fuel input rate

For vented heaters equipped with two stage thermostats, calculate $L_{I,OFF}$ defined as:

$L_{I,OFF} = X_1 L_{I,OFF,red} + X_2 L_{I,OFF,max}$

where:

X_1 = as defined in section 4.1.14 of this appendix

$L_{I,OFF,red}$ = as defined as $L_{I,OFF}$ in section 4.3.5 of this appendix at the reduced fuel input rate

X_2 = as defined in section 4.1.15 of this appendix

$L_{I,OFF,Max}$ = as defined as $L_{I,OFF}$ in section 4.3.5 of this appendix at the maximum fuel input rate

Calculate the off-cycle infiltration heat loss $(L_{I,OFF})$ expressed as a percent and defined as:

$$L_{I,OFF} = \frac{100(0.24)(1.3)(0.7)(70 - T_{OA})}{Q_{in} t_{on}} \sum m_{S,OFF}$$

where:

100 = conversion factor for percent

0.24 = specific heat of air in Btu per pound—°F

1.3 = dimensionless factor for converting laboratory measured stack flow to typical field conditions

0.7 = infiltration parameter

70 = assumed average indoor air temperature, °F

T_{OA} = average outdoor temperature as defined in section 4.3.4 of this appendix

Q_{in} = fuel input rate, as defined in section 3.1 of this appendix in Btu per minute (as appropriate for the firing rate)

t_{on} = average burner on-time per cycle and is 20 minutes

$\Sigma\, m_{S,OFF}$ = summation of the twenty values of the quantity, $m_{S,OFF}$, measured in

accordance with section 3.3 of this appendix

$m_{S,OFF}$ = as defined in section 4.3.3 of this appendix

4.3.6 *Part-load fuel utilization efficiency.* Calculate the part-load fuel utilization efficiency (η_u) expressed as a percent and defined as:

$$\eta_u = 100 - L_{L,A} - C_j L_j - \left[\frac{t_{on}}{t_{on} + P_F\, t_{off}}\right] \times \left[L_{S,ON} + L_{S,OFF} + L_{I,ON} + L_{I,OFF}\right]$$

where:

C_j = 2.8, adjustment factor,

L_j = jacket loss as defined in section 4.1.5,

$L_{L,A}$ = Latent heat loss, as defined in section 4.1.6 of this appendix (for condensing vented heaters $L_{L,A}*$ for cyclic conditions),

t_{on} = Average burner on time which is 20 minutes,

$L_{S,ON}$ = On-cycle sensible heat loss, as defined in section 4.3.1 of this appendix,

$L_{S,OFF}$ = Off-cycle sensible heat loss, as defined in section 4.3.3 of this appendix,

$L_{I,ON}$ = On-cycle infiltration heat loss, as defined in section 4.3.2 of this appendix,

$L_{I,OFF}$ = Off-cycle infiltration heat loss, as defined in section 4.3.5 of this appendix,

P_F = Pilot fraction, as defined in section 4.1.4 of this appendix, and

t_{OFF} = average burner off-time per cycle, which is 20 minutes.

* * * * *

4.5.1 *Optional procedure for determining D_P for vented home heating equipment.* Calculate the ratio (D_P) of the rate of flue gas mass through the vented heater during the off-period, $M_{F,OFF}(T_{F,SS})$, to the rate of flue gas mass flow during the on-period, $M_{F,SS}(T_{F,SS})$, and defined as:

$D_P = M_{F,OFF}(T_{F,SS})/M_{F,SS}(T_{F,SS})$

For vented heaters in which no draft is maintained during the steady-state or cool down tests, $M_{F,OFF}(T_{F,SS})$ is defined as:

$$M_{F,OFF}(T_{F,SS}) = M_{F,OFF}(T_{F,OFF}^*) \left[\frac{(T_{F,SS} - T_{RA})}{(T_{F,OFF}^* - T_{RA})}\right]^{.56} \left[\frac{(T_{F,OFF}^* + 460)}{(T_{F,SS} + 460)}\right]^{1.19}$$

For oil fueled vented heaters in which an imposed draft is maintained, as described in

section 3.6 of this appendix, $M_{F,OFF}(T_{F,SS})$ is defined as:

$M_{F,OFF}(T_{F,SS}) = M_{F,OFF}(T^*_{F,OFF})$

where:

$T_{F,SS}$ = as defined in section 3.1.1 of this appendix,

$T^*_{F,OFF}$ = flue gas temperature during the off-period measured in accordance with

section 3.6 of this appendix in degrees Fahrenheit, and

T_{RA} = as defined in section 2.9 of this appendix.

$$M_{F,OFF}(T^*_{F,OFF}) = \frac{1.325 P_B V_T (C_{T*} - C_T)}{C_T (T_T + 460)}$$

P_B = barometric pressure measured in accordance with section 3.6 of this appendix in inches of mercury,

V_T = flow rate of tracer gas through the vented heater measured in accordance with section 3.6 of this appendix in cubic feet per minute,

C_T = concentration by volume of tracer gas present in the flue gas sample measured in accordance with section 3.6 of this appendix in percent,

C_{T*} = concentration by volume of the active tracer gas in the mixture in percent and is 100 when the tracer gas is a single component gas,

T_T = the temperature of the tracer gas entering the flow meter measured in accordance with section 3.6 of this appendix in degrees Fahrenheit, and

$(T_T + 460)$ = absolute temperature of the tracer gas entering the flow meter in degrees Rankine.

$M_{F,SS}(T_{F,SS}) = Q_{in}[R_{T,F}(A/F)+1]/[60 HHV_A]$

Q_{in} = as defined in section 3.1 of this appendix,

$R_{T,F}$ = as defined in section 4.1.7 of this appendix,

A/F = as defined in section 4.2.2 of this appendix, and

HHV_A = as defined in section 4.2.2 of this appendix.

4.5.2 *Optional procedure for determining off-cycle draft factor for flue gas flow for vented heaters.* For systems numbered 1 through 10, calculate the off-cycle draft factor for flue gas flow (D_F) defined as:
$D_F = D_P$
For systems numbered 11 or 12: $D_F = D_P D_O$
For systems complying with section 3.6.1 or 3.6.2, $D_F = 0.05$

Where:

D_P = as defined in section 4.5.1. of this appendix, and

D_O = as defined in section 4.4 of this appendix.

4.5.3 *Optional procedure for determining off-cycle draft factor for stack gas flow for vented heaters.* Calculate the off-cycle draft factor for stack gas flow (D_S) defined as:
For systems numbered 1 or 2: $D_S = 1.0$
For systems numbered 3 or 4: $D_S = (D_P+0.79)/1.4$
For systems numbered 5 or 6: $D_S = D_O$
For systems numbered 7 or 8 and if $D_O(S/F)<1$:$D_S = D_O D_P$
For systems numbered 7 or 8 and if $D_O(S/F)>1$:
$D_S = D_O D_P+[0.85-D_O D_P][D_O(S/F)-1]/[S/F-1]$

where:

D_P = as defined in section 4.5.1 or 3.6.1 of this appendix, as applicable

D_O = as defined in section 4.4 of this appendix

*   *   *   *   *

TABLE 1—OFF–CYCLE DRAFT FACTORS FOR FLUE GAS FLOW (D_F) AND FOR STACK GAS FLOW (D_S) FOR VENTED HOME HEATING EQUIPMENT EQUIPPED WITHOUT THERMAL STACK DAMPERS

System number	(D_F)	(D_S)	Burner type	Venting system type [1]
1	1.0	1.0	Atmospheric	Draft hood or diverter.
2	0.4	1.0	Power	Draft hood or diverter.
3	1.0	1.0	Atmospheric	Barometric draft regulator.
4	0.4	0.85	Power	Barometric draft regulator.
5	1.0	D_O	Atmospheric	Draft hood or diverter with damper.
6	0.4	D_O	Power	Draft hood or diverter with damper.
7	1.0	D_O	Atmospheric	Barometric draft regulator with damper.
8	0.4	$D_O D_P$	Power	Barometric draft regulator with damper.
9	1.0	0	Atmospheric	Direct vent.
10	0.4	0	Power	Direct vent.
11	D_O	0	Atmospheric	Direct vent with damper.
12	$0.4 D_O$	0	Power	Direct vent with damper.

[1] Venting systems listed with dampers means electromechanical dampers only.

*   *   *   *   *

■ 6. Revise Appendix P to subpart B of part 430 to read as follows:

Appendix P to Subpart B of Part 430— Uniform Test Method for Measuring the Energy Consumption of Pool Heaters

Note: On and after July 6, 2015, any representations made with respect to the energy use or efficiency of all pool heaters must be made in accordance with the results of testing pursuant to this appendix. On and after this date, if a manufacturer makes representations of standby mode and off mode energy consumption, then testing must also include the provisions of this appendix related to standby mode and off mode energy consumption. Until July 6, 2015, manufacturers must test gas-fired pool heaters in accordance with this appendix, or

appendix P as it appeared at 10 CFR part 430, subpart B revised as of January 1, 2014. Any representations made with respect to the energy use or efficiency of such pool heaters must be in accordance with whichever version is selected. DOE notes that, because testing under this appendix P must be completed as of July 6, 2015, manufacturers may wish to begin using this test procedure immediately.

1. *Definitions.*

1.1 *Active mode* means the condition during the pool heating season in which the pool heater is connected to the power source, and the main burner, electric resistance element, or heat pump is activated to heat pool water.

1.2 *Coefficient of performance (COP)*, as applied to heat pump pool heaters, means the ratio of heat output in kW to the total power input in kW.

1.3 *Electric heat pump pool heater* means an appliance designed for heating nonpotable water and employing a compressor, water-cooled condenser, and outdoor air coil.

1.4 *Electric resistance pool heater* means an appliance designed for heating nonpotable water and employing electric resistance heating elements.

1.5 *Fossil fuel-fired pool heater* means an appliance designed for heating nonpotable water and employing natural gas or oil burners.

1.6 *Hybrid pool heater* means an appliance designed for heating nonpotable water and employing both a heat pump (compressor, water-cooled condenser, and outdoor air coil) and a fossil fueled burner as heating sources.

1.7 *Off mode* means the condition during the pool non-heating season in which the pool heater is connected to the power source,

and neither the main burner, nor the electric resistance elements, nor the heat pump is activated, and the seasonal off switch, if present, is in the ''off'' position.

1.8 *Seasonal off switch* means a switch that results in different energy consumption in off mode as compared to standby mode.

1.9 *Standby mode* means the condition during the pool heating season in which the pool heater is connected to the power source, and neither the main burner, nor the electric resistance elements, nor the heat pump is activated.

2. *Test method.*

2.1 *Active mode.*

2.1.1 *Fossil fuel-fired pool heaters.* The test method for testing fossil fuel-fired pool heaters in active mode is as specified in section 2.10 of ANSI Z21.56 (incorporated by reference, see § 430.3), with the following additional clarifications.

1. Burner input rate is adjusted as specified in section 2.3.3 of ANSI Z21.56,

2. Equilibrium is defined as in section 9.1.3 of ASHRAE 146 (incorporated by reference; see § 430.3)

3. Units are only to be tested using a recirculating loop and a pump if: the use of the recirculating loop and pump are listed as required; a minimum flow rate is specified in the installation or operation manual provided with the unit; the pump is packaged with the unit by the manufacturer; or such use is required for testing.

4. A water temperature rise of less than 40° F is allowed only as specified in the installation or operation manual(s) provided with the unit.

2.1.2 *Electric resistance pool heaters.* The test method for testing electric resistance pool heaters in active mode is as specified in ASHRAE 146 (incorporated by reference; see § 430.3).

2.1.3 *Electric heat pump pool heaters.* The test method for testing electric heat pump pool heaters in active mode is as specified in AHRI 1160 (incorporated by reference; see § 430.3), which references ASHRAE 146 (incorporated by reference; see § 430.3).

2.1.4 *Hybrid pool heaters.* [Reserved]

2.2 *Standby mode.* The test method for testing the energy consumption of pool heaters in standby mode is as described in sections 3 through 5 of this appendix.

2.3 *Off mode.*

2.3.1 *Pool heaters with a seasonal off switch.* For pool heaters with a seasonal off switch, no off mode test is required.

2.3.2 *Pool heaters without a seasonal off switch.* For pool heaters without a seasonal off switch, the test method for testing the energy consumption of the pool heater is as described in sections 3 through 5 of this appendix.

3. *Test conditions.*

3.1 *Active mode.*

3.1.1 *Fossil fuel-fired pool heaters.* Establish the test conditions specified in section 2.10 of ANSI Z21.56 (incorporated by reference; see § 430.3).

3.1.2 *Electric resistance pool heaters.* Establish the test conditions specified in section 9.1.4 of ASHRAE 146 (incorporated by reference; see § 430.3).

3.1.3 *Electric heat pump pool heaters.* Establish the test conditions specified in

section 5 of AHRI 1160. The air temperature surrounding the unit shall be at the ''High Air Temperature—Mid Humidity (63% RH)'' level specified in section 6 of AHRI 1160 (incorporated by reference, see § 430.3) (80.6 °F [27.0 °C] Dry-Bulb, 71.2 °F [21.8 °C]).

3.1.4 *Hybrid pool heaters.* [Reserved]

3.2 *Standby mode and off mode.* After completing the active mode tests described in sections 3.1 and 4.1 of this appendix, reduce the thermostat setting to a low enough temperature to put the pool heater into standby mode. Reapply the energy sources and operate the pool heater in standby mode for 60 minutes.

4. *Measurements*

4.1 *Active mode*

4.1.1 *Fossil fuel-fired pool heaters.* Measure the quantities delineated in section 2.10 of ANSI Z21.56 (incorporated by reference; see § 430.3). The measurement of energy consumption for oil-fired pool heaters in Btu is to be carried out in appropriate units (*e.g.,* gallons).

4.1.2 *Electric resistance pool heaters.* Measure the quantities delineated in section 9.1.4 of ASHRAE 146 (incorporated by reference; see § 430.3) during and at the end of the 30-minute period when water is flowing through the pool heater.

4.1.3 *Electric heat pump pool heaters.* Measure the quantities delineated in section 9.1.1 and Table 2 of ASHRAE 146 (incorporated by reference; see § 430.3). Record the elapsed time, t_{HP}, from the start of electric power metering to the end, in minutes.

4.1.4 *Hybrid pool heaters.* [Reserved]

4.2 *Standby mode.* For all pool heaters, record the average electric power consumption during the standby mode test, $P_{W,SB}$, in W, in accordance with section 5 of IEC 62301 (incorporated by reference; see § 430.3). For fossil fuel-fired pool heaters, record the fossil fuel energy consumption during the standby test, Q_p, in Btu. (Milli-volt electrical consumption need not be considered in units so equipped.) Ambient temperature and voltage specifications in section 4.1 of this appendix shall apply to this standby mode testing. Round the recorded standby power ($P_{W,SB}$) to the second decimal place, and for loads greater than or equal to 10 W, record at least three significant figures.

4.3 *Off mode.*

4.3.1 *Pool heaters with a seasonal off switch.* For pool heaters with a seasonal off switch, the average electric power consumption during the off mode, $P_{W,OFF} = 0$, and the fossil fuel energy consumed during the off mode, $Q_{off} = 0$.

4.3.2 *Pool heaters without a seasonal off switch.* For all pool heaters without a seasonal off switch, record the average electric power consumption during the standby/off mode test, $P_{W,OFF} = P_{W,SB}$, in W, in accordance with section 5 of IEC 62301 (incorporated by reference; see § 430.3). For fossil fuel-fired pool heaters without a seasonal off switch, record the fossil fuel energy consumption during the off mode test, $Q_{off} (= Q_p)$, in Btu. (Milli-volt electrical consumption need not be considered in units so equipped.) Ambient temperature and voltage specifications in section 4.1 of this

appendix shall apply to this off mode testing. Round the recorded off mode power ($P_{W,OFF}$) to the second decimal place, and for loads greater than or equal to 10 W, record at least three significant figures.

5. *Calculations.*

5.1 *Thermal efficiency.*

5.1.1 *Fossil fuel-fired pool heaters.* Calculate the thermal efficiency, E_t (expressed as a percent), as specified in section 2.10 of ANSI Z21.56 (incorporated by reference; see § 430.3). The expression of fuel consumption for oil-fired pool heaters shall be in Btu.

5.1.2 *Electric resistance pool heaters.* Calculate the thermal efficiency, E_t (expressed as a percent), as specified in section 11.1 of ASHRAE 146 (incorporated by reference; see § 430.3).

5.1.3 *Electric heat pump pool heaters.* Calculate the COP according to section 11.1 of ASHRAE 146. Calculate the thermal efficiency, E_t (expressed as a percent): $E_t = COP$.

5.1.4 *Hybrid pool heaters.* [Reserved]

5.2 *Average annual fossil fuel energy for pool heaters.* For electric resistance and electric heat pump pool heaters, the average annual fuel energy for pool heaters, $E_F = 0$.

For fossil fuel-fired pool heaters, the average annual fuel energy for pool heaters, E_F, is defined as:

$$E_F = BOH\ Q_{IN} + (POH - BOH)Q_{PR} + (8760 - POH)\ Q_{off,R}$$

Where:

BOH = average number of burner operating hours = 104 h,

POH = average number of pool operating hours = 4,464 h,

Q_{IN} = rated fuel energy input as defined according to section 2.10.1 or section 2.10.2 of ANSI, Z21.56 (incorporated by reference; see § 430.3), as appropriate. (For electric resistance and electric heat pump pool heaters, $Q_{IN} = 0$.),

Q_{PR} = average energy consumption rate of continuously operating pilot light, if employed, $= (Q_P/1\ h)$,

Q_P = energy consumption of continuously operating pilot light, if employed, as measured in section 4.2 of this appendix, in Btu,

8760 = number of hours in one year,

$Q_{off,R}$ = average off mode fossil fuel energy consumption rate = $Q_{off}/(1\ h)$, and

Q_{off} = off mode energy consumption as defined in section 4.3 of this appendix.

5.3 *Average annual electrical energy consumption for pool heaters.* The average annual electrical energy consumption for pool heaters, E_{AE}, is expressed in Btu and defined as:

(1) $E_{AE} = E_{AE,active} + E_{AE,standby,off}$

(2) $E_{AE,active} = BOH * PE$

(3) $E_{AE,standby,off} = (POH - BOH)\ P_{W,SB}(Btu/h) + (8760 - POH)\ P_{W,OFF}(Btu/h)$

where:

$E_{AE,active}$ = electrical consumption in the active mode,

$E_{AE,standby,off}$ = auxiliary electrical consumption in the standby mode and off mode,

PE = $2E_c$, for fossil fuel-fired heaters tested according to section 2.10.1 of ANSI Z21.56 (incorporated by reference; see

§ 430.3) and for electric resistance pool heaters, in Btu/h,

= 3.412 PE_{rated}, for fossil fuel-fired heaters tested according to section 2.10.2 of ANSI Z21.56, in Btu/h,

= $E_{c,HP}$ * (60/t_{HP}), for electric heat pump pool heaters, in Btu/h.

E_c = electrical consumption in Btu per 30 min. This includes the electrical consumption (converted to Btus) of the pool heater and, if present, a recirculating pump during the 30-minute thermal efficiency test. The 30-minute thermal efficiency test is defined in section 2.10.1 of ANSI Z21.56 for fossil fuel-fired pool heaters and section 9.1.4 of ASHRAE 146 (incorporated by reference; see § 430.3) for electric resistance pool heaters.

2 = conversion factor to convert unit from per 30 min. to per h.

PE_{rated} = nameplate rating of auxiliary electrical equipment of heater, in Watts

$E_{c,HP}$ = electrical consumption of the electric heat pump pool heater (converted to equivalent unit of Btu), including the electrical energy to the recirculating pump if used, during the thermal efficiency test, as defined in section 9.1 of ASHRAE 146, in Btu.

t_{HP} = elapsed time of data recording during the thermal efficiency test on electric heat pump pool heater, as defined in section 9.1 of ASHRAE 146, in minutes.

BOH = as defined in section 5.2 of this appendix,

POH = as defined in section 5.2 of this appendix,

$P_{W,SB}$ (Btu/h) = electrical energy consumption rate during standby mode expressed in Btu/h = 3.412 $P_{W,SB}$, Btu/h,

$P_{W,SB}$ = as defined in section 4.2 of this appendix,

$P_{W,OFF}$ (Btu/h) = electrical energy consumption rate during off mode expressed in Btu/h = 3.412 $P_{W,OFF}$, Btu/h, and

$P_{W,OFF}$ = as defined in section 4.3 of this appendix.

5.4 *Integrated thermal efficiency.*

5.4.1 Calculate the seasonal useful output of the pool heater as:

E_{OUT} = BOH[(E_t/100)(Q_{IN} + PE)]

where:

BOH = as defined in section 5.2 of this appendix,

E_t = thermal efficiency as defined in section 5.1 of this appendix,

Q_{IN} = as defined in section 5.2 of this appendix,

PE = as defined in section 5.3 of this appendix, and

100 = conversion factor, from percent to fraction.

5.4.2 Calculate the annual input to the pool heater as:

E_{IN} = E_F + E_{AE}

where:

E_F = as defined in section 5.2 of this appendix, and

E_{AE} = as defined in section 5.3 of this appendix.

5.4.3 Calculate the pool heater integrated thermal efficiency (TE_I) (in percent).

TE_I = 100(E_{OUT}/E_{IN})

where:

E_{OUT} = as defined in section 5.4.1 of this appendix,

E_{IN} = as defined in section 5.4.2 of this appendix, and

100 = conversion factor, from fraction to percent.

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